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Beyond the Pill: Psychosocial and Behavioural Predictors of ART Non-Adherence Following the Single-Tablet Regimen Transition in Yaoundé, Cameroon

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Abstract

Achieving the UNAIDS 95-95-95 targets depends on optimal adherence to antiretroviral therapy (ART). While Cameroon transitioned to simplified Dolutegravir-based Single-Tablet Regimens (STR), the impact on adherence relative to Multiple-Tablet Regimens (MTR) remains to be elucidated. This hospital-based cross-sectional study among 680 participants at Yaoundé Jamot Hospital quantified adherence using a modified CPCRA 7-day recall and CASE Adherence Index. Results indicated an optimal adherence prevalence of 79.7% (95% CI: 76.4–82.7%) for the 7-day recall and 80.9% for the CASE Index. No significant difference in adherence was observed between STR and MTR users ($p = 0.494$). Multivariable modified Poisson regression revealed that lack of family support was the strongest predictor of non-adherence (aPR: 1.407, 95% CI: 1.203–1.646; $p < 0.001$). Other significant factors included depressive symptoms (aPR: 1.257, 95% CI: 1.036–1.525) and risky alcohol consumption (aPR: 1.158, 95% CI: 1.096–1.224). These findings suggest that in the era of simplified regimens, adherence is driven primarily by psychosocial and behavioural determinants rather than physical drug complexity. To bridge the final 20% gap, interventions must prioritize family support systems and mental health screening alongside pharmacological simplification.

Keywords: Alcohol, ART Adherence, Cameroon, CASE Index, Dolutegravir, Single-Tablet Regimen.

Introduction

The global effort to end the Human Immunodeficiency Virus (HIV) epidemic is currently guided by the Joint United Nations Programme on HIV/AIDS (UNAIDS) 95-95-95 targets [1]. These goals aim for 95% of people living with HIV (PLHIV) to know their status, 95% of those diagnosed to receive antiretroviral therapy (ART), and 95% of those on ART to achieve durable viral suppression. While the first two targets rely on health system infrastructure and diagnostic reach, the third target (viral suppression) is fundamentally dependent on optimal medication adherence

[2]. Historically, an adherence threshold of $\geq 95\%$ was considered the gold standard to prevent virologic failure and the emergence of drug resistance [3]. In sub-Saharan Africa, and specifically in Cameroon, the landscape of HIV treatment has undergone a significant transformation. In 2020, Cameroon transitioned to Dolutegravir (DTG)-based Single-Tablet Regimens (STR) as the standard first-line therapy. This programmatic shift was predicated on the assumption that reducing the "pill burden" from traditional Multi-Tablet Regimens (MTR) would automatically resolve adherence challenges [4]. However, clinical evidence suggests that the transition to

simplified regimens does not occur in a vacuum; patients continue to face a myriad of psychosocial and structural barriers that can impede their ability to maintain treatment consistency.

The programmatic transition to Dolutegravir (DTG) in Cameroon was part of a broader continental shift toward more potent antiretroviral regimens. In 2019, the World Health Organization recommended DTG as the preferred first-line agent due to its superior efficacy and high genetic barrier to resistance compared to older NNRTI-based regimens [5]. Regional evidence from the NAMSAL ANRS 12313 trial conducted in Cameroon demonstrated that DTG-based therapy was non-inferior to low-dose Efavirenz, showing rapid viral load suppression even in patients with high baseline viremia [6]. Similar findings across sub-Saharan Africa, such as the ADVANCE trial, confirmed that the single-tablet

TLD (Tenofovir/Lamivudine/Dolutegravir) combination significantly reduced pill burden and improved clinical outcomes [7]. Despite these pharmacological milestones, the "pill-centric" transition assumes that clinical efficacy translates directly into behavioural consistency, an assumption challenged by emerging data suggesting that social drivers remain the primary gatekeepers of long-term success [8]. Clinical observations in high-volume centers suggest that a significant proportion of patients continue to struggle to reach the 95% adherence threshold. While DTG is noted for its high genetic barrier to resistance, sub-optimal adherence remains the primary pathway to treatment failure and the potential development of secondary drug resistance [2]. Previous studies in Cameroon have established that pharmacological simplification may address the physical burden, but it does not necessarily mitigate behavioural barriers such as depression and substance use [9].

In the clinical management of HIV, adherence is defined as taking 95% - 100% of

the right drug, in the right way, at the right time, and in the right dose. Adherence requires an informed choice, a relationship of trust between the patient, their family or peers, and the care provider, and the implementation of evaluation procedures for better monitoring of patients on ART [10]. It is the consistent commitment to an antiretroviral therapy (ART) regimen. This requires patients to take their medications every day, exactly as prescribed, and maintain regular attendance at all scheduled medical appointments. Historically, researchers like Chesney and colleagues established that although taking the medication correctly is essential for viral suppression, remaining "retained in care" through clinic visits is equally critical for long-term health, and a 95% threshold of dose consistency was necessary for treatment success [11].

Despite this clear framework, adherence in Cameroon remains vulnerable to structural inequities; recent evidence from the Cité des Palmiers District Hospital indicates that nearly half of patients struggle to be consistent due to service-related barriers and medication-related discomfort [12]. Furthermore, the ongoing sociopolitical instability in the Northwest and Southwest regions has introduced unique disruptions to the national supply chain, forcing involuntary treatment interruptions and displacing patients into urban centers like Yaoundé, which strains local healthcare delivery [13]. These factors suggest that achieving the 95-95-95 targets requires a resilient healthcare infrastructure, particularly regarding transport accessibility, supply chain stability, and economic support that goes beyond the pharmacological benefits of drug simplification [14].

In Cameroon, where HIV prevalence, although experiencing a decreasing trend over the years, remains significant at 2.7% [15]. The specific factors influencing adherence during the national STR transition have not been fully elucidated in a large-scale clinical cohort [3]. Most existing literature focuses on biological

outcomes such as viral load suppression rates, leaving a gap in understanding the underlying behavioural and social drivers that persist even when treatment is simplified to a single pill per day [8]. There is an urgent need to identify whether the barriers to adherence in the modern treatment era are clinical, behavioural, or psychosocial in nature [16]. This study aims to evaluate the prevalence of ART adherence among adults at the Yaoundé Jamot Hospital and identify the independent predictors of non-adherence in Cameroon's STR era. By identifying these persistent barriers, this research seeks to inform a more patient-centred model of care that addresses the human side of the HIV response.

Materials and Methods

Study Design and Setting

This research utilized a hospital-based, analytical cross-sectional design. This design facilitated the simultaneous assessment of ART adherence prevalence and the identification of clinical, behavioural, and psychosocial associations at a single point in time during Cameroon's transition to Dolutegravir-based Single-Tablet Regimens (STR). The study was conducted at the Yaoundé Jamot Hospital (HJY), a premier tertiary referral center in Cameroon's capital. HJY's Care and Treatment Center (CTA) is one of the highest-volume HIV facilities in the Centre Region, serving a socio-demographically diverse urban and peri-urban population. The facility operates under the National AIDS Control Committee (NACC) framework, providing integrated pharmacological management, psychosocial counselling, and routine viral load monitoring.

Study Population and Eligibility Criteria

The target population consisted of adults living with HIV (PLHIV) currently receiving antiretroviral therapy at HJY. To be eligible for inclusion, participants had to be aged 21 years or older, have been on ART for at least six months to ensure established treatment

patterns, and provide written informed consent. Patients were excluded from the study if they presented with severe cognitive impairment or were clinically too ill to complete the interview process, as these factors could compromise the reliability of the self-reported data.

Sample Size Determination and Sampling Technique

The sample size was determined using a dual-methodological approach to ensure adequate statistical power for both prevalence estimation and multivariable modelling. Initially, the Lorentz formula was used to determine minimum prevalence requirements, which were then adjusted utilizing the Events Per Variable (EPV) criterion to maintain model stability and reduce the risk of overfitting. This adjustment considered candidate variables such as alcohol use, depression, and family support, resulting in a final robust sample size of 680 participants. A consecutive sampling technique was employed, where every eligible patient visiting the ART clinic during the study period was recruited until the target was reached.

Data Collection Procedures and Instruments

Data were collected using a structured, pre-tested questionnaire supplemented by clinical data, including the most recent viral load and current ART regimen types, extracted directly from patient clinical files. To ensure diagnostic and behavioural accuracy, the study utilized validated screening tools and standardized operational thresholds. The primary outcome, ART adherence, was cross-validated using the CPCRA 7-day Recall [17] and the CASE Adherence Index [18]. Optimal adherence was operationally defined as a score of $\geq 95\%$ on the 7-day recall or a composite score > 10 on the CASE Index. Agreement between these two measures was evaluated to ensure the reliability of self-reported data in the context of the transition to simplified regimens.

Behavioural and psychosocial risks were quantified using standardized instruments to identify independent predictors of treatment interruption. Depressive symptoms were screened using the Patient Health Questionnaire-2 (PHQ-2), where a score of ≥ 3 was identified as a threshold indicating a high probability of major depressive disorder [19]. Risky alcohol consumption was assessed via the AUDIT-C tool, with thresholds defined as a score of ≥ 3 for women and ≥ 4 for men [20]. Following the National AIDS Control Committee in Cameroon (NACC) guidelines for treatment monitoring, viral suppression was operationally defined as a viral load <1000 copies/mL and unsuppressed as a viral load >1000 copies/mL. These standardized metrics allowed for a robust analytical comparison between Single-Tablet Regimen (STR) and Multi-Tablet Regimen (MTR) users while controlling for psychosocial confounders.

Study Variables

The primary dependent variable for this study was ART adherence status, categorized as adherent or non-adherent. The independent variables comprised several domains, including socio-demographic factors such as age, sex, residence, educational status, and professional or marital status. Clinical and treatment-related variables included the duration of ART, current regimen type (STR vs. MTR), WHO clinical staging, and most recent viral load results. Finally, behavioural and psychosocial variables were assessed, focusing on risky alcohol use, the presence of depressive symptoms, HIV status disclosure, stigma, Healthcare worker relationship, perceived ART effectiveness, knowledge of ART, ART timing, medication side effects, clinic accessibility, and the level of perceived family or social support.

Data Management and Statistical Analysis

Data were processed and analysed using R Statistical Software (version 4.5.1). Descriptive

statistics summarized the cohort, with categorical variables reported as frequencies and percentages, and continuous variables summarized as means with standard deviations or medians with interquartile ranges (IQRs), depending on the data distribution. Cohen's Kappa (k) was calculated to assess agreement between the CPCRA and CASE adherence tools. For the analytical phase, variables with $p < 0.05$ in bivariate analysis were included in a multivariable modified Poisson regression model with robust standard errors. This produced adjusted prevalence ratios (aPR), and diagnostic testing, including the generalized variance inflation factor ($GVIF < 1.15$), was conducted to verify statistical integrity and rule out multicollinearity.

Handling of Missing Data

Data completeness was assessed before analysis. Variables with missing values were examined to determine the extent and pattern of missingness. Overall, the proportion of missing data across key study variables was low ($<5\%$). Given the minimal level of missingness and the cross-sectional nature of the study, a complete-case analysis approach was applied. Participants with missing data for specific variables were excluded only from analyses involving those variables and retained in all other analyses where data were complete. No statistical imputation was performed, as the low level of missing data was unlikely to introduce significant bias or compromise statistical power.

Results

Socio-demographic and Clinical Profile of Study Participants

The study enrolled a total of 680 participants. The mean age of the cohort was 42.8 years ($SD \pm 10.4$), with the highest proportion of participants in the 41–50 age group (38.5%). As summarized in Table 1, the cohort was predominantly female ($n = 458, 67.4\%$), and the majority were married or cohabiting ($n = 430$,

63.2%). Regarding clinical characteristics, 78.5% (n= 534) were on Single-Tablet Regimens (STR), and viral suppression (<1000 copies/mL) was 95.1% (n= 647).

Anthropometric data indicated 57.9% of participants had a normal BMI, and over 36% were classified as either overweight or obese (See Table 1).

Table 1. Socio-Demographic and Clinical Characteristics of Study Participants

Characteristic	Category	Frequency (n)	Percentage (%)
Socio-demographic			
Sex	Female	458	67.4
	Male	222	32.6
Age Group (years)	21–30	85	12.5
	31–40	201	29.5
	41–50	262	38.5
	>50	132	19.4
Marital Status	Married/Cohabiting	430	63.2
	Single/Divorced/Widowed	250	36.8
Education Level	No Formal/Primary	118	17.4
	Secondary	415	61.0
	University/Tertiary	147	21.6
Employment Status	Employed/Self-employed	396	58.2
	Unemployed/Student	284	41.8
Residence	Urban (Yaoundé)	556	81.8
	Peri-urban/Rural	124	18.2
Anthropometric			
Body Mass Index (BMI)	Underweight (<18.5)	41	6.0
	Normal (18.5–24.9)	394	57.9
	Overweight (25.0–29.9)	161	23.7
	Obese (≥30.0)	84	12.4
Clinical			
ART Regimen Type	Single-Tablet (STR)	534	78.5
	Multi-Tablet (MTR)	146	21.5
Duration on ART	6 months – 2 years	129	19.0
	2 years – 5 years	258	38.0
	>5 years	293	43.0
WHO Clinical Stage	Stage I / II	592	87.1
	Stage III / IV	88	12.9
Viral Load Status	Suppressed (<1000 c/mL)	647	95.1
	Unsuppressed (≥1000 c/mL)	33	4.9

Prevalence of ART Adherence and Tool Comparison

The overall prevalence of adherence was 79.7% (n=542) according to the CPCRA 7-day recall and 80.9% (n=550) via the CASE Index.

As detailed in Table 2, adherence rates were further analysed by specific regimen types: DTG-based STR, Other STRs (TELE), and Multiple Tablet Regimens (MTR). For the 7-day recall, adherence was 79.2% for DTG-based STR, 100.0% for TELE-based STR, and

80.2% for MTR. No statistically significant difference in adherence was found across these treatment groups ($p = 0.494$). Similarly, the CASE Index demonstrated adherence rates of 80.2%, 100.0%, and 81.8%, respectively,

showing no significant variation by regimen type ($p = 0.462$). The agreement between the two adherence measurement tools was substantial, with a Cohen's Kappa of $k = 0.768$ ($p < 0.001$), as detailed in Table 4.

Table 2. Prevalence of ART Adherence and Measurement Tool Comparison

Adherence Measure	Adherent <i>n</i> (%)	DTG-based STR (<i>n</i> =485)	Other STR (TELE) (<i>n</i> =8)	Multi-Tablet (MTR) (<i>n</i> =187)	<i>p</i> -value
7-Day Recall (CPCRA)	542 (79.7%)				0.494
Adherent ($\geq 95\%$)		384 (79.2%)	8 (100.0%)	150 (80.2%)	
Non-Adherent ($< 95\%$)		101 (20.8%)	0 (0.0%)	37 (19.8%)	
CASE Index	550 (80.9%)				0.462
Adherent		389 (80.2%)	8 (100.0%)	153 (81.8%)	
Non-Adherent		96 (19.8%)	0 (0.0%)	34 (18.2%)	

Note: DTG= Dolutegravir, STR= Single Tablet Regimen, TELE= Tenofovir/Lamivudine/Efavirenz (single dose), MTR= Multi Tablet Regimen.

Table 3. CPCRA & CASE Index Concordance

Measurement Tool	CASE Index Adherent(<i>n</i>)	CASE Index Non-adherent(<i>n</i>)	Total(<i>n</i>)
7-day Recall Adherent(<i>n</i>)	521	21	542
7-day Recall Non-adherent(<i>n</i>)	29	109	138
Total(<i>n</i>)	550	130	680

Cohen's Kappa ($k = 0.768$ [95% CI: 0.706 – 0.829] $p < 0.001$)

Concordance: 92.65% ($n=630$), discordance: 7.35% ($n=50$).

Independent Predictors of Non-Adherence

Multivariable modified Poisson regression analysis identified four independent predictors of non-adherence (Table 4). Lack of family support was the strongest predictor, associated with a 40.7% increase in the prevalence of non-adherence (aPR: 1.407, 95% CI: 1.203–1.646; $p < 0.001$). Depressive symptoms were

associated with a 25.7% increase in non-adherence (aPR: 1.257, 95% CI: 1.036–1.525; $p = 0.020$). Participants engaging in risky alcohol consumption had a 15.8% higher prevalence of non-adherence (aPR: 1.158, 95% CI: 1.096–1.224; $p < 0.001$). Finally, non-disclosure of HIV status was associated with an 11.4% increase in non-adherence (aPR: 1.114, 95% CI: 1.050–1.182; $p < 0.001$).

Table 4. Multivariable Predictors of ART Adherence

Predictor Variable	7-day Recall aPR [95% CI]	p-value	CASE Index aPR [95% CI]	p-value
Psychosocial Factors				
Risky Alcohol Use (Yes)	1.158 [1.096 – 1.224]	< 0.001*	1.151 [1.091 – 1.215]	< 0.001*
Depressive Symptoms (Yes)	1.257 [1.036 – 1.525]	0.020*	1.230 [1.003 – 1.510]	0.047*
Family support (disagree)	1.407 [1.203 – 1.646]	< 0.001*	1.375 [1.171 – 1.615]	< 0.001*
Disclosure (disagree)	1.048 [0.986 – 1.114]	0.133	1.114 [1.047 – 1.185]	< 0.001*
Clinical Factors				
Viral Load (>1000 cps)	1.068 [0.936 – 1.219]	0.327	1.142 [1.000 – 1.306]	0.051
Few Side Effects (Disagree)	0.950 [0.873 – 1.034]	0.239	0.962 [0.883 – 1.047]	0.367

Note: **aPR** = Adjusted Prevalence Ratio; **CI** = Confidence Interval. All models were adjusted for age and gender and utilized robust standard errors; *Statistically significant ($p < 0.05$).

Discussion

The prevalence of optimal ART adherence identified in this study (79.7% via CPCRA and 80.9% via CASE Index) reveals a critical adherence gap of ~20% at the Yaoundé Jamot Hospital. While these figures are consistent with other urban cohorts in sub-Saharan Africa, they fall short of the 95% threshold historically required for durable virologic success. Interestingly, the high rate of viral suppression (95.1%) observed in this cohort, despite a lower optimal adherence rate (79.7%), highlights what may be termed the 'Adherence-Suppression Paradox.' This phenomenon is supported by Byrd et al, who demonstrated that modern antiretrovirals can maintain suppression at adherence levels as low as 80%, thanks to the superior pharmacological forgiveness and a high genetic barrier to resistance of dolutegravir-based therapy [6] [21]. While this biological safety net is a milestone for the national STR transition, relying on drug potency to mask behavioural inconsistency is a precarious long-term strategy. As noted by Ndiaye and Bangsberg

[2], pharmacological simplification does not eliminate the behavioural drivers of resistance; rather, it shifts the clinical focus from 'pill counting' to managing the complex psychosocial lives of patients themselves.

One of the most significant findings of this research is the lack of statistical difference in adherence between participants on Single-Tablet Regimens (STR) and those on Multi-Tablet Regimens (MTR) ($p = 0.494$). These findings contradict a large body of global literature, which posits that pill burden is a primary determinant of treatment consistency. A 2008 meta-analysis and large-scale North American cohorts reported that simplified single-pill regimens significantly improved both adherence and virologic suppression compared to multi-pill alternatives [22]. Similarly, Altice et al. argued that the physical complexity of medication was a major barrier for patients with co-morbidities [23]. However, our findings align more closely with recent studies in sub-Saharan Africa, such as those by Ndiaye and Mbuagbaw [8, 14], which suggests that in resource-limited settings, the

convenience of a single pill is secondary to the availability of social support and food. This indicates that the 'Pill Burden' model, while valid in high-income settings, may have reached a point of diminishing returns in urban African cohorts like Yaoundé, where psychosocial stressors far outweigh the physical act of just swallowing tablets (3).

The multivariable analysis identified lack of family support as the most potent independent predictor of non-adherence (aPR: 1.407, $p < 0.001$). In the socio-cultural context of Yaoundé, the family unit serves as the primary infrastructure for treatment reminders, emotional resilience, and financial support for transport to the clinic. When this support is absent, the psychological burden of a chronic diagnosis is exacerbated, leading to treatment fatigue. This finding is further complicated by the significant association between non-disclosure of HIV status and non-adherence (aPR: 1.114, $p < 0.001$). Disclosure is not merely a social act but a clinical prerequisite for consistency. Patients who hide their status are often engaged in 'strategic non-adherence', intentionally skipping doses to avoid detection in social or professional settings [4, 24], which is a major barrier to ART adherence in Cameroon. This finding is consistent with evidence from Western Cameroon, where lack of disclosure to a close relative was a primary driver of treatment interruption [25]. The psychological energy required to maintain a 'double life' leads to cognitive exhaustion, suggesting that the benefits of a single-tablet regimen are neutralized if the patient cannot take that tablet openly within their domestic environment [26].

Furthermore, the intersection of mental health and substance use remains a critical bottleneck. Participants with depressive symptoms were 25.7% more likely to be non-adherent (aPR: 1.257, $p = 0.020$). Depression often manifests as a loss of motivation and cognitive "fog," making the habit of daily medication intake difficult to sustain.

Simultaneously, risky alcohol consumption showed a strong association with non-adherence (aPR: 1.158, $p < 0.001$). This mirrors findings by Tchakounté et al., [27], who identified alcohol consumption as a significant risky behaviour associated with ART interruption in Yaoundé. This behavioural pattern is often driven by 'interactive toxicity beliefs', the pervasive myth that mixing antiretrovirals with alcohol causes lethal liver toxicity, thus patients intentionally skip doses to avoid perceived harm [28].

The substantial agreement between the CPCRA 7-day recall and the CASE Adherence Index ($k = 0.768$, $p < 0.001$) validates the use of self-reported tools in this setting. While self-reporting is often prone to social desirability bias, the high correlation between these two distinct scales suggests that when patients are interviewed in a non-judgmental, clinical environment, they provide an accurate reflection of their behavioural patterns. This high agreement reinforces the feasibility of using simplified screening tools, such as the CASE Index, during routine clinic visits to identify at-risk patients before virologic failure occurs.

Despite these insights, several limitations must be acknowledged. First, the cross-sectional design of the study captures a single snapshot in time, which precludes establishing definitive causal relationships between psychosocial predictors and non-adherence. While we identified associations, we cannot definitively state whether depressive symptoms cause non-adherence or if the stress of struggling with a chronic treatment regimen exacerbates mental health challenges. Second, although the CASE Index and 7-day recall showed high concordance, the study lacked an objective measure of adherence, such as electronic pill monitoring (MEMS), which is less susceptible to the "Hawthorne effect" in which patients improve their behaviour because they are being watched. Third, the research was conducted at a single tertiary referral center

(Yaoundé Jamot Hospital). While this facility is representative of high-volume urban care in Cameroon, the findings may not be fully generalizable to rural primary health centers where structural barriers, such as drug stock-outs or extreme travel distances, may play a more dominant role than the psychosocial factors identified here.

Conversely, this study possesses significant strengths. With a robust sample size of 680 participants, it is one of the largest contemporary analyses of the Single-Tablet Regimen (STR) transition in the Centre Region of Cameroon. Unlike many clinical studies that focus solely on biological outcomes, this research explicitly quantifies the "human side" of the HIV response, providing granular data on the roles of family support, alcohol, and mental health. Furthermore, the inclusion of both STR and MTR users allowed for a head-to-head comparison that challenges the prevailing "pill-burden" narrative, offering a more nuanced understanding of adherence in a resource-limited context. By cross-validating self-reported adherence against viral load data, the study provides a comprehensive overview of the "adherence-suppression paradox," making it a valuable baseline for future longitudinal research in the region.

Conclusion

In the contemporary landscape of HIV management in Cameroon, the transition to simplified, Dolutegravir-based Single-Tablet Regimens (STR) represents a significant pharmacological milestone. However, this study demonstrates that reducing the physical pill burden does not automatically translate into optimal treatment adherence. The finding that there was no statistically significant difference in adherence between STR and MTR users ($p = 0.494$) serves as a crucial indicator that the "pill-centric" approach to adherence has reached a point of diminishing returns.

The evidence presented here indicates that the main factors behind the 20.3% adherence

gap at Yaoundé Jamot Hospital are mainly psychosocial and behavioural rather than clinical. While the high rate of viral suppression (95.1%) demonstrates the strong biological effectiveness, high genetic resistance barriers, and the forgiving nature of modern regimens, the ongoing link between non-adherence and issues like lack of family support ($aPR = 1.407$), depressive symptoms ($aPR = 1.257$), and risky alcohol use ($aPR = 1.158$) shows a fragile success. Without addressing the social infrastructure and mental health needs of patients, maintaining the long-term progress toward the 95-95-95 targets remains uncertain. Ultimately, achieving optimal adherence today depends more on the strength of the support network around patients than on the simplicity of the medication.

Recommendations

Based on the findings of this study, several critical interventions are recommended to bridge the 20% adherence gap and sustain the successes of the Single-Tablet Regimen transition in Cameroon. At the policy level, prioritizing the integration of routine, simplified mental health screening into the national HIV guidelines and care package, utilizing validated tools such as the PHQ-2 at every clinical visit, would allow healthcare providers to identify patients struggling with depressive symptoms before behavioural lapses lead to virologic failure. Furthermore, clinical facilities should adopt multi-dimensional adherence assessments, such as the CASE Adherence Index, to supplement viral load monitoring and provide a more proactive view of patient behaviour.

At the clinical level, there is an urgent need to shift from an individual-centred treatment model to a family-centred approach. Given that the lack of family support was the most significant predictor of non-adherence in this study, clinicians must move beyond the mere provision of pills to facilitating safe disclosure processes and strengthening domestic support

networks. This is particularly vital in the context of polymedication, where the management of HIV alongside other clinical protocols increases the cognitive and psychological burden on the patient. This structural shift should be complemented by targeted behavioural counselling that adopts a nuanced harm-reduction strategy. It is imperative that healthcare providers actively debunk the widespread "interactive toxicity" myths concerning ART and alcohol specifically the belief that mixing the two leads to lethal poisoning, which remains a primary driver of intentional dose-skipping in the Centre Region.

Addressing this gap requires a dual-priority communication model; while clinicians must maintain necessary warnings regarding the impact of alcohol on general liver health and its complications within a framework of polymedication, they must explicitly clarify that alcohol does not render antiretrovirals toxic. By uncoupling the fear of "poisoning" from the advice on healthy lifestyle choices, providers can prevent the dangerous practice of intentional treatment interruption. Ultimately, by integrating family-centered counselling, the domestic environment can be transformed from one of secrecy and fear into a supportive network that ensures medication consistency even in the face of complex social and behavioural challenges.

Finally, community-level interventions must be expanded to provide a safety net for patients who lack strong domestic support systems. The expansion of community-led "adherence support groups" and peer-navigator programs can provide the social accountability and emotional resilience necessary for long-term treatment consistency. Future research should focus on longitudinal designs to evaluate the long-term durability of Dolutegravir-based regimens in the context of persistent sub-optimal adherence (<95%), alongside qualitative explorations into the cultural nuances of non-disclosure. Such a comprehensive, multi-sectoral approach will be

essential to ensuring that pharmacological simplification is matched by robust psychosocial care, ultimately securing the path toward the UNAIDS 95-95-95 targets.

Data Availability

The dataset analysed during the current study is available from the corresponding author upon reasonable request, subject to ethical approval and institutional data-sharing policies.

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Conflict of Interest

The authors declare no conflicts of interest related to this study.

Ethical Approval

Ethical clearance was obtained from the Regional Ethics Committee for Human Research-Center (CRERSH-CE) (No. 0021-/CRERSH/2025). Before conducting the study, written informed consent was obtained, and all identifying information (names, initials) was omitted to ensure confidentiality. Participation was free and voluntary; participants could leave the study at any time without affecting the care they received in this hospital.

Author Contributions

- **Mbohli Semirnyuy Sharon Lum:** Conceptualization, methodology, investigation, formal analysis, writing-original manuscript.
- **Pefura Yone Eric Walter:** Supervision, methodology, writing-review & editing.
- **Djenabou Amadou:** Writing-review & editing.

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References

- [1]. UNAIDS, 2022, Global HIV & AIDS statistics. *UNAIDS Reports*, Geneva. https://www.unaids.org/en/resources/documents/2022/2022_Global_AIDS_Update.
- [2]. Bangsberg, D. R., et al., 2001, Non-adherence to highly active antiretroviral therapy predicts progression to AIDS. *AIDS*, 15(9), 1181–1183, <https://doi.org/10.1097/00002030-200106150-00015>
- [3]. Fonsah, J. Y., et al., 2017, Adherence to Antiretroviral Therapy (ART) in Yaoundé, Cameroon: Association with Opportunistic Infections, Depression, ART Regimen, and Side Effects. *PLoS One*, 12(1), e0170893, <https://doi.org/10.1371/journal.pone.0170893>.
- [4]. Pefura-Yone, E. W., et al., 2013, Non-adherence to antiretroviral therapy in Yaounde: Prevalence, determinants and the concordance of two screening criteria. *Journal of Infection and Public Health*, 6(4), 307–315, <https://doi.org/10.1016/j.jiph.2013.02.003>.
- [5]. World Health Organization, 2019, Update of recommendations on first- and second-line antiretroviral regimens. *WHO Guidelines*, Geneva.
- [6]. Kounafack, et al., 2019, Dolutegravir-Based or Low-Dose Efavirenz-Based Regimen for the Treatment of HIV-1. *New England Journal of Medicine*, 381(9), 816–826, <https://doi.org/10.1056/NEJMoa1904340>.
- [7]. Venter, W. D. F., et al., 2019, Dolutegravir-based ART for HIV treatment: Evidence and implications. *Lancet HIV*, 6(7), e430–e442.
- [8]. Mbengue, M. A. S., et al., 2019, Prevalence and determinants of adherence to antiretroviral treatment among HIV patients on first-line regimen: a cross-sectional study in Dakar, Senegal. *Pan African Medical Journal*, 33(95), <https://doi.org/10.11604/pamj.2019.33.95.17248>.
- [9]. Tchokonte-Nana, V., et al., 2021, The effectiveness of SMS reminders to improve ART adherence in Cameroon. *Pan African Medical Journal*, 38(6), 307.
- [10]. Diyir, E. B., et al., 2025, HIV/AIDS and Adolescent Adherence to Antiretroviral Therapy: A Cross-Sectional Study of Adolescents in the Bamenda Health Districts, Cameroon. *Journal of Biosciences and Medicines*, 13(11), 237–266, <https://doi.org/10.4236/jbm.2025.1311017>.
- [11]. Chesney, M. A., et al., 2000, Adherence to HIV combination therapy. *Social Science & Medicine*, 50(11), 1599–1605, [https://doi.org/10.1016/S0277-9536\(99\)00468-2](https://doi.org/10.1016/S0277-9536(99)00468-2).
- [12]. Rostant Pokam Djoko, G., et al., 2024, Factors influencing adherence to antiretroviral treatment among people living with HIV aged 15–60 years at Cité des Palmiers District Hospital, Cameroon. *Global Health Economics and Sustainability*, 3(1), 118, <https://doi.org/10.36922/ghes.4077>.
- [13]. Mekolle, J. E., et al., 2023, Political instability and HIV/AIDS response in the south west and north west regions of Cameroon: a qualitative study. *BMC Public Health*, 23(1), 2155, <https://doi.org/10.1186/s12889-023-16994-w>.
- [14]. Mbuagbaw, L., et al., 2012, Trends and determining factors associated with adherence to antiretroviral therapy (ART) in Cameroon: a systematic review and analysis of the CAMPS trial. *AIDS Research and Therapy*, 9(1), 37, <https://doi.org/10.1186/1742-6405-9-37>.
- [15]. Cameroon Demographic and Health Survey (DHS), 2018, HIV prevalence statistics. DHS Program, Rockville, MD.
- [16]. Mannheimer, S. B., et al., 2006, The CASE adherence index: A novel method for measuring adherence to antiretroviral therapy. *AIDS Care*, 18(7), 853–861, <https://doi.org/10.1080/09540120500465160>.
- [17]. Chesney, M. A., et al., 2000, Self-reported adherence to antiretroviral medications among participants in HIV clinical trials: The AACTG Adherence Instruments. *AIDS Care*, 12(3), 255–266, <https://doi.org/10.1080/09540120050042891>.
- [18]. Mannheimer, S. B., et al., 2006, The CASE adherence index: A novel method for measuring adherence to antiretroviral therapy. *AIDS Care*, 18(7), 853–861, <https://doi.org/10.1080/09540120500465160>.
- [19]. Kroenke, K., et al., 2003, The Patient Health Questionnaire-2. *Medical Care*, 41(11), 1284–1292, <https://doi.org/10.1097/01.MLR.0000093487.78664.3C>.

- [20]. Bush, K., et al., 1998, The AUDIT Alcohol Consumption Questions (AUDIT-C): An Effective Brief Screening Test for Problem Drinking. *Archives of Internal Medicine*, 158(16), 1789, <https://doi.org/10.1001/archinte.158.16.1789>.
- [21]. Byrd, K. K., et al., 2019, Antiretroviral adherence level necessary for HIV viral suppression using real-world data. *JAIDS Journal of Acquired Immune Deficiency Syndromes*, 82(3), 245–251, <https://doi.org/10.1097/QAI.0000000000002142>.
- [22]. Clay, P. G., et al., 2018, A meta-analysis comparing 48-week treatment outcomes of single and multi-tablet antiretroviral regimens for the treatment of people living with HIV. *AIDS Research and Therapy*, 15(1), 17, <https://doi.org/10.1186/s12981-018-0204-0>.
- [23]. Altice, F., et al., 2019, Adherence to HIV treatment regimens: systematic literature review and meta-analysis. *Patient Preference and Adherence*, 13, 475–490, <https://doi.org/10.2147/PPA.S192735>.
- [24]. Braitstein, P., et al., 2008, Gender and the Use of Antiretroviral Treatment in Resource-Constrained Settings: Findings from a Multicenter Collaboration. *Journal of Women's Health*, 17(1), 47–55, <https://doi.org/10.1089/jwh.2007.0353>.
- [25]. Mabou, G. T., et al., 2025, Factors associated with HIV status non-disclosure among people entering care at IeDEA sites in Cameroon: a cross-sectional study. *AIDS Research and Therapy*, 22(1), 100, <https://doi.org/10.1186/s12981-025-00765-1>.
- [26]. Kagee, A., et al., 2011, Structural barriers to ART adherence in Southern Africa: Challenges and potential ways forward. *Global Public Health*, 6(1), 83–97, <https://doi.org/10.1080/17441691003796387>.
- [27]. Constantin, T., et al., 2020, Risky Behaviors among HIV Serodiscordant and Seroconcordant Couples in Yaounde-Cameroon. *International Journal of Virology and AIDS*, 7(1), <https://doi.org/10.23937/2469-567X/1510062>.
- [28]. Kalichman, S. C., et al., 2012, Alcohol and Adherence to Antiretroviral Medications: Interactive Toxicity Beliefs Among People Living With HIV. *Journal of the Association of Nurses in AIDS Care*, 23(6), 511–520, <https://doi.org/10.1016/j.jana.2011.11.005>.

Evaluating the Psychosocial Needs and Reintegration of Returnee Migrants in Nigeria

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Abstract

Returnee migrants in Nigeria face complex psychosocial challenges that hinder their reintegration into society. This study evaluated the psychosocial needs and reintegration experiences of returnee migrants across Nigeria. A mixed-method design was used to assess returnees' psychosocial needs. Quantitative data were collected from 1,316 returnee migrants using a structured, pretested questionnaire with a 5-point Likert scale, selected through multistage sampling across Nigeria's six geopolitical zones. Qualitative data were obtained through 8 focus group discussions (FGD) with 12 participants each. Quantitative data were analyzed using SPSS version 28.0, while qualitative data were analyzed thematically using QDA Miner. The mean age of respondent was 29.11 ± 6.21 . Psychosocial needs assessments revealed limited access to mental health services (36.6%). Most respondents reported weak community belonging (75.7%) and high levels of social isolation (84.7%), while stigma related to returnee status was widely prevalent (85.1%). Psychosocial factors such as Sex, and religion shows a strong independent association with psychosocial needs among returnees. Male respondents have significantly higher odds ($AOR = 5.533$; $p < 0.001$) of reporting psychosocial needs compared to females. Muslim participants reported lower odds of psychosocial needs ($AOR = 0.559$; $p = 0.026$) compared to Christian respondents. Qualitative findings revealed widespread stigma, broken relationships, and systemic exclusion, particularly affecting women. Returnees emphasized the need for trauma-informed mental health care, sustainable livelihoods, and structural support such as transitional housing. Returnee migrants in Nigeria experience profound psychosocial distress characterized by stigma, economic hardship, and weak community integration. Interventions should focus on reducing stigma, strengthening community acceptance, and integrating psychosocial support.

Keywords: Psychosocial Needs, Returnee Migrants, Reintegration.

Introduction

Returnee migrants often face significant mental health issues such as depression, anxiety, and post-traumatic stress disorder (PTSD) [1]. Studies highlight that the migration

journey itself can involve traumatic experiences, including exploitation, abuse, and exposure to unsafe conditions. For example, migrants who are forcibly returned may experience heightened distress due to the abrupt nature of their return, compounded by feelings

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of failure and societal stigma [2, 3]. Also, the stigma surrounding mental health in many countries exacerbates the reluctance of returnees to seek psychological support [4].

Social reintegration is a major challenge for returnee migrants. The loss of social networks abroad and difficulties in re-establishing connections in their home communities create a sense of isolation [5]. Returnees often experience alienation due to changes in societal norms and expectations during their absence [6]. Additionally, family relationships can become strained, as returnees face disappointment or resentment from family members who expected financial success abroad [7]. Women, in particular, may encounter unique gendered expectations and pressures upon return, which can intensify their psychosocial stress.

Economic insecurity further exacerbates the psychosocial difficulties faced by returnee migrants. Many struggle to secure employment or initiate business ventures due to limited financial capital, skill mismatches, and social discrimination [8]. Such economic instability fosters frustration, low self-worth, and depressive symptoms.

Interventions or programs, whether delivered intentionally or unintentionally, are anticipated to yield health benefits as their primary outcome, while also potentially generating social, economic, or psychological effects on the individuals exposed to them [9]. Psychosocial interventions encompass a broad range of strategies designed to address behavioural, psychological, and health-related issues. Psychological and psychosocial interventions focus on modifying processes or situations by implementing strategies for change. These approaches aim not only to reduce risk factors but also to activate and enhance protective factors [9].

Returnee migrants in Nigeria face difficulties reintegrating into their communities [10]. Many returnees return without employment prospects or opportunities to

resume income-generating activities. This results in depression for many migrants' returnees. Unemployment or dissatisfaction with income is a major factor driving migration for many Nigerians. Although some returnees can find work in their previous sectors, such as hairdressing, welding, and motorcycle riding, many had to sell their businesses, land, and properties and borrow money to finance their journeys [10]. Economic support is crucial for returnees, but finding employment in Nigeria's high-unemployment context is challenging. Most returnees lack qualifications or professional experience, making job acquisition difficult. Consequently, many seek to create their own income-generating activities, which require startup capital, another significant challenge due to limited funding for reintegration assistance [10].

Returned migrants may experience stigma and discrimination, particularly from their families, if they are unable to meet societal expectations, potentially leading to the development of an inferiority complex and significant mental health challenges [11]. Both voluntary and forced returnees often face social stigma and rejection upon returning to their home country, which can negatively impact their mental well-being [12]. Returnee migrants often exhibit significant levels of resilience, post-traumatic growth (PTG), and a sense of coherence (SOC) [13]. Moreover, limited access to psychosocial support services in Nigeria compounds the vulnerability of returnees, leaving many without the necessary resources to cope effectively with post-return challenges. Studies have highlighted that psychosocial well-being plays a pivotal role in the overall reintegration process, influencing an individual's ability to regain social functioning, secure employment, and rebuild self-esteem.

Despite growing policy attention to reintegration programs, there remains a significant gap in understanding the specific psychosocial needs of returnee migrants in Nigeria. Existing interventions have largely

prioritized economic empowerment, often overlooking the mental health and social dimensions of reintegration. Evaluating these psychosocial needs is essential to inform evidence-based strategies that promote holistic reintegration and sustainable wellbeing among returnees. This study, therefore, seeks to assess the psychosocial needs and reintegration of returnee migrants in Nigeria, identifying key challenges, coping mechanisms, and support systems required to foster psychological resilience and social inclusion. By addressing this gap, the research contributes to the broader discourse on migration, mental health, and reintegration within the Nigerian and sub-Saharan African context.

Methodology

Research Design

This study adopted a mixed-method research design, combining quantitative and qualitative approaches to evaluate the psychosocial needs and reintegration of returnee migrants in Nigeria. The quantitative component involved a structured questionnaire administered to a representative sample of returnees, while the qualitative component consisted of Focus Group Discussions that provided deeper insights into the lived experiences of reintegration and the psychosocial needs of returnee migrants. This design was particularly appropriate given the complex and multidimensional nature of psychosocial issues faced by returnees.

Study Setting and Population

The study was conducted across Nigeria, the most populous country in West Africa, known for its ethnic, cultural, and linguistic diversity. Nigeria is administratively divided into six geopolitical zones, North Central, North-East, North-West, South-East, South-South, and South-West, each characterized by unique migration trends, socioeconomic contexts, and reintegration challenges.

The target population consisted of returnee migrants who had previously migrated outside Nigeria and had now returned, either voluntarily or involuntarily, under various reintegration programs. These individuals represent a vulnerable group often confronted with significant psychosocial, economic, and social reintegration challenges.

Inclusion and Exclusion Criteria

The inclusion criteria for this study focused on individuals who had returned to Nigeria after a period of migration, whether voluntarily or forcibly. These participants were expected to have experienced some form of psychosocial challenge during or after their migration journey. To ensure the collection of informed and mature perspectives, only adults aged 18 years and above were considered eligible. Participation in the study was entirely voluntary, and only those who provided informed consent were included, ensuring that respondents fully understood the study's purpose and agreed to take part willingly.

Conversely, individuals below 18 years of age who had not undergone international migration and return were excluded from the study. Additionally, persons with cognitive, psychological, or mental impairments that could hinder their ability to comprehend the study objectives or give informed consent were not included in order to maintain the ethical and methodological integrity of the research.

Sample Size Determination

Given the large number of Nigerian returnees, it was impractical to include all individuals in the study; therefore, a representative sample was determined using Cochran's formula, adjusted for a finite population to prevent oversampling. The 2024 population of 30,573 returnees assisted by IOM under the UN-IOM Joint Initiative for Migrant Protection and Reintegration served as the population size.

Since the Finite population size is known, Yamane's Formula below was utilized to calculate the sample for this study [14].

$$\frac{N}{1 + N (e)^2}$$

Where:

n = sample size

N = total population (30,574) [15]

e = margin of error (commonly 5% or 0.05)

deff = 3

$$\begin{array}{r} 30,574 \\ 1 + 30,574 (0.05)^2 \\ 30,574 \\ 1 + 30,574 \times 0.025 \\ 30,574 \\ 77,435 \\ = 395 \end{array}$$

The design effect (deff) adjusts for the increased variability introduced by sampling methods such as cluster sampling. When a deff of 3 is applied, the sample size is increased accordingly to obtain the adjusted sample size which is

$$= n \times \text{deff}$$

Where:

n = 395 (original sample size from Yamane's formula)

$$\text{deff} = 3$$

$$= 395 \times 3$$

$$= 1,185$$

$$\text{Non-response (10\%)} = n/0.9$$

$$n = 1316$$

For the qualitative phase, 8 FGDs were conducted across the geopolitical zone, each comprising approximately 12 participants, ensuring broad representation and diversity in experiences and perspectives.

Sampling Techniques

A four-stage multistage sampling technique was employed to ensure representativeness across the six geopolitical zones.

The sampling process was carried out in four distinct stages to ensure that the selection of participants adequately represented returnee migrants across Nigeria. In the first stage, returnees were categorized according to the

country's six geopolitical zones: North Central, North-East, South-East, South-South, North-West, and South-West, using data obtained from the National Population Commission (NPC, 2021) and the International Organization for Migration (IOM, 2023). This stratification reflected the varying numbers of returnees across zones, ranging from the highest in the South-South to the lowest in the North-West.

In the second stage, the study employed a Probability Proportional to Size (PPS) technique to determine the number of participants to be drawn from each zone, ensuring that regions with larger returnee populations had a proportionately higher representation. Consequently, 1,316 participants were distributed across the zones, with the largest share allocated to the South-South and the smallest to the North-West.

The third stage involved a further breakdown within states. The PPS approach was again applied to allocate participants to specific states such as Edo, Delta, and Lagos, maintaining proportional representation across the country and ensuring that no region was underrepresented.

Finally, at the community level, convenience and snowball sampling methods were employed to identify and recruit participants. This stage relied heavily on existing returnee networks, such as the Greater Returnee Foundation, to reach potential participants. This approach was particularly useful given the high mobility and scattered distribution of returnees, allowing the research team to access respondents who might otherwise have been difficult to locate.

Data Collection Procedure

Data collection was carried out using both quantitative and qualitative methods to ensure a comprehensive understanding of the psychosocial needs and reintegration of returnee migrants. The quantitative phase involved administering a structured interviewer-administered questionnaire to

eligible participants across the six geopolitical zones of Nigeria. Trained research assistants facilitated the process, ensuring clarity of questions and accuracy of responses. Prior to data collection, participants were briefed on the study objectives and their rights, and informed consent was obtained. The questionnaire captured information on demographic characteristics, psychosocial need of returnee migrants in Nigeria. Quantitative data was collected between May to July 2025.

For the qualitative phase, 8 Focus Group Discussions were organized in each geopolitical zone, with each session comprising 12 returnee participants. These discussions provided deeper insights into personal experiences, coping mechanisms, and community reintegration challenges. Each session was moderated by a trained facilitator and recorded with participants' permission. Notes and audio recordings were later transcribed verbatim for thematic analysis. The combined approach allowed for triangulation of findings, enhancing the richness and validity of the study results.

Data Collection Instruments

Data collection was carried out using a carefully structured, interviewer-administered questionnaire that had been pretested to ensure effectiveness and reliability. The questionnaire was developed to obtain comprehensive information on the psychosocial needs of returnee and reintegration experiences of returnee migrants, covering key areas such as socio-demographic background, migration and reintegration history, and various dimensions of psychosocial challenges. The Psychosocial Need was measured using a 5-point Likert scale. The Likert scale is a commonly used tool for assessing ideas, feelings, or attitudes that cannot be directly observed, using a set of organised response options [16]. It presents a number of statements or questions, each followed by a balanced range of answer choices that show how strongly a respondent agrees or

disagrees. In its usual five-point format, responses can range from “Strongly Disagree” to “Strongly Agree”, with options such as “Disagree”, a neutral “Neither Agree nor Disagree”, and “Agree” in between. The Likert scale tool for used this study was adapted from Koo & Yang, (2025) research on Likert-Type Scale [17]. To ensure cultural relevance and respondent comfort, the tool was piloted on two separate occasions over a two-week period among a small sample of returnees. Feedback from this pilot exercise guided revisions to improve question clarity and phrasing, while emotionally sensitive items were reworded in a more empathetic and culturally appropriate manner to foster honest and accurate responses.

Validity and Reliability

Content validity was established through expert review by specialists in migration psychology and public health to ensure that items accurately captured psychosocial-related constructs. Criterion validity was confirmed by aligning the questionnaire with validated international tools used in migrant health research.

Reliability was tested using Cronbach's Alpha, yielding a coefficient of 0.80, indicating strong internal consistency. Test-retest reliability was also confirmed, with a correlation coefficient of $r = 0.85$, indicating the instrument's stability over time.

Data Analysis

Data was first entered and cleaned in Microsoft Excel, with incomplete or inconsistent responses (approximately 20%) removed before analysis. Quantitative data were analyzed using IBM SPSS version 28.0. Descriptive statistics such as frequency and percentage was used to summarize the assessment of psychosocial needs of the respondents. and identify associations between psychosocial factors, and socio-demographic variables. Multivariate logistic regression analysis was used to assess the factors

associated with psychosocial needs among returnee migrants. The level of significance was set at $p < 0.05$.

For the qualitative data, all FGDs were audio-recorded, transcribed verbatim, and analyzed thematically. Thematic analysis involved coding, categorizing, and identifying emerging themes using QDA Miner software, which facilitated systematic data management and triangulation with quantitative findings.

Result

Quantitative Analysis

Socio-Demographic Characteristics of Returnee Migrants

Table 1 shows that the majority of returnee migrants were young adults aged 18–30 years (65.7%), with a mean age of 29 ± 6.2 years, indicating a predominantly youthful population. Females (56.5%) slightly outnumbered males (43.5%). Most respondents were single (58.3%), while over one-third were married (38.4%). Christianity was the dominant religion (79.0%). In terms of ethnicity, Edo respondents constituted the largest proportion (50.9%), followed by Hausa (15.8%), while Igbo (7.9%) and Yoruba (9.7%) accounted for smaller shares.

Table 1. Socio-Demographic Characteristics of Returnee Migrants

Variables	Category	Frequency (n=1316)	Percentage (%)
Age Category	0-17 Years	5	0.4
	18-30 Years	864	65.7
	31-50 Years	441	33.5
	51 Years	6	0.5
Mean Age		29 ± 6.212	
Gender	Male	572	43.5
	Female	744	56.5
Marital Status	Single	776	58.3
	Married	506	38.4
	Separated	5	0.4
	Divorce	24	1.8
	Widowed	14	1.1
Religion	Christianity	1040	79.0
	Islam	276	21.0
	Hausa	208	15.8
Ethnic Group	Igbo	104	7.9
	Yoruba	127	9.7
	Edo	670	50.9
	Others	207	15.7

Assessment of Psychosocial Needs of Returnee Migrants

Table 2 shows that most returnees were neutral about having access to mental health support services (50.2%), while 35.3% disagreed. A strong sense of community belonging was limited, with 51.1% disagreeing and 24.5% strongly disagreeing. Financial hardship was widespread, with 60.1% strongly disagreeing that they experience financial difficulties, reflecting the absence of stable

income sources. Additionally, most respondents disagreed that reintegration was a challenge (72.1%), while social isolation was common, with 72.5% agreeing and 12.1% strongly agreeing that they felt excluded. Stigma was also prevalent, with 34.7% agreeing and 50.4% strongly agreeing they experienced stigma as returnees. Housing access was limited, as 50.2% disagreed they had adequate shelter, while 59.6% were neutral about having strong family support.

Table 2. Assessment of Psychosocial Needs of Returnee Migrants

Variable	Frequency (n=1316)	Percentage (%)
I have access to mental health support services		
Strongly Disagree	16	1.2
Disagree	466	35.4
Neutral	660	50.2
Agree	167	12.7
Strongly Agree	7	0.5
I feel a strong sense of belonging in my community.		
Strongly Disagree	324	24.6
Disagree	673	51.1
Neutral	87	6.6
Agree	176	13.4
Strongly Agree	56	4.3
I experience financial difficulties affecting my well-being		
Strongly Disagree	792	60.2
Disagree	486	36.9
Neutral	17	1.3
Agree	9	0.7
Strongly Agree	12	0.9
I struggle with reintegrating into Nigerian society		
Strongly Disagree	156	11.9
Disagree	949	72.1
Neutral	100	7.6
Agree	102	7.8
Strongly Agree	9	0.7
I feel socially isolated or excluded.		
Strongly Disagree	8	0.6
Disagree	103	7.8
Neutral	90	7.0
Agree	956	72.6
Strongly Agree	159	12.1
I have experienced stigma related to being a returnee migrant		

Strongly Disagree	21	1.6
Disagree	108	8.2
Neutral	67	5.1
Agree	455	34.6
Strongly Agree	665	50.5
I have adequate housing and shelter.		
Strongly Disagree	78	5.9
Disagree	660	50.2
Neutral	402	30.5
Agree	168	12.8
I have a strong support system from family and friends		
Strongly Disagree	50	3.8
Disagree	43	3.3
Neutral	784	59.6
Agree	434	33.0
Strongly Agree	5	0.4
I feel safe and secure in my living environment		
Strongly Disagree	32	2.4
Disagree	353	26.8
Neutral	684	52.0
Agree	238	18.1
Strongly Agree	9	0.7
I have access to job opportunities that meet my skills		
Strongly Disagree	65	4.9
Disagree	613	46.6
Neutral	456	34.7
Agree	168	12.8
Strongly Agree	14	1.1

Table 3 presents the results of a multivariate logistic regression analysis of factors associated with psychosocial needs among returnee migrants. After adjusting for covariates, several sociodemographic characteristics remained significantly associated with higher psychosocial needs among returnee migrants ($p < 0.05$). Sex showed a strong independent association with male returnees had significantly higher odds of reporting high

psychosocial needs compared to females (AOR = 5.533, 95% CI: 3.984–7.683, $p < 0.001$). Religious affiliation was also significant, with Muslim respondents showing lower odds of psychosocial needs compared to Christians (AOR = 0.56, $p = 0.026$). Ethnicity showed strong associations, as Igbo, Yoruba, Edo, and other ethnic groups had significantly lower odds of psychosocial needs compared to Hausa returnees ($p < 0.001$ for all).

Table 3. Multivariate Logistic Regression Analysis of Factors Associated with Psychosocial Needs among Returnee Migrants

Variable	COR	95%CI	P value	AOR	95%CI	P value
Age						
0-17 Years	Ref	-	-	Ref	-	-

18-30 Years	0.322	0.037-2.981	0.325	0.366	0.034-3.884	0.404
31-50 Years	0.465	0.051-4.192	0.495	0.355	0.033-3.815	0.393
51 Years	1.250	0.058-26.869	0.887	1.109	0.040-31.026	0.951
Sex						
Male	7.683	5.876-10.044	<0.001*	5.533	3.984-7.683	<0.001*
Female		Ref	-	Ref		-
Religion						
Christianity		Ref	-	Ref		-
Islam	1.823	1.369-2.427	<0.001*	0.559	0.335-0.933	0.026*
Ethnicity						
Hausa	Ref		-	Ref		-
Igbo	0.151	0.090-0.255	<0.001*	0.234	0.103-0.531	<0.001*
Yoruba	0.149	0.090-0.246	<0.001*	0.073	0.035-0.151	<0.001*
Edo	0.206	0.140-0.304	<0.001*	0.085	0.042-0.174	<0.001*
Others	3.496	1.766-6.918	<0.001*	0.097	0.052-0.181	<0.001*
Education						
None	7.378	0.849-64.078	0.070	1.311	0.829-2.073	0.246
Primary	10.982	1.254-96.200	0.030*	0.805	0.572-1.134	0.215
Secondary	6.490	0.755-55.808	0.088	1.572	0.889-2.779	0.120
Tertiary	13.621	1.526-121.558	0.019*	0.189	0.018-2.002	0.167
Dropped out	Ref		-	Ref		-

* $p < 0.05$ statistically significant, COR (Crude odd ratio), AOR (Adjusted odd ratio).

Qualitative Result

Psychosocial Needs

Major Social Challenges Faced After Returning to Nigeria

Returnees face deep social challenges that hinder reintegration, including stigma, broken relationships, and systemic exclusion. These issues often overlap, worsening psychological and social strain, especially for women and those returning without financial success.

Widespread Stigma and Rejection

Returnees are often labeled as failures, criminals, or sex workers, shaping how others treat them.

“People look down on me because I returned empty; others succeeded.” — R7, Kano 2 FGD

“My marriage ended because people assumed I traveled for prostitution.” — R3, Lagos FGD

“Employers reject me when they learn I’m a returnee.” — R4, Kano 2 FGD

Broken Trust and Emotional Strain

Many described losing trust in others and withdrawing socially due to fear of judgment.

“Noise disturbs me; I avoid gatherings.” — R1, Ikorodu Lagos FGD

“Men suspect I traveled for sex work; finding a partner is impossible.” — R4, Abuja FGD

Systemic Exclusion and Daily Struggles

Returnees often face structural barriers that deepen their marginalization.

“My certificates don’t stop employers from rejecting me.” — R5, Lagos FGD

“Transport and electricity shortages make daily life stressful.” — R3, Abuja FGD

“I drown memories in alcohol and drugs.” — R4, Yobe 2 FGD

Returnees navigate stigma, distrust, and structural neglect, with women facing the harshest gendered stigma. Their experiences reveal that social reintegration remains incomplete without addressing prejudice, institutional exclusion, and trauma recovery.

How Has Your Return Affected Your Relationships with Family and Friends?

Return migration reshapes personal relationships, often blending relief with resentment. While some returnees rebuilt trust and found emotional renewal, others faced alienation, stigma, or permanent estrangement.

Reconnection and Strengthened Bonds

For some returnees, coming home brought emotional healing and restored unity.

Family Relief and Celebration

“My family now celebrates my birthday; my return healed their ailments.” — R1, Fremnet House/Oreyo Lagos FGD

Mending Past Trauma

“Marriage made my family forget the pain of my journey.” — R5, Kano 2 FGD

Advocacy and Healing Roles

“I now educate others to avoid the mistakes I made.” — R4, Ikeja Onigbongbo Lagos FGD

Fractured Trust and Emotional Distance

Others described damaged relationships marked by guilt, debt, and distrust.

Financial Strain and Disappointment

“My mother went into debt for my trip, and I can’t repay her.” — R4, Ikeja Lagos FGD

Self-Isolation as Defense

“I avoid family to escape the shame of my condition.” — R4, Ogijo-Ikorodu Lagos FGD

Unspoken Trauma

“I can’t talk about Libya, and that silence creates distance.” — R4, Ikeja Onigbongbo Lagos FGD

Selective Support Systems

Some returnees found fragmented but meaningful support, often from unexpected sources.

Unexpected Allies

“One friend checks on me when family won’t.” — R4, Fremnet House/Oreyo Lagos FGD

Gendered Divides

“My marriage ended, and I lost custody of my kids.” — R4, Ogijo-Ikorodu Lagos FGD

Conditional Acceptance

“They fund my care but complain about the cost.” — R4, Yobe 2 FGD

Return migration acts as a powerful test of relationships, repairing some while breaking others beyond recovery.

Do You Feel Accepted and Supported by Your Community? Why or Why Not?

Community acceptance reveals deep divisions between returnees and the societies they rejoined.

Systemic Exclusion from Residential Communities

Most returnees viewed their neighbourhoods as unwelcoming, where interactions were often driven by curiosity or material interest.

Stigma and Mockery

“The community stigmatizes us; they only ask what I brought from abroad.” — R4, Kano 2 FGD

Exploitative Expectations

“They don’t support us—they only take from us.” — R1, Fremnet House/Oreyo Lagos FGD

“My church mocked me after I shared my story, so I left.” — Ikeja Onigbongbo Lagos FGD

Gendered Exclusion

“Acceptance matters more for women who rely on others; men face indifference.” — Ikeja, Lagos FGD.

Returnee Networks as Alternative Communities

When local acceptance failed, returnees-built solidarity among themselves, forming informal support networks.

Mutual Understanding

“Only fellow returnees accept us—we’ve become each other’s family.” — Ikeja, Lagos FGD

Collective Advocacy

“Our sensitization programs help others avoid the pain we went through.” — R2, Fremnet House/Oreyo Lagos FGD

Conditional Acceptance

A small number experienced partial acceptance, often dependent on perceived success or financial contribution.

Tolerance Without Support

“My community accepted me but offered no help since I came back poor.” — R1, Abuja FGD

Fragile Reconciliation

“My family reunited after I returned—but only briefly.” — R3, Ikeja Onigbongbo FGD

Community acceptance remains largely conditional and fragile, shaped by social status, economic outcomes, and gender expectations. The findings reveal a need for inclusive community initiatives that promote empathy, equality, and sustainable reintegration rather than judgment or transactional acceptance.

What Support Do Returnee Migrants Need Most to Successfully Reintegrate?

Returnees outlined a holistic vision of reintegration, emphasizing that financial assistance alone cannot resolve the layered challenges they face. Their responses call for integrated systems that prioritize mental health, economic stability, and structural reform.

Mental Health and Psychosocial Support (MHPSS) as the Foundation

Participants consistently emphasized that psychological recovery must precede economic empowerment.

“Psychological support must come before business grants—trauma doesn’t leave at

once.” — R2, Fremnet House/Oreyo Lagos FGD

“Four of six training days should focus on mental health stabilization.” — R3, Ikeja Onigbongbo Lagos FGD

Economic Empowerment with Structural Safeguards

Returnees stressed the need for sustainable and dignified livelihood opportunities rather than short-term relief.

“The current grants can’t sustain reintegration—we need mentorship too.” — R3, Fremnet-Ogijo Lagos FGD

“Government should provide one-year living stipends during transition.” — R3, Benin City FGD

Systemic Enablers of Reintegration

Returnees identified structural reforms needed to create a stable foundation for reintegration.

Housing as a Priority

“Shelter is urgent, many can’t return to stigmatizing communities.” — R4, Ikeja Lagos FGD

“Government and NGOs should establish transitional housing camps.” — R6, Ikeja Onigbongbo Lagos FGD

Returnees envision reintegration as a gradual, multi-phase process that begins with trauma healing, advances through sustained economic empowerment, and is reinforced by systemic protection. Effective reintegration, they argue, depends as much on emotional recovery and dignity as on financial stability.

What Are the Most Critical Needs for Returnee Migrants’ Successful Reintegration?

Returnee migrants identified three core pillars for effective reintegration: mental health recovery, sustainable livelihoods, and structural community support. The findings outline both immediate needs and long-term policy priorities for holistic reintegration.

Mental Health as the Foundation

Returnees consistently stressed the importance of trauma-informed care before economic interventions, noting that current psychosocial support remains inadequate.

“Four of six training days should focus on mental health stabilization—business skills come after healing.” — R3, Ikeja Onigbongbo, Lagos FGD

Sustainable Livelihood Opportunities

Participants called for structured employment pathways and vocational programs that ensure dignity and long-term stability, rather than short-term grants.

“Government should link us to contracts that match our skills, not just give temporary stipends.” — R1, MaryLand, Lagos FGD

Structural Safety Nets

Systemic issues such as housing insecurity and stigma were identified as major obstacles to reintegration. Returnees proposed institutional measures to ensure protection and inclusion.

“Many can’t return to their communities; we need dedicated reintegration shelters.”
— R3, Ikeja, Lagos FGD

Successful reintegration, according to returnees, requires a sequenced and dignity-centered approach; healing first, empowerment second, and protection throughout.

Have You Faced Stigma or Discrimination as a Returnee Migrant?

Returnee migrants reported widespread stigma that shaped nearly every aspect of their reintegration. Discrimination appeared through social exclusion, verbal abuse, and institutional bias, reflecting entrenched stereotypes about migration failure.

Institutional Stigma within Support Systems

Many returnees described humiliating treatment from organizations responsible for their welfare, eroding trust in aid services.

“IOM staff insult us like beggars, their body language shows disgust.” — R3, Yobe FGD

Gendered and Sexualized Stigma

Female returnees endured heightened discrimination linked to assumptions about morality and motherhood.

“My betrothed said countless men must have used me abroad.” — R1, Benin City FGD

Community-Level Dehumanization

Participants frequently recounted social rejection and public ridicule within their neighborhoods.

“They call us ‘never-do-wells’ and treat us like failures.” — R4, Kano 2 FGD

Stigma against returnees operates at institutional, community, and interpersonal levels, reinforcing cycles of exclusion and psychological distress.

Discussion

Findings from this study shows that majority of respondents expressed lack of community belonging, inadequate job opportunities, poor housing, and limited access to mental health services. Alarming, 72.6% reported feeling socially isolated, and 50.5% strongly agreed that they experienced stigma related to being a returnee migrant. Financial difficulties emerged as the most pressing issue. These findings are consistent with Tessitore et al. study who documented that Nigerian returnees often face hostility, unemployment, and economic marginalization, which hinder reintegration and worsen psychological distress [18]. Stigma, in particular, has been identified as a barrier to social reintegration, as communities may perceive returnees as “failures” or carriers of foreign problems [19]. A study by Nwozor et al. reported that many Nigerian returnees faced ostracization upon their return, with

communities viewing them as failures for not achieving the success often associated with migration [20]. This social rejection created a sense of alienation, contributing to loneliness and a lack of belonging. The absence of robust social networks made it difficult for returnees to access resources and rebuild their lives effectively.

Psychosocial needs assessments indicated several critical gaps. Sex shows a strong independent association with psychosocial needs among returnees, where males have significantly higher odds (AOR= 5.533 ; $p<0.001$) of reporting high psychosocial needs compared to females [21]. Religion also independently influences psychosocial needs; Muslim participants reported lower odds of psychosocial needs (AOR=0.559: $p=0.026$) compared to Christian respondents, suggesting that religious affiliation may shape mental health experiences and access to support. Ethnicity plays a significant role, with Igbo, Yoruba, and Edo respondents showing substantially lower odds of high psychosocial needs compared to the Hausa ethnic group, indicating that cultural and social factors linked to ethnicity affect psychosocial well-being.

Stigma emerged as one of the most significant challenges for returnees. Being labelled as failures, criminals, or sex workers eroded their sense of dignity and obstructed community reintegration. The intensity of stigma was particularly gendered, with women bearing disproportionate burdens linked to assumptions of prostitution, sexual exploitation, and single motherhood. These findings resonate with Richardson & Laurie research, who highlighted the sexual stigma trafficked women face post-return. Institutional discrimination, whether from employers or even state actors further entrenched marginalization [22]. This suggests that stigma is not only interpersonal but also systemic, perpetuated by policies and practices that fail to protect returnees' dignity. The relational disruptions described by FGD participants

reflect how trauma reshapes interpersonal bonds. Withdrawal, self-isolation, and difficulty sustaining romantic partnerships illustrate the lingering psychological scars of migration. Distrust, both of others and of self, points to diminished relational confidence. Comparable studies also show that family expectations of financial gain, coupled with returnees' migrants inability to meet these, often fuel estrangement and shame [23]. For women, the collapse of marriages, engagements, and loss of custody illustrates how migration outcomes intersect with gender norms, leaving them especially vulnerable to relational and social breakdown. Beyond interpersonal stigma, returnees face structural challenges such as unemployment, housing insecurity, and poor infrastructure. Participants expressed frustration that vocational certificates or training often failed to translate into job opportunities, which supports Medase & Barasa findings on the limited absorptive capacity of Nigeria's labour market [24]. Safety concerns, including reports of kidnapping and community hostility, further expose returnees to ongoing vulnerability. These structural exclusions demonstrate how reintegration is undermined by weak governance, fragile economies, and systemic insecurity.

Returnees' experiences with communities reflected a spectrum ranging from outright rejection to conditional acceptance based on perceived success. Most accounts highlighted transactional or exploitative community interactions, where returnees were valued only for material contributions. This resonates with Nisrane research, who noted that African communities often judge returnees through economic rather than social lenses [25]. In contrast, peer networks and returnee associations emerged as critical safe havens, providing solidarity and mutual understanding. These findings suggest that while mainstream communities often perpetuate stigma, returnee-led networks function as alternative communities of care and resilience.

Limitation

Although the study employed a robust mixed-method design that integrated both quantitative and qualitative approaches, a few limitations were encountered. First, the use of convenience and snowball sampling at the community level may have introduced some selection bias, as participants who were more socially connected or active within returnee networks were more likely to be included. This could limit the representativeness of the sample. Additionally, self-reported information collected through questionnaires and Focus Group Discussions may have been affected by recall bias or social desirability bias, particularly when discussing sensitive psychosocial experiences.

Mitigation

To mitigate these limitations, the study applied a multistage sampling approach with Probability Proportional to Size (PPS) at earlier stages to enhance representativeness across all six geopolitical zones. Research assistants were trained to create a supportive and nonjudgmental environment that encouraged honest disclosure, while the triangulation of quantitative and qualitative data strengthened the credibility and validity of findings. Furthermore, piloting of the data collection instruments and expert validation helped to improve reliability and minimize bias in the responses obtained.

Conclusion

The findings demonstrate that returnee migrants experience substantial unmet psychosocial needs, characterized by social isolation, stigma, weak community integration, limited access to mental health services, and economic and housing insecurity. Male returnees were particularly vulnerable, with significantly higher psychosocial needs than females. Also, persistent stigma, social isolation, and financial instability significantly impede recovery and community acceptance.

Addressing these challenges requires a coordinated, trauma-informed approach that combines mental health and psychosocial support with sustainable livelihood programs and inclusive community policies. Strengthening institutional responsiveness and fostering empathy-driven reintegration frameworks are essential.

Financial Support and Sponsorship

No external financial support.

Conflicts of Interest

There are no conflicts of interest.

Data Availability

The quantitative and qualitative datasets generated and analyzed during this study are not publicly available due to ethical restrictions and the sensitive nature of the information collected from returnee migrants. However, de-identified data may be made available from the corresponding author upon reasonable request and subject to approval by the Nigerian Institute of Medical Research (NIMR) ethics committee.

Ethical Considerations

Ethical clearance for the study was granted by the Nigerian Institute of Medical Research (NIMR) under reference number IRB/24/017. Prior to data collection, each participant was fully briefed on the study's purpose, procedures, and their rights, after which informed consent was obtained. Participation was entirely voluntary, with individuals assured of their right to withdraw at any point without consequence. To safeguard privacy, all responses were treated with strict confidentiality, and participants' identities were protected using coded identifiers instead of personal names. In instances where participants exhibited signs of emotional distress during interviews or discussions, they were promptly referred to qualified psychosocial support services for further assistance. Throughout the research process, the study remained firmly guided by the ethical principles of respect for

persons, beneficence, and justice, ensuring that participants' dignity and well-being were prioritized at every stage.

Author Contributions

Observation:

- **Kazeem Abimbola**
Uthman: Conceptualization, Writing – Review & Editing, Supervision. [Kazeem Abimbola Uthman was omitted]
- **Olatunji Joshua**
Awolaye: Conceptualization, Methodology, Data Curation, Investigation, Writing – Original Draft, Funding Acquisition.
- **Florence Ngozi Uchendu:** Supervision, Writing – Review & Editing, Project Administration, Funding Acquisition.
- **Olaniyi Felix Sanni:** Formal Analysis, Methodology, Data Curation, Writing – Review & Editing.

References

- [1]. Henkelmann, J. R., de Best, S., Deckers, C., Jensen, K., Shahab, M., Elzinga, B., et al., 2020, Anxiety, depression and post-traumatic stress disorder in refugees resettling in high-income countries: A systematic review and meta-analysis. *BJPsych Open*, 6, 1–8. <https://doi.org/10.1192/bjo.2020.54>
- [2]. Siriwardhana, C., Stewart, R., 2013, Forced migration and mental health: Prolonged internal displacement, return migration and resilience. *International Health*, 5, 19–23. <https://doi.org/10.1093/inthealth/ihs014>
- [3]. World Health Organization (WHO), 2022, Refugee and Migrant Health. *World Health Organization*. <https://www.who.int/news-room/fact-sheets/detail/refugee-and-migrant-health>
- [4]. Blais, R. K., Renshaw, K. D., Jakupcak, M., 2014, Posttraumatic stress and stigma in active-duty service members relate to lower likelihood of seeking support. *Journal of Traumatic Stress*, 27, 116–119. <https://doi.org/10.1002/jts.21888>

All authors read and approved of the final manuscript.

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- [5]. Chy, M. T., Uddin, M. K., Ahmmed, H. U., 2023, Forced returnee Bangladeshi female migrant domestic workers and their social reintegration experiences. *Current Sociology*, 71, 133–151. <https://doi.org/10.1177/00113921211048533>
- [6]. Mreji, P., Barnard, H., 2021, The micro-foundations of the returnee liability: The interpersonal challenges of returnee entrepreneurs in Kenya. *Journal of International Management*, 27. <https://doi.org/10.1016/j.intman.2021.100846>
- [7]. Konzett-Smoliner, S., 2016, Return migration as a ‘family project’: Exploring the relationship between family life and the readjustment experiences of highly skilled Austrians. *Journal of Ethnic and Migration Studies*, 42, 1094–1114. <https://doi.org/10.1080/1369183X.2016.1138853>
- [8]. Aker, D. Y., Görmüş, A., 2018, Employment of return migrants in Turkey: Evidence from the labour force survey. *Migration Letters*, 15, 437–451. <https://doi.org/10.33182/ml.v15i3.364>
- [9]. Openshaw, E. H., 2022, Effects of psychological and psychosocial interventions for refugees: A systematic review.

- [10]. Wapmuk, S., 2019, International migration, Nigerian returnee migrants, and challenges of reintegration. *Journal of Social Sciences*, 9, 158–180.
- [11]. Mercier, M., David, A., Mahia, R., De Arce, R., 2016, Reintegration upon return: Insights from Ecuadorian returnees from Spain. *International Migration*, 54, 56–73. <https://doi.org/10.1111/imig.12288>
- [12]. Zandonini, G., 2020, Nigerians returned from Europe face stigma and growing hardship. *The New Humanitarian*. <https://www.thenewhumanitarian.org/news-feature/2020/07/28/Nigeria-migrants-return-Europe>
- [13]. Lindert, J., Samkange-Zeeb, F., Jakubauskiene, M., Bain, P. A., Mollica, R., 2023, Factors contributing to resilience among first-generation migrants, refugees and asylum seekers: A systematic review. *International Journal of Public Health*, 68. <https://doi.org/10.3389/ijph.2023.1606406>
- [14]. Yamane, Y., 1967, Mathematical formulae for sample size determination. *Open Journal of Statistics*, 12, 291–302.
- [15]. International Organization for Migration (IOM), 2023, IOM Nigeria Annual Report. *International Organization for Migration*.
- [16]. Joshi, A., Kale, S., Chandel, S., Pal, D., 2015, Likert scale: Explored and explained. *British Journal of Applied Science & Technology*, 7, 396–403. <https://doi.org/10.9734/bjast/2015/14975>
- [17]. Koo, M., Yang, S., 2025, *Likert-type scale*.
- [18]. Tessitore, F., Parola, A., Margherita, G., 2023, Mental health risk and protective factors of Nigerian male asylum seekers hosted in Southern Italy: A culturally sensitive quantitative investigation. *Journal of Racial and Ethnic Health Disparities*, 10, 730–742. <https://doi.org/10.1007/s40615-022-01260-3>
- [19]. Sen, P., 2016, The mental health needs of asylum seekers and refugees – challenges and solutions. *BJPsych International*, 13, 30–32. <https://doi.org/10.1192/s2056474000001069>
- [20]. Nwozor, A., Oshewolo, S., Olanrewaju, J. S., Ake, M. B., Okidu, O., 2022, Return migration and the challenges of diasporic reintegration in Nigeria. *Third World Quarterly*, 43, 432–451. <https://doi.org/10.1080/01436597.2022.2026216>
- [21]. Karimi, B. A., Azizi, B. A., Zahir, A. H., 2025, The effects of forced deportation of migrants on their mental health in Herat City. *Kunduz University International Journal of Islamic Studies and Social Sciences*, 2, 215–228. <https://doi.org/10.71082/fsdhd609>
- [22]. Richardson, D., Laurie, N., 2019, Returning to sexual stigma: Post-trafficking lives. *British Journal of Sociology*, 70, 1926–1945. <https://doi.org/10.1111/1468-4446.12707>
- [23]. Simoni, V., Voirol, J., 2025, Moral articulations of economic life in returns to Ecuador and Cuba. *Open Research Europe*, 5, 68. <https://doi.org/10.12688/openreseurope.19587.1>
- [24]. Medase, K., Barasa, L., 2019, Absorptive capacity, marketing capabilities, and innovation commercialisation in Nigeria. *European Journal of Innovation Management*, 22, 790–820. <https://doi.org/10.1108/EJIM-09-2018-0194>
- [25]. Nisrane, B. L., 2020, Home, but not ‘at home’: The reintegration of unskilled Ethiopian female return migrants from Arabian Gulf countries. *Ekonomika Regiona*, 32.

Perceptions of Healthcare Seekers on Universal Health Coverage in Lubero Territory and Butembo City in Democratic Republic of Congo

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Abstract

This study aims to contribute to the implementation of universal health coverage in the Democratic Republic of Congo and to assess the implementation of UHC through the level of perception of healthcare seekers. The study is descriptive, cross-sectional, comparative, and correlational. It was conducted from March to August 2025. A survey was carried out using an interview guide submitted to 1, 068 heads of households in nine health zones in Lubero Territory and Butembo City. After data analysis, the findings read as follows: First, expectations regarding the UHC were positive in Lubero ($M= 3.50 \pm 0.85$) and in Butembo ($M=3.30 \pm 0.82$). Second, perceptions in terms of fears were considered negative in Lubero Territory ($M= 2.68 \pm 0.94$) and in Butembo City ($M= 2.74 \pm 0.86$). Third, the expectations of healthcare seekers differ according to place of residence ($t = 3.75$; $p=0.000$), whereas fears do not ($t=-1.01$; $p=0.310$). Fourth, the expectations of healthcare seekers do not differ according to main profession ($F=0.500$; $p=0.776$), while fears do ($F=5.052$; $p=0.000$). Fifth, perceptions of UHC differ according to marital status ($F=3.806$; $p=0.010$) but not according to gender ($F=-0.696$; $p=0.486$). Sixth, there was no significant relationship between expectations of UHC and characteristics such as age, level of education, household size, and household income. Indeed, fears about UHC are influenced by educational level ($r=0.117$; $p=0.000$), household size ($r=-0.125$; $p=0.000$), and household income ($r=-0.101$; $p=0.001$).

Keywords: *Expectation, Fear, Healthcare Seeker, Perception, Universal Health Coverage (UHC).*

Introduction

To achieve universal health coverage, every human being has the right to quality health services without financial hardship, as stipulated by the Sustainable Development Goals set for 2030 [20]. Most countries in sub-Saharan Africa face a high burden of disease and insufficient financial resources to fund the provision of quality health services [14].

In 2019, world leaders adopted a declaration seeking strengthening health systems to ensure that they are equitable, resilient, and capable of meeting everyone's needs. This declaration

restated that everyone deserves access to quality health services, both in crisis and peace times [16, 2]. Accordingly, Universal health coverage (UHC) is a means of fulfilling the right to healthcare and the right of every person to enjoy the highest possible level of physical and mental health, as recognized by international law [19].

Several countries have demonstrated that measures can be taken to achieve UHC, even with limited resources. This is the case in countries such as Cambodia, Chile, China, Colombia, Ghana, Indonesia, Mexico, the Philippines, Rwanda, Thailand, and Vietnam

[19]. A study conducted in the Sahel showed that health coverage gradually increased from 23% to 50% in Mali and from 2% to 100% in Chad [4].

Universal health coverage is being extended in many countries, particularly in the area of healthcare and the establishment of national social protection floors, expanded access to cash transfers, and universal social pensions [3]. UNAIDS [21] reports that in 2017, less than half of the world's population was covered by essential health services, and it is estimated that only 60% of the world's population will have universal health coverage by 2030.

In the Democratic Republic of Congo (DRC), it is estimated that 60% of the population does not have access to the healthcare system. The Democratic Republic of Congo has had its 2019-2022 strategic plan for universal health coverage in place since 2018. Law No. 18/035 of December 13, 2018, establishing the fundamental principles relating to the organization of public health in the DRC, stipulates in Article 41 that a universal health coverage system based on the principles of equity, quality assurance of care, and financial protection for all shall be established in the Democratic Republic of Congo a universal health coverage system based on the principles of equity, quality assurance of care, and financial protection for all [22].

The Democratic Republic of Congo has its own strategic plan for universal health coverage, which has not yet been implemented despite having already been announced by the country's authorities. We believe that a study is necessary to properly establish this program. In this respect, this research has been guided by the following general question: Does the current level of awareness among healthcare seekers in Lubero Territory and Butembo City of regarding universal health coverage reflect progress toward its implementation in the Democratic Republic of Congo?

This general question generates the following specific questions:

1. What is the level of awareness among healthcare seekers in Lubero and Butembo regarding universal health coverage in terms of expectations and fears?
2. Does the awareness of UHC differ significantly between the two entities (rural Lubero and urban Butembo)?
3. Do socio-demographic characteristics such as age, education level, gender, household size, marital status, main occupation, and household income significantly influence healthcare seekers' perceptions of universal health coverage?

The study is based on the assumptions that:

1. Perceptions of UHC would significantly differ between the two entities;
2. The socio-demographic characteristics of respondents, such as age, level of education, gender, household size, marital status, main occupation, and household income, would significantly influence the perceptions of healthcare seekers.

This work aims at contributing to the implementation of universal health coverage in the Democratic Republic of Congo and to assess the implementation of UHC through the level of perception of healthcare seekers in Lubero Territory and Butembo City.

More narrowly, the study aims at:

1. Determining the level of perception of healthcare seekers in Lubero and Butembo regarding universal health coverage in terms of expectations and fears.
2. Testing the difference in perception of UHC between rural areas (Lubero Territory) and urban ones areas (Butembo city).

3. Verifying the statistical relationship between socio-demographic characteristics and healthcare seekers' perceptions of UHC.

Three dimensions characterize UHC: population coverage, service coverage, and financial protection [16, 21]. Each dimension is to be supplied with a brief explanation. Population coverage is “the share of the population that can benefit from a range of basic services, whether through public schemes or private primary health insurance” [18]. This implies that each person can access the health services they need when they need them without constraint [7].

Coverage of services implies access to all the health services that applicants need, with quality for all and provided by competent staff. Health services include preventive, curative, and rehabilitative services, health promotion, and access to medicines and technologies [7].

Financial protection entails that healthcare is affordable for everyone. This means that financial difficulties cannot prevent a person from accessing the healthcare and services they need. Financial protection must be as comprehensive as possible. Therefore, health financing systems must evolve in such a way as to avoid large direct payments at the time of service delivery by promoting prepayment of contributions for health care and services. This method of financing should spare the population from catastrophic expenses and the impoverishment of people who need healthcare [6, 7].

Materials and Methods

The study is descriptive, cross-sectional, comparative, and correlational. We used a quantitative approach. It ran from March to August 2025, a period of six months. The study was conducted in Lubero Territory and Butembo City, two entities in North Kivu Province, Democratic Republic of Congo (DRC), in Central Africa. Nine health zones (HZs) were involved. They are: the Urban HZs

of Katwa and Butembo in Butembo city, and the Rural HZs of Masereka, Kayna, Alimbongo, Lubero, Musinene, Biena, and Manguredjipa in Lubero Territory.

The population in our study consisted of heads of households considered to be healthcare seekers in Lubero Territory and Butembo City. Lubero Territory and Butembo City have a population of 2,628,333, and the number of households is estimated at 439,254 spread across nine health zones, including 130,405 in Butembo City and 308,849 in Lubero Territory.

The study has been conducted with a sample of 1,068 heads of households, including 712 in rural areas and 356 in urban areas. It has used non-random sampling with the Politz method to collect data from heads of households. A non-probability sampling method of the Politz type was adopted due to practical and contextual constraints specific to the study setting. Indeed, insecurity in the study area has led to population displacement and the mobility of healthcare providers. These conditions did not allow for the implementation of a probabilistic sampling strategy [23-27].

Data have been collected using an interview guide written in French and translated into Swahili and Kinande. The data collection tool has been validated by seven experts. Prior to data collection, a preliminary study was conducted with 40 participants to assess the reliability of the instrument. Its results were tested using Cronbach's alpha coefficient. The study retained the variable when Cronbach's alpha value was greater than or equal to 0,70 and less than 0,9. In the present study, the overall Cronbach's alpha coefficient was 0,794, indicating satisfactory internal consistency.

The data collection tool has been developed and validated by the ethics committee before conducting a pilot study. To test the validity of our data collection tools, we have used content validity analysis. The test/retest method has been used to test the reliability of the collection tools. The questionnaire has been administered

twice to the same sample, and the results have been compared and interpreted using Cronbach's alpha coefficient.

Data analysis has been performed using SPSS version 20 software. OpenEpi software has been used to determine confidence intervals for proportions at a 5% significance level using Fleiss's exact quadratic method. The study has used frequencies and percentages to analyze socio-demographic characteristics. Means and standard deviations have been used to interpret the level of perception.

The chi-square test was used to compare the proportions of information on UHC to determine whether there was a difference between them. We used Student's t-test to test the difference between the means of two groups. The one-way ANOVA test for an independent sample allowed us to test the difference in means of more than two groups. The mean difference in understanding and/or perception was determined using Scheffe's and Tukey's post hoc tests. Bravais Pearson's r correlation test helped us test the relationship between other variables. Pearson's correlation coefficient was used for the variables age, level of education, household size, and household income due to their quantitative or quasi-quantitative nature and the objective of examining linear relationships with the studied scores. Given the sample size and the approximately normal distribution of these

variables, the use of Pearson's correlation was considered appropriate [28, 29].

Results

Characteristics of Respondents

The results in Table 1 have shown that, among the 1,068 healthcare seekers surveyed, 712 (66.7%) are from Lubero Territory (rural area) and 357 (33.3%) are from Butembo City (urban area); 327 (30.6%) are aged between 30 and 40, and 186 (17.4%) are aged 51 and over; 573 (53.7%) are male and 495 (46.3%) are female; Married people dominate with 660, or 61.8%, and divorced and separated people are the minority with 82, or 7.7%; those who had completed high school are the majority with 327, or 30.6%. Those who had not completed university are in the minority, with 50 (4.7%); 478 (45.8%) are farmers, and 51 (4.8%) are students; 456, or 42.7%, belonged to households with fewer than five people. Those who belonged to households with more than six people number 312, or 29.2%, while those who belong to households with 5 to 6 people number 300, or 28.1%; 808 (75.7%) have a daily income of less than \$2.14 per person per day, while 260 (24.3%) have estimated their income to be greater than or equal to \$2.14 per person per day; 709, or 66.4%, have two meals a day, and 141, or 13.1%, take only one meal a day. Only 219 care seekers, or 20.5%, take three meals a day.

Table 1. Distribution of Healthcare Seekers according to Characteristics

Residence	Frequency (%)
Lubero Territory (rural area)	712 (66.7)
Butembo City (urban area)	356 (33.3)
Total	1,068 (100.0)
Age groups	Frequency (%)
Under 30	292(27.4)
30 to 40	327(30.6)
41 to 50	263(24.6)
51 and over	186(17.4)
Total	1068(100.0)
Gender	Frequency (%)
Feminine	495(46.3)

Masculine	573(53.7)
Total	1068(100.0)
Marital status	Frequency (%)
Single	239(22.4)
Married	660(61.8)
Divorced/Separated	82(7.7)
Widowed	87(8.1)
Total	1068(100.0)
Level of education	Frequency (%)
No level	98(9.2)
Primary school not completed	141(13.2)
Primary school completed	80(7.5)
Secondary school not completed	269(27.2)
Secondary school completed	327(30.6)
University not completed	50(4.7)
University completed	103(9.6)
Total	1068(100.0)
Main occupation	Frequency (%)
Agriculture	478(44.8)
Commerce	219(20.5)
Crafts	87(8.1)
Public service	134(12.5)
Private service	99(9.3)
Student	51(4.8)
Total	1068(100.0)
Household size	Frequency (%)
Fewer than 5 people	456(42.7)
5 to 6 people	300(28.1)
More than 6 people	312(29.2)
Total	1068(100.0)
Daily household income	Frequency (%)
Income less than \$2.14 per person per day	808(75.7)
Income greater than or equal to \$2.14 per person per day	260(24.3)
Total	1068(100.0)
Number of meals	Frequency (%)
One meal per day	140(13.1)
Two meals per day	709(66.4)
Three meals per day	219(20.5)
Total	1068(100.0)

Perception of Universal Health Coverage (UHC)

The level of healthcare seekers' perception of UHC has been measured by their expectations and fears regarding UHC.

Expectations of Healthcare Seekers regarding UHC

Considering the five components selected, healthcare seekers' expectations regarding

access to quality healthcare through UHC has scored highest in Lubero Territory ($A = 3.58 \pm 1.05$), while in the city of Butembo, it has been in terms of free healthcare ($A = 3.56 \pm 1.07$), which is also reflected in the sum of the two entities ($A = 3.50 [3.35; 3.57] \pm 1.07$). In general, healthcare seekers' expectations have been positive in Lubero ($A = 3.50 \pm 0.85$) and Butembo ($A = 3.30 \pm 0.82$), and across both entities ($A = 3.43 [3.38; 3.48] \pm 1.07$), as shown in Table 2.

Table 2. Perception of Expectations Regarding UHC by Healthcare Seekers (n=1068)

Expectations of healthcare seekers	Lubero			Butembo			Total		
	A	SD	VI	A	SD	VI	A [CI]	SD	VI
Belief that with UHC, we will all have equal access to healthcare	3.51	1.09	PP	3.19	1.09	PP	3.41[3.34 ; 3.47]	1.10	PP
Belief that UHC will enable us to receive quality care	3.58	1.05	PP	3.04	1.15	PP	3.41[3.35 ; 3.48]	1.10	PP
Belief that UHC will improve our household income	3.47	1.10	PP	3.23	1.09	PP	3.39[3.32 ; 3.46]	1.10	PP
Belief that UHC will promote free healthcare	3.47	1.60	PP	3.56	1.07	PP	3.50[3.35 ; 3.57]	1.07	PP
Belief that UHC will relieve the financial burden on the population	3.47	1.07	PP	3.42	1.04	PP	3.45[3.39 ; 3.52]	1.07	PP
Overall average	3.50	0.85	PP	3.30	0.76	PP	3.43[3.38 ; 3.48]	0.82	PP

Note: PP = Positive perception if the average is > 3, I = Indifference if the average is equal to 3, NP = Negative perception if the average is < 3, VI = Verbal interpretation, P = Perception, A = Average, SD = Standard deviation; CI = Confidence interval.

Seekers' Fears about UHC

Of the three components selected, healthcare seekers in Lubero Territory have expressed the greatest concern about the decline in the quality of healthcare due to UHC ($A = 2.75 \pm 1.15$). In contrast, those in Butembo City have most been concerned about discrimination against patients due to UHC ($A = 2.76 \pm 1.10$). Overall,

healthcare seekers' perceptions of fear in the Lubero territory ($A = 2.68 \pm 0.94$) and in the city of Butembo ($A = 2.74 \pm 0.86$) have been considered negative. The perception of healthcare seekers in terms of fears in the two entities combined ($A = 2.70 [2.64; 2.76] \pm 0.91$) has also been considered negative, as detailed in Table 3.

Table 3. Perception of Fears about UHC among Healthcare Seekers (n=1068)

Fears of healthcare Seekers	Lubero			Butembo			Total		
	A	SD	VI	A	SD	VI	A [CI]	SD	VI
Concerned that UHC will lower the quality of healthcare	2.75	1.15	NP	2.72	1.09	NP	2.74 [2.67; 2.81]	1.13	NP
Concerned that managers divert the funds allocated to institutions	2.67	1.06	NP	2.75	1.05	NP	2.70 [2.63; 2.76]	1.06	NP
Concerned that healthcare workers may discriminate patients because of UHC	2.62	1.10	NP	2.76	1.10	NP	2.67 [2.59; 2.73]	1.10	NP
Overall average	2.68	0.94	NP	2.74	0.86	NP	2.70 [2.64; 2.76]	0.91	NP

Note: PP = Positive perception if the average is > 3, I = Indifference if the average is equal to 3, NP = Negative perception if the average is < 3, VI = Verbal interpretation, P = Perception, A = Average, SD = Standard deviation; CI = Confidence interval.

Summary of Healthcare Seekers' Perceptions

Considering the two components of perception of UHC, healthcare seekers in Lubero Territory have come out on top ($M=3.09 \pm 0.63$) with a perception deemed

positive, compared to those in Butembo City ($M=3.01 \pm 0.55$) with a perception also deemed positive. The mean of the respondents from both entities ($M=3.06 [3.03; 3.10] \pm 0.60$) indicates that healthcare seekers have a positive perception of UHC, as shown in Table 4.

Table 4. Summary of Perceptions among Healthcare Seekers (n=1,068)

Perception	Lubero			Butembo			Total		
	A	SD	VI	A	SD	VI	A [CI]	SD	VI
Expectations of care seekers	3.50	0.85	PP	3.30	0.76	PP	3.43[3.38; 3.48]	0.82	PP
Fears of care seekers	2.68	0.94	NP	2.74	0.86	NP	2.70[2.64; 2.75]	0.91	NP
Overall average	3.09	0.63	PP	3.01	0.55	PP	3.06[3.03; 3.10]	0.60	PP

Note: PP = Positive perception if the average is > 3, I = Indifference if the average is equal to 3, NP = Negative perception if the average is < 3, VI = Verbal interpretation, P = Perception, A = Average, SD = Standard deviation; CI = Confidence interval.

Differences in Perceptions of UHC

This section covers healthcare seekers' perceptions of UHC in the two entities. It concludes with perceptions among healthcare seekers.

Differences in Healthcare Seekers' Perceptions of UHC in the Two Entities

In terms of expectations, a comparison of the average scores between healthcare seekers in Lubero ($A=3.50 \pm 0.85$) and those in Butembo ($A=3.30 \pm 0.76$) yields a t-value of 3.75 ($p=0.000$). In terms of fears, a comparison of

healthcare seekers in Lubero ($A = 2.68 \pm 0.94$) with those in Butembo ($A = 2.74 \pm 0.86$) yielded a t-value of -1.01 ($p = 0.310$). This result suggests a highly significant difference in

the expectations of care seekers in these two entities, whereas the comparison of fears does not suggest a significant difference, as shown in Table 5.

Table 5. Perception of Healthcare Seekers regarding UHC in the Two Entities

Entity	n	Average	Ecart-type	df	T	p	VI
Expectations of healthcare seekers							
Lubero Territory	712	3.50	0.85	1066	3.75	0.000	S
Butembo City	356	3.30	0.76				
Fears of healthcare seekers							
Lubero Territory	712	2.68	0.94	1066	-1.01	0.310	NS
Butembo City	356	2.74	0.86				

Note: n=sample size; df=degrees of freedom; t=Student's t-test difference value; p=significance threshold; VI=verbal interpretation; NS=Not Significant if $p \geq 0.05$; S=Significant if $p < 0.05$.

Differences in Perceptions of UHC According to Profession

The ANOVA test for independent samples has been used to assess differences in understanding and perceptions of UHC. The Scheffé test and Tukey test have been used to identify mean perceptions that have significantly been different from each other after an overall difference was found using ANOVA.

Differences in perceptions among healthcare seekers by main occupation. Healthcare

seekers' perceptions of UHC have been assessed in terms of average expectations and fears. The main occupations considered have been: agriculture, commerce, crafts, public service, private service and student service. The overall average expectation has been 3.4331 ± 0.82345 and the average fear 2.6998 ± 0.91350 . The results have shown that the average expectations of care seekers has not differed according to their main occupation ($F=0.500$; $p=0.776$), while their fears have ($F=5.052$; $p=0.000$), as shown in Table 6.

Table 6. Difference in Perceptions of Care Seekers by Main Occupation

Perception	Occupation	Average	Standard deviation	df	F	p	IV
Expectations	Agriculture	3.4197	0.85446				
	Commerce	3.4247	0.79881				
	Crafts	3.4437	0.61864	5	.500	0.776	NS
	Public service	3.4970	0.81959				
	Private service	3.4848	0.91834				
	Student	3.3098	0.76870				
	Total	3.4331	0.82345				
Fears	Agriculture	2.7462	0.93671				
	Commerce	2.6499	0.86099				
	Crafts	3.0575	0.92651	5	5.052	0.000	S
	Public service	2.5473	0.90980				

	Private service	2.4781	0.87826				
	Student	2.6993	0.77533				
	Total	2.6998	0.91350				

Note: n=sample size; df=degrees of freedom; t=Student's t-test difference value; p=significance threshold; VI=verbal interpretation; NS=Not Significant if $p \geq 0.05$; S=Significant if $p < 0.05$.

Determination of the Average Difference in the Perception of Fears

Applying Scheffé's test has revealed statistically significant differences in the

average level of fear among the craft trades and professions, such as retail ($p=0.018$), public service ($p=0.005$), and private service ($p=0.002$), as shown in Table 7.

Table 7. Determination of the Average Difference in the Perception of Fears

(I) Principal occupation	(J) Principal occupation	Difference in averages (I-J)	p
Agriculture	Commerce	-0.09624	0.889
	Craft	0.31131	0.122
	Public service	-0.19890	0.410
	Private service	-0.26805	0.207
	Student	-0.04682	1.000
Commerce	Agriculture	0.09624	0.889
	Craft	0.40755	0.028
	Public service	-0.10266	0.957
	Private service	-0.17181	0.783
	Student	0.04942	1.000
Craft	Agriculture	-0.31131	0.122
	Commerce	-0.40755	0.028
	Public service	-0.51021	0.005
	Private service	-0.57936	0.002
	Student	-0.35812	0.412
Public service	Agriculture	0.19890	0.410
	Commerce	0.10266	0.957
	Craft	0.51021	0.005
	Private service é	-0.06915	0.997
	Student	0.15208	0.959
Private service	Agriculture	0.26805	0.207
	Commerce	0.17181	0.783
	Craft	0.57936	0.002
	Public service	0.06915	0.997
	Student	0.22123	0.847
Student	Agriculture	0.04682	1.000
	Commerce	-0.04942	1.000
	Craft	0.35812	0.412
	Public service	-0.15208	0.959
	Private service	-0.22123	0.847

Perception according to Socio-Demographic Characteristics

Difference in Perceptions of Healthcare Seekers according to Gender

The overall average perception of healthcare seekers regarding UHC has been 3.05 ± 0.65 for

female healthcare seekers and 3.08 ± 0.57 for male healthcare seekers. The results showed that healthcare seekers' average perceptions did not differ by gender ($F = -0.696$; $p = 0.486$). Details are provided in Table 8.

Table 8. Difference in Perceptions of Care Seekers by Gender

Gender	Average	Standard deviation	df	t	p	VI
Feminine	3.05	0,65	1066	-0,696	0,486	NS
Masculine	3.08	0,57				

Note: N=sample size; df=degrees of freedom; t=Student's t-test difference value; p=significance threshold; VI=verbal interpretation; NS=Not significant if $p \geq 0.05$; S=Significant if $p < 0.05$.

Difference in Perceptions of Healthcare Seekers according to Marital Status

The average score for healthcare seekers' overall perception of UHC has been 3.07 ± 0.60

in both entities. The results indicate that healthcare seekers' average perceptions differ by marital status ($F=3.806$; $p=0.010$), as shown in Table 9.

Table 9. Difference in Perceptions of Care Seekers according to Marital Status

Marital status	Average	Standard deviation	df	F	p	VI
Single	3.06	0.62				
Married	3.04	0.57	3	3.806	0.010	S
Divorced/Separated	3.28	0.63				
Widowed	3.08	0.76				
Total	3.07	0.60				

Note: df= degrees of freedom, F= Snedescor file or value of the difference in variances, p= significance, VI= verbal interpretation, NS= Not significant if $p \geq 0.05$, S= Significant if $p < 0.05$.

Determination of the Average Difference in Perception according to Marital Status

The application of Scheffé's test revealed statistically significant differences in

perception averages between divorced/separated individuals and married individuals ($p=0.010$) and single individuals ($p=0.046$), as shown in Table 10.

Table 10. Determination of the Average Difference in Perception according to Marital Status

(I) Marital status	(J) Marital status	Difference in averages (I-J)	p
Single	Married	0.01844	0.983
	Divorced/Separated	-0.21865*	0.046
	Widowed	-0.02530	0.990
Married	Single	-0.01844	0.983
	Divorced/Separated	-0.23709*	0.010
	Widowed	-0.04374	0.939
Divorced/Separated	Single	0.21865*	0.046
	Married	0.23709*	0.010

	Widowed	0.19335	0.227
Widowed	Single	0.02530	0.990
	Married	0.04374	0.939
	Divorced/Separated	-0.19335	0.227

Socio-Demographic Characteristics and Expectations of Healthcare Seekers

The results has indicated that there is no statistically significant relationship between

healthcare seekers' expectations of UHC and socio-demographic characteristics such as respondent age, educational attainment, household size and household income, as detailed in Table 11.

Table 11. Relationship between Socio-demographic Characteristics and Care Seekers' Expectations

	Expectations of healthcare seekers regarding UHC		
Characteristics	<i>r</i>	<i>p</i>	<i>VI</i>
Age of the respondent	0.023	0.459	NS
Level of education	0.057	0.065	NS
Household size	0.035	0.257	NS
Monthly household income	-0.039	0.206	NS

Note: *r*=Pearson coefficient, *p*=significance threshold, *VI*=verbal interpretation, *NS*=non-significant if $p \geq 0.05$, *S*=significant if $p < 0.05$.

Socio-Demographic Characteristics and Fears of Healthcare Seekers Regarding UHC

The results have shown that there is a statistically significant relationship between the fears of healthcare seekers and characteristics such as: level of education ($r=0.117$; $p=0.000$),

household size ($r=-0.125$; $p=0.000$) and household income ($r=-0.101$; $p=0.001$), i.e. fears about the three objectives of UHC increase not only with the level of education but also with decreasing household size and income. The relationship between fears and the respondent's age is insignificant, as shown in Table 12.

Table 12. Relationship between Socio-demographic Characteristics and Fears of Healthcare Seekers

	Fears of healthcare seekers regarding the UHC		
Characteristics	<i>r</i>	<i>p</i>	<i>VI</i>
Age of the respondent	-0.027	0.386	NS
Level of education	0.117	0.000	S
Household size	-0.125	0.000	S
Monthly household income	-0.101	0.001	S

Note: *r*=Pearson coefficient, *p*=significance threshold, *VI*=verbal interpretation, *NS*=non-significant if $p \geq 0.05$, *S*=significant if $p < 0.05$.

Discussion

This section presents the discussion of the results according to the three research questions. These are the level of perception of

healthcare seekers regarding UHC, differences in perception, and the influence of socio-demographic characteristics on perception.

Perception of Healthcare Seekers Regarding Universal Health Coverage

Expectations of Healthcare Seekers Regarding UHC

The results in Table 2 indicate that healthcare seekers in Lubero Territory and Butembo City are convinced that UHC will promote free healthcare ($A=3.50[3.35; 3.57] \pm 1.07$) and lessen the financial burden on the population ($A=3.45[3.39; 3.52] \pm 1.07$), that UHC will enable them to receive quality care ($A=3.41[3.35; 3.48] \pm 1.10$), and that with UHC, they will all have equal access to healthcare ($A=3.41[3.34; 3.47] \pm 1.10$) and that it will improve their household income ($A=3.39[3.32; 3.46] \pm 1.10$). In general, the perception of healthcare seekers in terms of expectations has been positive in Lubero ($A=3.50 \pm 0.85$) and Butembo ($A=3.30 \pm 0.82$) and across both entities ($A=3.43 [3.38; 3.48] \pm 1.07$).

These results are consistent with those of the 2020 survey conducted in 37 OECD countries, which showed that average satisfaction with the availability of quality health services was 71%. The most satisfied populations were those in Northern Norway (93%), Belgium and the Netherlands (92% each), while the least satisfied were those in Poland (26%), Greece (38%) and Chile (39%) [18].

Although respondents reported a positive perception of the free healthcare that UHC could offer the population, Senegal's experience with the Sésame plan shows that free healthcare can negatively affect the quality of care. Fortunately, people aged 60 and over who benefited from this care were satisfied with it [5]. At this point, we would like to emphasise that poverty and ignorance about the quality of care and services can positively influence perceptions. A population living in extreme poverty, such as that of the DRC, can only view the promised and, above all, free healthcare in a positive sense. We will see below what healthcare providers' expectations and fears are.

The results of the study conducted by Alkodaymi et al. [1] have shown that 57.3% expected that the Saudi Arabian healthcare system provides effective and appropriate healthcare services to its entire population.

In terms of perception, the study conducted by Heikel [10] suggests that Moroccans are not satisfied with the quality of care provided by public healthcare services in their country. It is worth noting that when asked about future healthcare, only 37.6% would like to receive treatment in public facilities, compared to 54.9% who would like to receive treatment in ones and 1.5% of respondents who would like to receive treatment abroad. Moroccan respondents hope that with the Compulsory Health Insurance (AMO) scheme, there will be an improvement in the general condition of healthcare facilities and an increase in basic equipment. They hope that with the AMO, corruption and clientelism within healthcare facilities will be combated.

The expectations expressed by respondents indicate that the Moroccan healthcare system does not meet the needs of those seeking treatment. This can be viewed as a negative perception based on expectations of UHC. We conclude that this judgment was influenced by the Moroccan respondents' level of knowledge or understanding of the quality of healthcare services. In Mali, the results of Nana's doctoral thesis [15] showed that 82.7% of patients were satisfied with the courtesy at the entrance to the university hospital and 77.6% with the orientation at the hospital. However, it was observed that 38.7% of patients did not feel comfortable. A study conducted in South Africa, in the Ugu district, found that 61.92% of respondents had a positive perception of national health insurance [8].

A study conducted in Uganda on health workers' awareness and perceptions of UHC found that 66% of health professionals had a good understanding of UHC, while 34% had no knowledge of it. Out of 233 respondents, 85% had a good understanding of the definition of

Universal Health Coverage [9]. The study led by Nkuoh and his colleagues [17], conducted in southwestern Cameroon, found that health professionals had a good understanding of the definition of Universal Health Coverage. However, some points of the definition and its components were misunderstood.

Fears of Healthcare Seekers Regarding the USC

Regarding healthcare seekers' fears about the USC, the results in Table 3 show that healthcare seekers' perceptions in the Lubero Territory ($A = 2.68 \pm 0.94$) and in Butembo City ($A = 2.74 \pm 0.86$) are negative. The perception of healthcare seekers regarding fears in the two entities combined ($A = 2.70 [2.64; 2.76] \pm 0.91$) is also considered negative. They reported a negative perception that UHC would lower the quality of healthcare ($A = 2.74 [2.67; 2.81] \pm 1.13$), they fear that healthcare providers may discriminate against patients because of UHC ($A = 2.70 [2.63; 2.76] \pm 1.06$) and that the funds allocated to healthcare facilities may be diverted by managers ($A = 2.67 [2.59; 2.73] \pm 1.10$).

Considering the two components of perception of UHC, the results in Table 4 indicate that healthcare seekers in Lubero Territory have come out on top ($A = 3.09 \pm 0.63$) with a perception deemed positive, compared to those in Butembo City ($A = 3.01 \pm 0.55$) with a perception also deemed positive. The sum of the respondents from both entities ($A = 3.06 [3.03; 3.10] \pm 0.60$) shows that healthcare seekers have a positive perception of UHC.

A study conducted in France on the social categorization of beneficiaries of universal mutual coverage by physiotherapists showed that access to healthcare was unequal depending on people's socio-economic status [11]. This demonstrates healthcare inequality, in contrast to the positive perception reported by healthcare seekers in the present study. Indeed, given the critical situation facing the population in eastern DRC, some people have

high hopes for the UHC program, especially as they had already experienced a period of free healthcare during the Ebola virus disease and COVID-19 epidemics. A study conducted in four rural districts in Tanzania that evaluated the implementation of healthcare interventions concluded that healthcare recipients considered the quality of care poor. Only 47.9% of women were very satisfied with the care provided [13]. The results of the present study support those of Ismail [12], who examined the economic evaluation of health insurance reform in Tunisia. That study concluded that healthcare consumption is influenced by the living environment.

Socio-Demographic Characteristics and UHC

Differences in perceptions among healthcare seekers according to main occupation. The results in Table 6 show that the average expectations of healthcare seekers do not differ by main occupation ($F = 0.500$; $p = 0.776$), whereas fears do differ by main occupation ($F = 5.052$; $p = 0.000$). The application of Scheffé's test in Table 7 shows statistically significant differences in average fears between craftsmen and occupations such as traders ($p = 0.018$), public service ($p = 0.005$), and private service ($p = 0.002$).

These results partially confirm the research hypothesis that sociodemographic characteristics, such as age, educational level, gender, household size, marital status, main occupation, and household income, significantly influence the understanding and perceptions of healthcare seekers and providers regarding UHC. This difference in perception may be due to fears, as artisans are often self-employed and therefore responsible for their own affiliation with a social protection scheme, such as mutual health insurance. This is in contrast to traders, who are also self-employed but may have better accounting systems. They may also be better informed or connected to networks.

Difference in perceptions of care seekers by gender. The results in Table 8 indicate that the perceptions of care seekers do not differ by gender ($F=-0.696$; $p=0.486$). These results partially refute the research hypothesis that sociodemographic characteristics such as age, educational level, gender, household size, marital status, main occupation and household income significantly influence the understanding and perception of healthcare seekers and providers regarding UHC. The lack of difference in perceptions between men and women may be due to their all having access to the same basic services under UHC. However, men and women also receive the same information, which promotes a common understanding and perception.

Differences in perceptions of healthcare seekers by marital status. The results in Table 9 show that healthcare seekers' perceptions of UHC differ according to marital status ($F=3.806$; $p=0.010$). The Scheffé test (Table 10) indicates statistically significant differences in mean perceptions between divorced/separated individuals and those who are married ($p=0.010$) or single ($p=0.046$).

These results partially confirm the research hypothesis that presupposes that socio-demographic characteristics such as age, educational level, gender, household size, marital status, main occupation and household income would significantly influence the understanding and perception of healthcare seekers and providers regarding UHC. This difference in perception of UHC between divorced individuals (who have a more positive perception) and married or single individuals can be explained by the fact that divorce often leads to a decrease in income, especially for women, and a loss of health coverage that was previously linked to the spouse's employment. UHC then becomes a resource for maintaining access to healthcare.

Socio-demographic characteristics and expectations of healthcare seekers. The results in Table 11 show that there is no statistically

significant relationship between healthcare seekers' expectations of UHC and socio-demographic characteristics such as respondent age, educational attainment, household size and household income. These results partially refute the research hypothesis that socio-demographic characteristics such as age, educational attainment, gender, household size, marital status, main occupation, and household income would significantly influence the understanding and perception of healthcare seekers and providers regarding UHC.

These results do not corroborate those of Heikel [10], who found that UHC beneficiaries' expectations are linked to their socio-economic status and level of education. This difference in results may be due to the tests used by the researchers. Indeed, the present study used Pearson's correlation coefficient r , whereas Heikel used the Pearson chi-square test. Accordingly, expectations regarding UHC do not appear to be strongly influenced by age, level of education, household size, and household income, as health is a fundamental need shared by all.

Socio-demographic characteristics and healthcare seekers' fears about UHC. The results in Table 12 show that there is a statistically significant relationship between healthcare seekers' fears about UHC and characteristics such as: level of education ($r=0.117$; $p=0.000$), household size ($r=-0.125$; $p=0.000$), and household income ($r=-0.101$; $p=0.001$). Although the observed correlation was statistically significant, the effect size remains weak, suggesting a limited association in practical terms. In other words, fears about the three objectives of UHC increase with level of education and with decreasing household size and income. The relationship between fear and respondent age is not significant.

These results partially confirm the research hypothesis that socio-demographic characteristics such as age, educational attainment, gender, household size, marital status, main occupation and household income

would significantly influence the understanding and perception of healthcare seekers and providers regarding UHC. Fear of UHC often increases with age, as older people are more dependent on the health system and fear that it will no longer meet their specific needs. This is compounded by a poor understanding of UHC. Fear of UHC tends to increase as household size decreases and vice versa, due to social isolation and a lack of support or resources to understand and interpret health systems. This lack of communication and support can reinforce concerns about a system that is perceived as uncertain.

Conclusion

Universal health coverage must attract the attention of decision-makers, as its success is a factor in national development. Countries that are in the process of implementing it, such as the Democratic Republic of the Congo, should draw inspiration from others' experiences. This study, conducted in the Territory and the city of Butembo, has shown that healthcare seekers have a positive perception of UHC expectations. This is an indicator that the population expects satisfaction in the three dimensions that characterize UHC, namely: population coverage, service coverage and financial protection [16, 21]. As for fears, the population holds a negative perception, particularly regarding discrimination against healthcare seekers, a decline in the quality of care, and the fear that funds allocated to sanitary structures will be misused by managers. Decision-makers should therefore

take these fears into account and address them in the implementation of this program.

Conflict of Interest

The author declares no conflict of Interest.

Data Availability

Data will be made available on a reasonable request.

Approval and Consent to Participate

This study was conducted in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments. Ethical approval was obtained from the Adventist University of Lukanga, approval number SGR001/CER/04/CR2025. Written informed consent was obtained from all individual participants included in the study.

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Author Contributions

Both Paluku Kahuko and Katembo Kambere, authors, dealt with all phases of the study, from the formulation of the research protocol to the gathering of data and the analysis of results.

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References

[1]. Alkodaymi, S. M., Abou Shaar, B., Ashraf Fawzy, N., Alhabbbash, R., Senjab, A., & Rawan AlSaoudm, R., 2020, Knowledge, perception, and attitudes of Universal Health Coverage policies among Alfaisal University students in Saudi Arabia. *Journal of education and health promotion*.

<https://pmc.ncbi.nlm.nih.gov/articles/PMC7871921/>

[2]. USAID, 2017, *Financing Universal Health Coverage and Family Planning*.

[3]. AISS, 2023, Reforms in Africa to Expand Health Insurance Coverage. <https://www.issa.int/fr/analysis/reforms-africa-achieve-universal-health-coverage>

- [4]. Awawda, S., et al., 2021, Universal Health Coverage in the Sahel: *The Cases of Mali and Chad*. <https://hal-amu.archives-ouvertes.fr/hal-03552258/document>
- [5]. Boyer, A. & Nefzi, A., 2009, The Perception of Quality in the Field of Services: Toward a Clarification of Concepts. *The Journal of Management Sciences*, 2009/3 (237-238), pp. 43 – 54. Consulté sur file:///C:/Users/PC/Downloads/la-perception-de-la-qualite-dans-le-domaine-des-services-vers-une-clarification-des-concepts.pdf
- [6]. Boidin, B., 2018, Is Universal Health Coverage Possible in Africa Without an Integrated Health Policy? *French journal of Social Affairs*, 2018/1, pp 85-105, ed. DREES. DOI10.3917/rfas.181.0085
- [7]. Defrenne, F., & Chapiroix, G., 2016, Universal Health Coverage: Definition and Origins – Maison Médicale, Santé Conjuguée no76 available to <https://www.maisonmedicale.org/la-couverture-sanitaire-universelle-defi-nition-et-origine/>
- [8]. Govender, N., & Mahomet, O., 2020, Knowledge, attitude and perceptions of the national health insurance amongst health workers in Ugu district, Kwa-Zulu Natal, South Africa in 2017. *The Open Public Health Journal*, Tome 13, pp. 763-770. DOI: 10.2174/1874944502013010763
- [9]. Ifeagwu, S. C., Nakaboga Kikonyogo, R., Nakkazi, S., Beinomugisha, J., Ojiambo Wandera, S., Kiwanuka, S. N., King, R., Tine Van Bortel, T. V., Brayne, C., Parkes-Ratanshi, R., 2024, Sicknes has no time: Awareness and perceptions of health care workers on universal health coverage in Uganda. [La maladie n’a pas de date » : sensibilisation et perceptions des professionnels de santé sur la couverture sanitaire universelle en Ouganda]. *Plos one* 19(7). <https://doi.org/10.1371/journal.pone.0306922>
- [10]. Heikel, J., 2021, Evaluation des effets de la couverture sanitaire universelle (CSU) sur l’utilisation effective des services de santé au Maroc. [Thèse de doctorat, Université Sorbonne Paris Nord]. <https://theses.hal.science/tel-03357656/>
- [11]. Herry, S., 2020, Social Categorization of Universal Health Coverage Beneficiaries by Physiotherapists: Analysis of a Stereotype Attributed to Patients. *Physiotherapy*, (20) 219, pp. 3-9. <https://www.sciencedirect.com/science/article/abs/pii/S1779012320300012>
- [12]. Ismail, S., 2016, Economic Evaluation of Health Insurance Reform in Tunisia. [Doctoral Theses. PARIS-DAUPHINE UNIVERSITY]. <https://theses.hal.science/tel-01300569/>
- [13]. Larson, E., Mbaruku, G., Jessica, Cohen, J., & Kruk, M., 2020, Has a Quality Improvement Intervention Improved the Quality of Maternal Health Care? *International Journal for Quality in Health Care*, Volume 32, Issue 1, pp. 54-63. <https://doi.org/10.1093/intqhc/mzaa014>
- [14]. Mugo, M., 2022, Health Insurance and Health Status in Kenya: *Toward Universal Health Coverage*. <http://publication.aercafricalibrary.org/bitstream/handle/123456789/3390/HC-002.pdf?sequence=1&isAllowed=y>
- [15]. Nana, C., Y., 2014-2015, Assessment of Health Care Utilization Among Mandatory Health Insurance Beneficiaries at Point G University Hospital. [Doctoral Theses, University of Sciences, Techniques and Technologies of Bamako]. http://revues-ufhb-ci.org/fichiers/FICHIR_ARTICLE_2929.pdf
- [16]. United States, 2022, Report of the International Universal Health Coverage Day, 12 December. [entra%C3%AEnent%20pas%20de%20difficult%C3%A9s%20financi%C3%A8res](https://www.who.int/news-room/feature-stories/detail/universal-health-coverage-day-2022).
- [17]. Nkuoh, N. G., Banlack, E., Chiabi, E., & Tung, C. W., 2024, *Knowledge and perceptions of Universal Health Coverage among health professionals of the Southwest region of Cameroon*. Health sciences & diseases.
- [18]. OECD, 2021, Population Covered by Health Insurance », in Health at a Glance 2021: OECD Indicators, Éditions OCDE, Paris. <https://doi.org/10.1787/d9136695-fr>
- [19]. WHO., 2015, Making Fair Choices for Universal Health Coverage. https://iris.who.int/bitstream/handle/10665/185069/9789242507157_fre.pdf

- [20]. WHO, 2016, Global Strategy on Human Resources for Health: Workforce 2030. Geneva: WHO. , <https://www.who.int/hrh/resources/global-strategy-2030fr.pdf>
- [21]. ONUSIDA, 2019, Universal Health Coverage. <https://www.unaids.org/fr/topic/UHC#:~:text=Le%20but%20de%20la%20Couverture,%C3%A0%20payer%20pour%20ces%20services>.
- [22]. National Strategic Plan., 2020, National Strategic Plan for Universal Health Coverage 2020–2030.
- [23]. Etikan, I., Musa, S. A., & Alkassim, R. S., 2016, Comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics*, 5(1), 1–4.
- [24]. Lavrakas, P. J., 2008, Encyclopedia of Survey Research Methods. Sage.
- [25]. DeVellis, R. F., 2017, Scale Development: Theory and Applications (4th ed.). Sage.
- [26]. Boone, H. N., & Boone, D. A., 2012, Analyzing Likert data. *Journal of Extension*, 50(2), 1–5.
- [27]. Joshi, A., Kale, S., Chandel, S., & Pal, D. K., 2015, Likert scale: Explored and explained. *Current Journal of Applied Science and Technology*, 7(4), 396–403.
- [28]. Norman, G., 2010, Likert scales, levels of measurement and the “laws” of statistics. *Advances in Health Sciences Education*, 15(5), 625–632.
- [29]. Mukaka, M. M., 2012, A guide to the appropriate use of the correlation coefficient in medical research. *Malawi Medical Journal*, 24(3), 69–71.

Strengthening Public Health through Prioritization of Village Resilience Components Using the Quadrant of Difficulty-Usefulness Approach

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Abstract

This study aims to evaluate the resilience of Disaster Resilient Villages (Destana) in Magetan Regency, East Java, Indonesia in facing public health crises due to disasters, and to map the priority of village resilience components using the Quadrant of Difficulty and Usefulness (QoDU) approach. This descriptive study took place over eight months in 32 villages, involving 640 respondents consisting of 20 active administrators per village. The evaluation was conducted using the PKD (Village Resilience Assessment) questionnaire which included 32 indicators and 128 questions, filled out through Focus Group Discussions (FGD), while determining the priority of components that had high benefits but were difficult to realize using the QoDU-VR (Quadrant of Difficulty-Usefulness Village Resilience Questionnaire) questionnaire. The results showed that 3 villages (9.4%) were in the primary category, 12 villages (37.5%) were in the middle category, and 17 villages (53.1%) were in the main category, with the district's resilience level at the middle level (score 80.06). The recovery preparedness component scored the lowest (69.94), followed by prevention and mitigation (70.75). Using the QoDU approach, the prevention and mitigation components were prioritized due to their high utility but difficulty in implementation, followed by the post-disaster recovery component. The study also found that disaster-resilient villages in the primary category were not yet fully capable of implementing prevention and mitigation measures, and that the majority of villages did not yet have a post-crisis recovery plan document. The QoDU approach helps establish strategic priorities in building public health resilience. These findings form the basis for strengthening public health through participatory studies based on component and sub-component prioritization strategies in further research.

Keywords: Disaster, Public Health, Quadrant of Difficulty-Usefulness, Village Resilience.

Introduction

The first village resilience assessment in Indonesia was conducted in 2019 by the National Disaster Management Agency (BNPB) as an annual program to support regional disaster management. The village resilience assessment framework adopted the

village and sub-district disaster resilience standards in the Indonesian National Standard (SNI 8357:2017) and the Disaster Resilience of Place (DROP) model [1].

This study uses the PKD instrument, which consists of five components, namely:

1. Basic services.
2. Disaster Management Regulations and Policies.
3. Prevention and Mitigation.
4. Emergency Preparedness.
5. Recovery Preparedness.

This instrument consists of 32 indicators and 128 questions. After conducting a resilience assessment, the score is used to determine the resilience category, namely: 1) Primary resilience score <58.33 , 2) Middle resilience score $58.33-83.33$, and 3) Main resilience score > 83.33 . Based on the obtained score, recommendations are provided to increase resilience. Village capacity often has difficulty prioritizing which recommendations are prioritized to be implemented first, because there is no instrument that can be adopted. This research produces an instrument that can be used to measure the capacity to realize resilience, based on the level of difficulty and usefulness in the form of the QoDU-VR (Quadrant of Difficulty-Usefulness Village Resilience Questionnaire), with an I-CVI value of 0.92 [2].

Magetan Regency, East Java Province, Indonesia, has a total of 235 villages/sub-districts. As of mid-2024, only 30 villages/sub-districts (9.23%) had been designated as Disaster Resilient Villages (Destana). Of these, 14 villages/sub-districts were classified as primary, 12 as middle, and 4 as main [3]. However, none of these Destanas had documented health crisis contingency plans or a command structure for handling health crises resulting from disasters. As a result, village capacity to reduce the risk of health crises in the community remains limited, particularly in terms of identifying vulnerable health groups, mapping capacity, mapping risk areas for health crises, and mapping responses during health crises. This situation increases community vulnerability, such as high cases of stunting, malnourished infants and toddlers, anemia and low energy calorie pregnant women, elderly people with chronic diseases, difficulty

accessing health services, and an increased risk of infectious diseases due to poor sanitation and overcrowding in evacuation sites [4].

In the long term, the various impacts of health vulnerability can lead to a decline in the achievement of public health indicators. Some indicators that indicate decline include: increasing rates of malnutrition, increasing prevalence of stunting, increasing morbidity and mortality, decreasing coverage of exclusive breastfeeding, and increasing cases of anemia among pregnant women and adolescents. These impacts contribute to socioeconomic losses, primarily due to high medical costs and decreased community productivity [5]. If not addressed promptly, community resilience to health crises caused by disasters will further weaken. This occurs because villages lack the capacity to prioritize activities that need to be implemented immediately to build health resilience through prevention, mitigation, and preparedness measures.

The low commitment of village governments to supporting disaster risk reduction programs, particularly in the public health sector, also hinders the overall strengthening of village resilience [6]. Previous research on the public health crisis response to disasters by the disaster health cluster generally focused on the emergency response phase, such as medical services, health logistics distribution, and victim referral systems [7]. This dominance of a curative approach indicates that the prevention, mitigation, and preparedness aspects of post-disaster public health recovery have not received adequate attention. This condition reflects that the capacity and potential of villages/sub-districts are not yet fully capable of ensuring public health resilience against disaster threats.

The urgency of this research lies in the importance of prioritizing resilience components or sub-components in realizing public health, based on recommendations from village resilience assessments. Each assessment result is always accompanied by

recommendations on components or sub-components that have not been implemented by existing capacity, because there are no specific guidelines regarding components and sub-components that need to be implemented immediately. Therefore, this research is very important to map priority components that have a high level of benefit but are difficult to implement, thereby encouraging more targeted and sustainable interventions in strengthening public health resilience. The novelty of this study lies in the use of the Quadrant of Difficulty-Usefulness (QoDU) approach in determining the priorities for developing village resilience in the health sector.

Materials and Methods

This descriptive study aims to identify the level of village resilience in facing health crises caused by disasters and map priority components that contribute to achieving this resilience, especially components that offer high benefits but are difficult to implement. This study was conducted for eight months, from March to October 2025, in 32 Disaster Resilient Villages (Destana) in Magetan Regency, East Java, Indonesia. The study sample consisted of 640 respondents, consisting of 20 respondents from each Destana. Respondents were selected purposively based on the following inclusion criteria: being an active administrator of the Destana Forum, representing village or sub-district officials, and being willing to participate by signing an informed consent. The variable studied was village resilience. The research instrument was a standardized village resilience assessment questionnaire consisting of 32 indicators with 128 questions from the National Disaster Management Agency (BNPB) [8]. To analyze priority

recommendations in realizing village resilience, the Difficulty-Usefulness Questionnaire in Realizing Village Resilience (QoDU-VR) was used, which contained 26 questions according to the QoDU model, with an I-CVI of 0.92 [2]. Data collection was carried out by filling out questionnaires in focus group discussions (FGDs) in each village. To ensure the validity of the data, researchers also conducted field observations and secondary data reviews.

The collected data were analyzed descriptively to calculate the village resilience score and QoDU Analysis to prioritize the recommendations of the resilience assessment components that have difficulties to realize but have very high benefits. The results of the study in the form of the distribution of hazard type and health risks due to disasters are presented in the form of maps, the results of the village resilience assessment are presented in the form of tables, the QoDU analysis for component priorities is presented in the form of images, and narratives for easy understanding. All respondents were given an explanation of the objectives, benefits, and procedures of the study before filling out the questionnaire, and were asked to sign an informed consent as a form of agreement to participate in the study.

Results

Figure 1 presents a map of the distribution of hazard types in each disaster-resilient village studied. Of the 32 disaster-resilient villages, six (18.7%) are located in lowland areas, with floods as the most common hazard. Meanwhile, 26 (81.3%) are located in highland areas, with landslides as the most common hazard, followed by tornadoes and forest and land fires. Furthermore, only one (Bedagung Village) has a flash flood as the most common hazard.

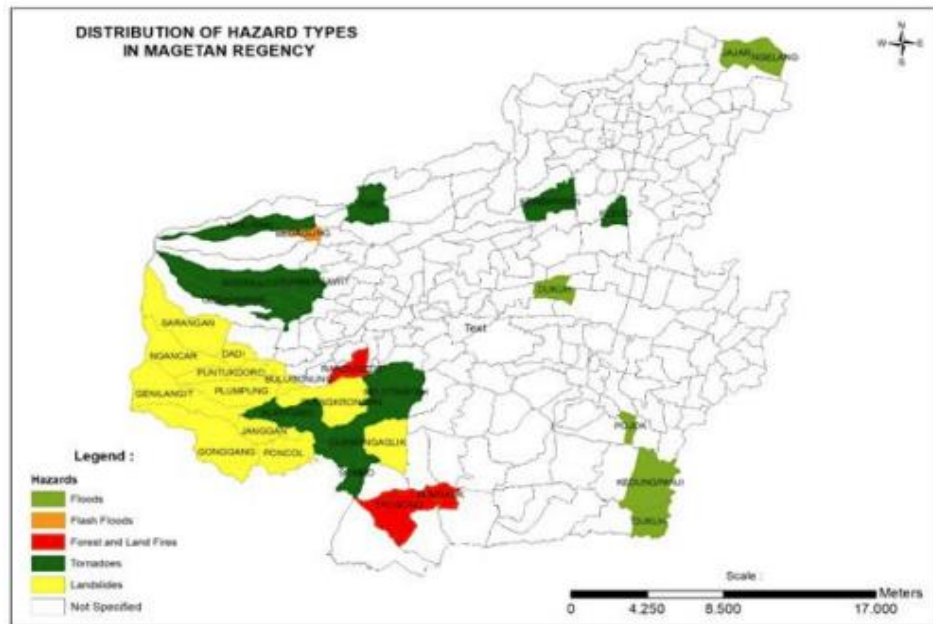


Figure 1. Map of the Distribution of Hazard types in 32 Disaster Resilient Villages in Magetan Regency

Table 1. Present village resilience scores based on the five main resilience components. Of the 32 villages/sub-districts assessed, 17 (53.1%) were classified as primary resilience, 12 (37.5%) as intermediate resilience, and 3 (9.4%) as primary resilience. The three villages in the primary category and the focus of resilience improvement are Dadi Village with a score of 54.8, Janggan Village with a score of

56.2, and Summersawit Village with a score of 20. Overall, disaster-resilient villages/sub-districts in Magetan Regency are in the intermediate category with an average score of 80.06. Of the five components assessed, the recovery preparedness component received the lowest average score of 69.94, followed by the prevention and mitigation component with a score of 70.75, based on a 20–100 scale.

Table 1. Scores for Each Resilience Component of 32 Villages/Sub-districts

No	Village	Resilience Components					Average Score	Category
		Basic Services	Disaster Management Regulations and Policies	Prevention and Mitigation	Emergency Preparedness	Recovery Preparedness		
1	Ngelang	87	100	87	97	100	94.2	Main
2	Jajar	87	100	87	100	100	94.8	Main
3	Alastuwo	96	100	72	87	95	90	Main
4	Randugede	84	88	73	93	85	84.6	Main
5	Dukuh	90	96	40	83	63	74.4	Middle
6	Pojok	89	84	72	87	40	74.4	Middle
7	Bungkuk	94	96	72	97	95	90.8	Main
8	Troso	93	100	76	100	100	93.8	Main
9	Sombo	99	88	76	76	80	83.8	Main
10	Ngaglik	89	100	74	67	50	76	Middle
11	Turi	87	88	47	63	85	74	Middle

12	Sidomulyo	96	100	72	73	65	81.2	Middle
13	Selotinatah	91	100	76	100	65	86.4	Main
14	Dadi	76	32	73	73	20	54.8	Primary
15	Puntukdoro	91	100	76	100	100	93.4	Main
16	Sarangan	99	84	76	97	85	88.2	Main
17	Ngancar	91	88	73	80	95	85.4	Main
18	Genilangit	87	100	84	100	100	94.2	Main
19	Gonggang	90	92	84	100	100	93.2	Main
20	Plangkronan	83	84	84	100	100	90.2	Main
21	Janggan	72	72	40	77	20	56.2	Primary
22	Kedungpanji	91	96	72	100	85	88.8	Main
23	Bedagung	93	100	72	83	70	83.6	Main
24	Kleco	87	92	83	97	40	79.8	Middle
25	Getasanyar	87	84	83	77	20	70.2	Middle
26	Cileng	84	64	87	80	20	67	Middle
27	Sumbersawit	20	20	20	20	20	20	Primary
28	Kembangan	83	100	74	100	100	91.4	Main
29	Ngiliran	89	92	76	73	50	76	Middle
30	Bulugunung	90	92	40	100	70	78.4	Middle
31	Poncol	91	96	72	97	60	83.2	Middle
32	Plumpung	69	80	71	67	60	69.4	Middle
Average		86.09	87.75	70.75	85.75	69.94	80.06	

Description: Main category > 83.33, Middle category 58.33-83.33, Primary category < 58.33

Figure 2 shows the distribution of disaster-related health risks in 32 disaster-resilient villages in Magetan Regency, East Java Province. Residents living in disaster-resilient villages in highland areas are predominantly at risk of experiencing health problems in the

form of physical trauma due to landslides and tornadoes, as well as acute respiratory infections triggered by forest and land fires. Meanwhile, residents living in lowland areas prone to flooding are at risk of experiencing health problems in the form of skin diseases.

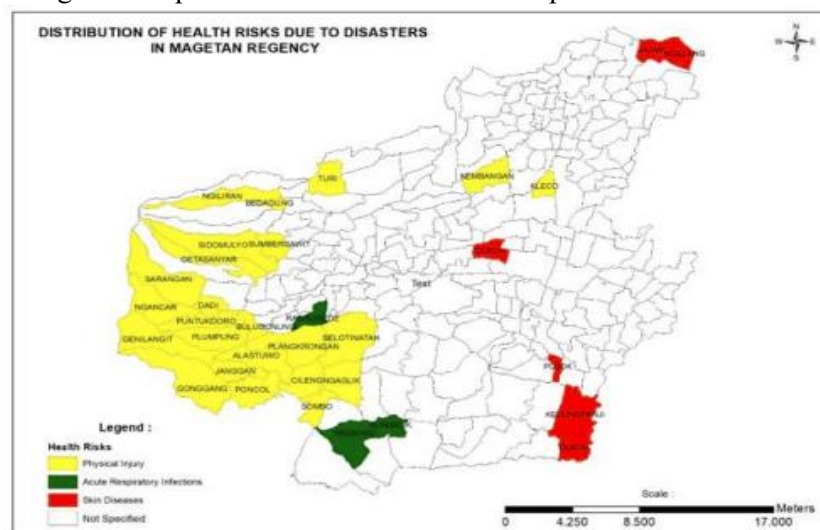


Figure 2. Map of the Distribution of Health Risks due to Disasters in 32 Disaster Desilient Villages in Magetan Regency

Figure 3. Presents a composite analysis of the five components of village resilience in dealing with public health crises due to disasters using the Quadrant of Difficulty-Usefulness (QoDU) approach. The prevention

and mitigation component is designated as the top priority because it is in quadrant I. Meanwhile, the preparedness component in post-disaster recovery is ranked as the next priority because it is in quadrant II.



Figure 3. Results of the Priority Analysis of the Five Components of Village Resilience in a Composite Manner using the QoDU Approach

Figure 4. Presents the results of the analysis of the prevention and mitigation sub-components using the QoDU approach. The main priorities for immediate implementation in realizing public health resilience are the disaster health crisis management program, and the availability of evacuation routes and final

evacuation sites. Meanwhile, Figure 5. Shows that the priority programs for the post-disaster recovery preparedness sub-component are capacity building activities in providing post-disaster public health services and ensuring the availability of post-disaster recovery plan documents.

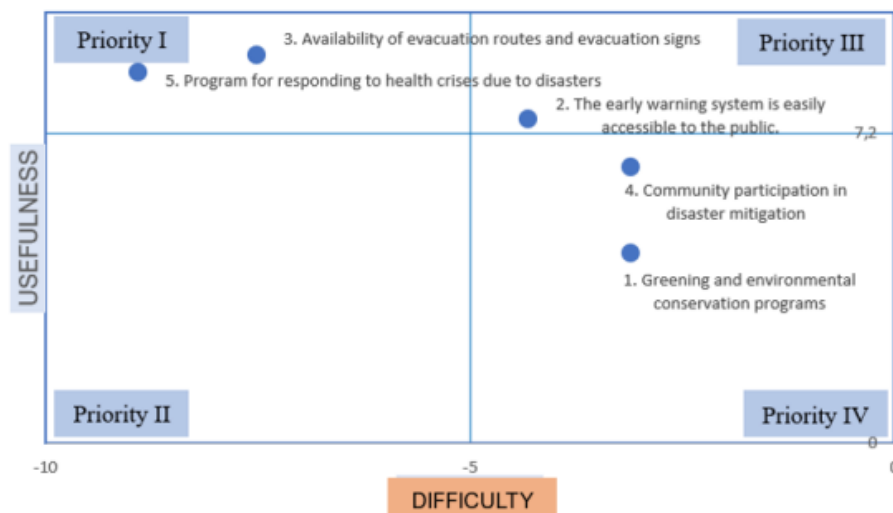


Figure 4. The Results of the Analysis of the Priority Sub-components of Prevention and Mitigation using the Quadrant of Difficulty and Usefulness (QoDU) Approach

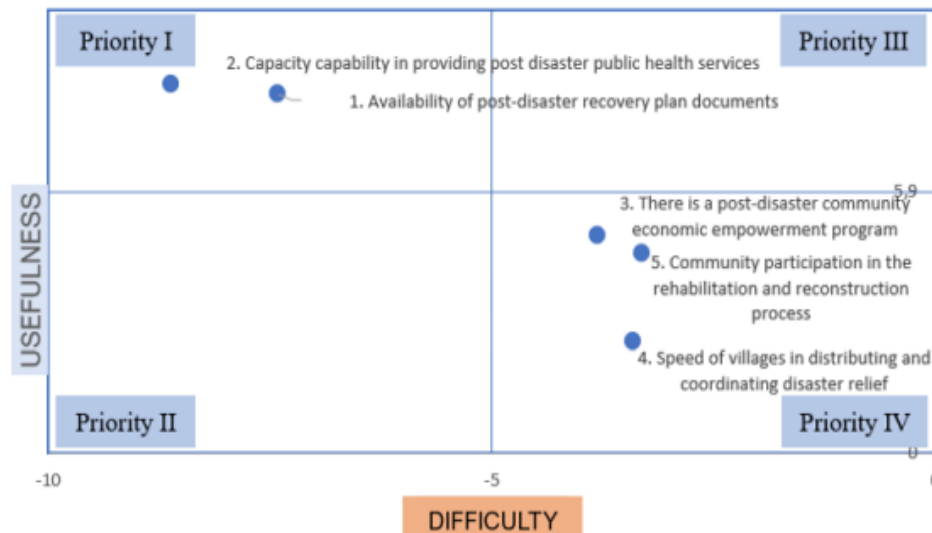


Figure 5. The Results of the Priority Analysis of Sub-components of Post-disaster Recovery Preparedness using the Quadrant of Difficulty and Usefulness (QoDU) Approach

Discussion

The resilience levels of the villages/sub-districts studied showed significant variation (Table 1). These differences were influenced by several factors, including government commitment, disaster management budget availability, institutional strength, facilities and infrastructure, basic service availability, resource capacity, number of vulnerable populations, level of community participation in disaster risk reduction activities, pentahelix collaboration, availability of early warning systems, routine response simulations, and the geographic and topographical conditions of the area [9]. These variations directly impact the ability of villages/sub-districts to maintain and improve the health of their communities. Several villages/sub-districts that have demonstrated resilience in maintaining public health stability include Ngelang and Jajar Villages in Kartoharjo District, Genilangit and Alastuwo Villages in Poncol District, Kedungpanji Village in Lembeyan District, and Bedagung Village in Panekan District. Meanwhile, other villages that are still in the primary and intermediate resilience categories still require further assistance to increase their capacity to protect public health in their areas from the threat of disasters.

Disaster-resilient villages with *madya* (intermediate) and *pratama* (basic) levels of resilience, based on observations and secondary data review, still face various weaknesses in preparedness. These shortcomings include limited collaboration in basic service components, disaster risk assessment documents and disaster management plans that are already outdated, the absence of regional risk maps, the lack of evacuation and contingency plans, infrequent emergency response simulations, and the absence of post-disaster recovery plans. This condition is generally caused by several factors, such as limited human resources and budget, low institutional capacity at the village level in managing documents and planning, insufficient technical assistance from relevant stakeholders, as well as the lack of awareness among village disaster risk reduction forums and communities regarding the importance of regularly updating data and conducting preparedness exercises.

The differences in health problems between lowland and highland areas can be explained by the characteristics of the dominant hazards in each region (Figure 1). In flood-prone lowland areas, prolonged standing water triggers high humidity and skin contact with contaminated water, resulting in more frequent skin diseases.

Conversely, in highland areas, the hazards of landslides, tornadoes, and forest and land fires pose a direct risk of physical trauma from falling material and wind exposure, as well as an indirect risk of acute respiratory infections from exposure to fire smoke. These findings align with similar studies in disaster-prone areas of Central Java and West Sumatra, which showed that flooding is more correlated with environmental-based diseases such as skin diseases and diarrhea, while forest fires and landslides cause more physical trauma and respiratory disorders [10]. This confirms that the dominant type of hazard in a region significantly determines the health risk profile of its population (Figure 2).

Field observations indicate that each village or sub-district has vulnerable community groups, such as the elderly, pregnant women, children, and people with disabilities. Therefore, a comprehensive mitigation approach is needed to reduce their vulnerability to health risks that may arise from disasters. Possible steps include: identifying the number and location of vulnerable groups, developing risk maps for vulnerable groups, educating and providing outreach regarding independent evacuation, and providing ongoing routine health services. Vulnerable groups, including people with disabilities, must be actively involved in the process of developing disaster management policies, including conducting emergency response simulations for health crises [11].

All of these approaches need to be integrated into disaster management plans and contingency plans at the village or sub-district level. Thus, mitigation efforts not only serve to reduce the physical impact of disasters but also serve as a key strategy in preventing health crises from the pre-disaster stage. The ultimate goal of this approach is to create more resilient and independent vulnerable groups in maintaining their health during crises [12]. However, the current challenge is that many disaster-resilient villages or sub-districts have

not updated their disaster management plans and do not have specific contingency plans for disaster-related health crises. Furthermore, limited capacity to prepare documents and prioritize appropriate activities to protect vulnerable groups is also a significant obstacle to implementing this strategy.

One approach to addressing these issues is an analysis of the five main components of village resilience using the Quadrant of Difficulty-Usefulness (QoDU) method [13, 14]. The analysis using this method found that the prevention-mitigation and recovery preparedness components are the components with the highest level of utility, but the most difficult to implement (Figure 3). Within the prevention and mitigation components, the most urgent subcomponents requiring immediate implementation are the disaster health crisis management program, as well as the provision of evacuation routes and final evacuation locations. Both activities can be implemented through facilitation or assistance in the preparation of the Disaster Health Crisis Contingency Plan and Evacuation Plan documents. As a follow-up, facilitation is needed in the form of training in preparing operational plans followed by simulations, in order to ensure community preparedness and the effectiveness of the established health crisis response system (Figure 4).

Meanwhile, within the emergency response and recovery component, subcomponents that require immediate implementation include increasing the capacity of public health services during disasters and developing a Post-Disaster Recovery Plan (Figure 5). Implementation of these activities is the responsibility of the Disaster Risk Reduction Forum (FPRB) at the village or sub-district level. As a local capacity building platform, the forum must encourage active community participation in all activities, ensuring that every step taken aligns with the principles of community-based disaster risk reduction [15].

Activities that can be undertaken include training health cadres and village volunteers in first aid and triage for disaster victims, establishing a disaster preparedness health team at the village level, and developing standard operating procedures (SOPs) for minimum basic health services during a crisis. Furthermore, the development of the Post-Disaster Recovery Plan can be facilitated through a participatory mentoring process involving facilitators, the community, the village government, the local government (Regional Disaster Management Agency), and the health sector. This activity is then followed by a simulation to ensure preparedness and the effectiveness of the health response during a disaster.

These findings provide important implications that community-based disaster risk reduction (CBDRM) is crucial in enhancing community resilience to health threats during disasters [16]. Building village resilience cannot rely solely on administrative or regulatory achievements, but must also emphasize strengthening technical and participatory aspects. Similar research has reported that developing Disaster Resilient Villages through CBDRM can improve overall community preparedness, including in health aspects [11, 17]. Furthermore, a study on Disaster Preparedness Villages confirms that a community-based approach is an effective policy instrument in building a resilient and inclusive local response system. The CBDRM guidelines developed by the Indonesian Disaster Management Society (MPBI) also emphasize the importance of best practices derived directly from communities, such as risk mapping, community involvement in planning, and strengthening local capacity. As a follow-up, the Participatory Action Research (PAR) approach can be used to facilitate priority activities by encouraging active [18].

Various studies have shown similar patterns in addressing the challenges of building community health resilience. A study in Chile

revealed that, while older adults have strategies for coping with crises in their daily lives, they still face limitations in their preparedness for large-scale disasters. Meanwhile, studies in Sierra Leone, India, and Kenya emphasize the importance of strong grassroots networks with cross-sectoral support to address disaster-induced health crises, although resource constraints and weak coordination remain major obstacles [19]. In Indonesia, the Participatory Action Research (PAR) approach has proven effective in increasing community capacity and preparedness through active involvement in developing contingency plans, designing simulated operational plans, conducting disaster-induced health crisis simulations, and mapping areas vulnerable to health crises [20]. This cross-study comparison reinforces the relevance of the finding that strengthening technical and participatory aspects of community participation is a key element in achieving sustainable village resilience.

The follow-up to the research findings was a six-day training program. This training is a strategic approach to building community health resilience to disaster-related crises. The training was designed using the Participatory Action Research method, emphasizing active community involvement in every stage of the activity [21]. Over the six days, participants, including village Disaster Risk Reduction Forum (FPRB) administrators, health cadres, volunteers, representatives from youth organizations, community leaders, community protection members, and village officials, were facilitated in developing disaster health crisis contingency plans, drill operations plans, evacuation plans, and post-disaster recovery plans. Furthermore, the training also covered technical materials such as first aid, triage of disaster victims, and the development of minimum standard operating procedures (SOPs) for basic health services during a crisis.

The total duration of the six-day training is approximately 48 hours, with approximately

eight hours allocated per day for both theory and practice. Practical activities can be conducted in a structured manner or independently. Each session combines theory, group discussions, local case studies, worksheet completion, and field practice, including simulations or drills as a form of preparedness testing. This approach not only equips participants with technical knowledge and skills but also strengthens community capacity in designing and implementing contextual and sustainable emergency response systems [22, 23]. Thus, this training serves as an important foundation for building health-based village resilience in a participatory and integrated manner.

The advantage of the Quadrant of Difficulty-Usefulness (QoDU) approach lies in emphasizing the difficulty aspect after first considering the level of usefulness of a component or subcomponent. In other words, the primary focus of the analysis is to identify components or subcomponents that have a high level of usefulness but are difficult to implement. This allows for the formulation of more strategic and impactful intervention priorities. Readers can immediately understand the position of each component through the points located in the four quadrants in the QoDU visualization. Components and subcomponents located in Quadrant I (top left) and Quadrant II (bottom left) are considered the top and second priorities, respectively, because they both demonstrate high usefulness, albeit with different implementation challenges.

In the context of strengthening village resilience in public health, the Quadrant of Difficulty-Usefulness (QoDU) approach offers a significant new state-of-the-art contribution. The main advantage of this approach lies in its ability to map intervention priorities based on two key dimensions: level of benefit and level of implementation difficulty. By placing the benefit aspect as the starting point of analysis, QoDU enables the identification of components or subcomponents that are highly beneficial but

difficult to implement, thus becoming the primary focus in strategic planning. The four-quadrant visualization also makes it easier for readers or policymakers to intuitively identify intervention priorities. Components in Quadrant I (high benefit, high difficulty) and Quadrant II (low benefit, but high difficulty) automatically become the top and second priorities in strengthening [14, 24].

This approach has not been widely used in previous studies, particularly in the context of community-based public health resilience mapping in rural/urban areas. Therefore, the application of QoDU in this study not only provides a practical and contextual framework but also enriches the methodological repertoire in community-based disaster health crisis risk reduction studies. This approach bridges the gap between local perceptions and technical needs and encourages more participatory and evidence-based decision-making. This study has several limitations, including the limited coverage of 32 villages in Magetan Regency. Data collection was conducted through a structured questionnaire with a high I-CVI, facilitated by focus group discussions (FGDs), which limited the depth of qualitative exploration of local social and cultural dynamics. Nevertheless, this study still provides an important contribution to strategic and participatory decision-making to strengthen village resilience, grounded in public health.

Conclusion

This study shows that the level of resilience of Disaster Resilient Villages/Sub-districts in Magetan Regency still varies, although most have achieved the Main resilience category. Key strengths lie in the provision of basic services, the existence of disaster management regulations, and emergency preparedness, which arise from the villages/sub-districts being frequently affected by disasters. However, aspects of prevention, mitigation, and health recovery preparedness still require

strengthening, while the capacity of the village Disaster Risk Reduction Forum (FPRB) is not optimal in prioritizing assessment recommendations due to the lack of available guidelines. Using the Quadrant of Difficulty and Usefulness (QoDU) approach, resilience components and sub-components within Priority Quadrants I and II have been identified, with a primary focus on disaster health crisis management programs, providing final evacuation routes and locations, increasing health service capacity during disasters, and developing post-disaster recovery plan documents. The follow-up to this research is mentoring of the disaster risk reduction forum in the form of training for 6 days, 8 hours each day or equivalent to 48 hours of training.

Conflict of Interest

There is no conflict of interest with anyone in writing this article.

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Ethical Approval

This research has received ethics approval from the Health Research Ethics Committee of the Surabaya Ministry of Health Polytechnic, under number EA/3177/KEPK-Poltekkes_Sby/V/2025. All respondents received an explanation of the research objectives, benefits, and procedures before participating in the research activities, and were asked to sign an informed consent form as a sign of their willingness to participate in the research.

Data Availability

The data used in this study are available upon reasonable request to the corresponding author.

Author Contributions

- **Sunarto:** (Lead author and corresponding author): Contributed to the research idea and design, conducted field data collection, primary data analysis, and wrote the initial draft of the manuscript.
- **Heru Santoso Wahito Nugroho:** Responsible for field data collection, ensuring the quality and completeness of the research data, QoDU analysis, and interpreting the research results.
- **Sulikah:** Conducted a literature review and contributed to the development of the discussion section, including linking the research results to national policies on village resilience in facing health crises caused by disasters.
- **Suparji:** Involved in the development of the research methodology, instrument validity testing, and cross-sector coordination.
- **Aries Prasetyo:** Critically reviewed the entire manuscript, provided substantive input on the interpretation of the results, map creation, and approved the final version for publication.
- **Setya Haksama:** Contributed to data visualization and assisted in the preparation of the results and conclusions sections of the research.

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References

- [1]. Jones, K. G., 2021, Disaster Resilience of Place (DROP) Model, in *A Handbook of Management Theories and Models for Office Environments and Services*, 65–74.
- [2]. Sunarto, 2025, Kuesioner Kesulitan-Kegunaan Mewujudkan Ketangguhan Desa (*QoDU-VR Questionnaire*), 1-12.
- [3]. Nugroho, H. S. W., Sunarto, Suparji, Prasetyo, A., Koesmantoro, H., 2024, Risalah Kebijakan (Policy Brief): Harmonisasi dan Akselerasi Destana (HaDe) Sebagai Pendekatan Pengembangan Desa Tangguh Bencana di Kabupaten Magetan, *Magetan*, 1–4.
- [4]. Sanggelorang, Y., Sebayang, F. A. A., Malonda, N. S. H., Rumayar, A. A., 2024, Insights Into Childhood Malnutrition: An Analysis on Food Vulnerability and Stunting Using 2021 Indonesia Nutritional Status Survey Data, *Natl. Nutr. J.*, 19(3), 282–290.
- [5]. Adom, P. K., 2024, Heliyon The socioeconomic impact of climate change in developing countries over the next decades : A literature survey, *Heliyon*, 10(5), e35134, doi: 10.1016/j.heliyon.2024.e35134.
- [6]. Handayani, E., Garad, A., Suyadi, A., Tubastuvi, N., 2023, Increasing the performance of village services with good governance and participation, *World Dev. Sustain.*, 3(6), 100089, doi: 10.1016/j.wds.2023.100089.
- [7]. Haksama, S., *et al.*, 2025, Health Disaster Capacity and Preparedness in the Case of Tsunami and Earthquake Disaster, *Texila Int. J. Public Heal.*, 13(1), 1–8, doi: 10.21522/TIJPH.2013.13.01.Art091.
- [8]. Purwanto, S., *et al.*, 2021. *Panduan: penilaian ketangguhan desa/kelurahan*. Jakarta: Direktorat Kesiapsiagaan, Kedeputian Bidang Pencegahan, Badan nasional Penanggulangan Bencana, 1-50.
- [9]. Ayuningtyas, D., Windiarti, S., Sapoan Hadi, M., Fasrini, U. U., Barinda, S., 2021, Disaster Preparedness and Mitigation in Indonesia: A Narrative Review, *Iran. J. Public Health*, 50(8), 1536–1546, doi: 10.18502/ijph.v50i8.6799.
- [10]. Karnaji, K., Susanti, E., Ariadi, S., Saud, M., 2024, Social impacts and post-disaster management in disaster-prone areas of East Java, Indonesia, *Jamba-Journal Disaster Risk Stud.*, 16(1), a1747, 1–9.
- [11]. Arifin, S., Wicaksono, S. S., Sumarto, S., Martitah, M., Sulistianingsih, D., 2021, Disaster resilient village-based approach to disaster risk reduction policy in Indonesia: A regulatory analysis, *Jamba J. Disaster Risk Stud.*, 13(1), 1–9, doi: 10.4102/JAMBA.V13I1.1021.
- [12]. Bishai, D., Saleh, B. M., Huda, M., Aly, E. M., Hafiz, M., Ardalan, A., 2024, Practical strategies to achieve resilient health systems: results from a scoping review, *BMC Health Serv. Res.*, 24(297), 1–11, doi: <https://doi.org/10.1186/s12913-024-10650-8>.
- [13]. Sunarto, Nugroho, H. S. W., Suparji, Santosa, B. J., 2024, Quadrant of difficulty and usefulness for prioritizing community-based disaster preparedness parameter elements, *Rawal Med. J.*, 49(1), 172–175, doi: 10.5455/rmj.20230918043333.
- [14]. Nugroho, H. S. W., *et al.*, 2020, Quadrant of difficulty-usefulness (QODU) as new method in preparing for improvement of e-learning in health college, *Risk Manag. Healthc. Policy*, 13, 1625–1632, 2020, doi: 10.2147/RMHP.S268814.
- [15]. Nkombi, Z., Wentink, G. J., 2022, The role of public participation in disaster risk reduction initiatives: The case of Katlehong township, *Jamba J. Disaster Risk Stud.*, 14(1), 1–12, doi: 10.4102/jamba.v14i1.1203.
- [16]. Lin, B., Lee, C., 2025, Enhancing community-based earthquake disaster management: resident preferences and adaptive, *Geomatics, Nat. Hazards Risk*, 16(1), 1–25, doi: 10.1080/19475705.2025.2450290.
- [17]. Sunarto *et al.*, 2025, Strengthening Disaster-Resilient Villages Through Participatory Approaches: Policy Recommendations for Village Governments, *Heal. Dyn.*, 2(4), 166–171, 2025, doi: 10.33846/hd20405.
- [18]. Sunarto, Nugroho, H. S. W., Suparji, Rahayu, T. P., Handayani, T. E., Haksama, S., 2024, Participatory Action Research to Realize Disaster Health Crisis Preparedness in the Community, *Texila Int. J. Public Heal.*, 12(4), doi: 10.21522/TIJPH.2013.12.04.Art087.
- [19]. Hati, B., 2025, Polymorphic grassroots

networks and implications for disaster resilience in popular settlements in Sierra Leone, India and Kenya, *Environ. Urban.*, 37(1), 159–182, doi: 10.1177/09562478251318230.

[20]. Sunarto, Nugroho, H. S. W., Suparji, Hanifah, A. N., Prasetyo, A., 2025, Integration of Participatory Action Research Approaches in Realizing Disaster Preparedness, *Disaster Adv.*, 18(4), 55–63, 2025, doi: 10.25303/184da055063.

[21]. Fortnam, M., Hailey, P., Witter, S., Balfour, N., 2023, Resilience in interconnected community and formal health (and connected) systems, *SSM - Heal. Syst.*, 3(11), 100027, doi: 10.1016/j.ssmhs.2024.100027.

[22]. Van Assen, M. F., 2021, Training, employee

involvement and continuous improvement-the moderating effect of a common improvement method, *Prod. Plan. Control*, 32(2), 132–144, doi: 10.1080/09537287.2020.1716405.

[23]. Srivastava, P., 2023, Evaluating the Role of Training Programs in Enhancing Employee Skills and Retention, *J. Bus. Manag.*, 25(8), 66–71, doi: 10.9790/487X-2508016671.

[24]. Nugroho, H. S. W., Suparji, Sunarto, 2019, Quadrant of Difficulty-Usefulness (QoDU): Metode baru untuk Menyusun Prioritas Perbaikan Elemen Sistem Informasi Kesehatan, *Bangli Bali: Aliansi Aktivis Kesehatan/Alliance of Health Activists (AloHA)*, 1-67.

Malaria Epidemiology and Control among Under-Five Children in Northeastern Nigeria

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Abstract

In Nigeria, malaria continues to be a leading cause of morbidity and mortality among children under five, with disproportionate effects in areas affected by violence. The findings and discussion of a doctoral thesis conducted in the Jere Local Government Area (LGA), Borno State, are presented in this study as a publication-ready synthesis. Multistage cluster sampling was used to gather data from 235 families with children under 5 through a community-based cross-sectional study. Sociodemographic traits, malaria episodes, preventive measures, treatment-seeking behavior, and surveillance performance were all evaluated using structured questionnaires that were modified from WHO and DHS assessments. To assess community outreach and reporting completeness, facility-based surveillance records were examined. SPSS version 26 was used to perform logistic regression analysis, chi-square tests, and descriptive statistics. Over 95% of households reported at least one malaria episode in the six months prior, indicating a persistently high malaria burden. Insecticide-treated nets (ITNs) and indoor residual spraying (IRS) were reported to have high preventive coverage; however, symptom-based evaluation was a major component of diagnostic confirmation. Despite widespread community awareness of government and non-governmental organization efforts, surveillance outreach and home visits by medical professionals were scarce. There was no statistically significant correlation found between the incidence of malaria and the age of caregivers. The results show a dichotomy between persistent hyperendemic transmission and high knowledge and reported preventative coverage. Achieving significant reductions in the malaria burden among children under five in conflict-affected areas requires bolstering community-based case detection, expanding surveillance reach, and strengthening diagnostic confirmation.

Keywords: *Control Measures, Malaria Epidemiology, Nigeria, Surveillance, Under-five Children.*

Introduction

Malaria is a major global public health concern, especially in sub-Saharan Africa, where the majority of malaria-related deaths occur in children under five [1]. Nigeria is the country with the largest malaria burden worldwide, accounting for over 25% of cases and roughly 33% of malaria-related deaths [2]. Due to protracted conflict, population dislocation, starvation, and compromised health services, northeastern Nigerian states

like Borno face increased vulnerability. Malaria transmission is steady in Jere Local Government Area, which is part of the Maiduguri metropolitan axis. It seasonally intensifies during the rainy season. Malaria prevalence among children under five is still high despite the recurrent application of control measures such as ITN distribution, IRS campaigns, and community education. Understanding the local epidemiology, effectiveness of surveillance mechanisms, and

utilization of control measures is critical for tailoring context-appropriate interventions [4].

Local variability is frequently obscured by national and state-level malaria data, especially in LGAs affected by violence. This study summarizes solid empirical data from Jere LGA to guide child health policy, surveillance enhancement, and malaria control initiatives in comparable humanitarian contexts. The epidemiological pattern of malaria among children under five in Jere LGA is described in this paper, along with an evaluation of the effectiveness and use of household-level malaria control measures, the performance of malaria surveillance and community outreach initiatives, and the socioeconomic impact of malaria on households with children under five.

This study looks at three closely related topics: control (prevention, treatment, and programmatic responses), surveillance (how cases and trends are identified and measured), and epidemiology (who is infected, where, and when). The study can address disease burden, drivers of transmission (such as household and school exposures, immunity gaps, and care-seeking behavior), and the efficacy of control measures like insecticide-treated nets (ITNs), seasonal malaria chemoprevention when

applicable, prompt diagnostic testing, and treatment by concentrating on schoolchildren under five, a group that is biologically more vulnerable to severe malaria and frequently less able to access prompt care. Linking individual-level outcomes (cases, severe disease, deaths) with system-level performance is made possible by framing the investigation around epidemiology, surveillance, and control [5].

The causes, prevalence, and practical remedies for malaria differ depending on the area, making public health issues context-dependent. Nigeria has the highest malaria burden in the world, accounting for a significant portion of cases and deaths worldwide, according to national-level data. As a result, national policy, funding, and program priorities (such as the National Malaria Strategic Plan) significantly influence the resources and interventions available at subnational levels [6]. To guide measurement of malaria burden, preventive coverage, and surveillance system performance in Jere LGA, key epidemiologic and surveillance indicators were defined. Table 1 summarizes the core indicators used in this study, their definitions, data sources, and analytical purpose.

Table 1. Surveillance and Epidemiologic Indicators

Indicator	Definition / Data source	Purpose
Confirmed malaria incidence (per 1,000 under-5s)	Laboratory-confirmed cases reported / population	Primary outcome
Test positivity rate (TPR)	Positive tests / total tests (facility & community)	Transmission intensity & testing coverage
LLIN ownership (%)	Households with ≥ 1 LLIN / total households (survey)	Exposure reduction proxy
LLIN use among under-5s (%)	Under-5s who slept under LLIN previous night	Intervention uptake
SMC coverage (%)	Proportion of eligible children receiving SMC per round	Preventive measure (seasonal)
Reporting timeliness (%)	Reports submitted on time / expected reports	Surveillance performance

Reporting completeness (%)	Reports received / expected reports	Surveillance performance
Stockout days (RDTs/ACTs)	Days without commodity / period days	Health system capacity

Methodology

A community-based cross-sectional study was conducted in Jere LGA, Borno State, Nigeria. The LGA comprises peri-urban and rural settlements with a high proportion of internally displaced persons. The study population consisted of caregivers of children under five years residing in selected communities. A multistage cluster sampling technique yielded 235 eligible households. One under-five child per household was selected as the index child. The data were collected using a structured questionnaire adapted from WHO malaria surveillance tools and the Nigeria Demographic and Health Survey. Sections included sociodemographic characteristics, malaria history, preventive practices, treatment-seeking behavior, and awareness of malaria interventions. The routine malaria surveillance data were abstracted from primary health care facilities and LGA health offices to assess reporting completeness, timeliness, and community-level surveillance activities. The data were then analyzed using SPSS version 26. Descriptive statistics summarized frequencies and proportions. Associations between malaria occurrence and explanatory variables were examined using chi-square tests, with statistical significance set at $p < 0.05$. The ethical approval was obtained from the relevant institutional

review board. Informed consent was obtained from all participating caregivers prior to data collection.

Result Presentation

Sociodemographic Characteristics of Respondents and Under-Five Children

Figures 1, present the age, sex, marital status, and caregiver-child relationship of respondents. The dominance of caregivers aged 26-35 years reflects the peak reproductive and caregiving age group in northeastern Nigeria. This age structure implies that malaria-related decision-making is concentrated among young adults who may simultaneously face economic precarity and high caregiving responsibilities. The high proportion of female respondents (mothers) aligns with national Demographic and Health Survey findings, where women are the primary health decision-makers for young children. Whereas Table 2 presents the distribution of common malaria symptoms among under-five children (multi-response).

Table 2 presents the distribution of common malaria symptoms among under-five children. Fever, vomiting, and loss of appetite (38.1%) were the most frequently reported symptom combination, followed by fever, vomiting, and weakness (10.5%), and fever, vomiting, weakness, and loss of appetite (7.1%).

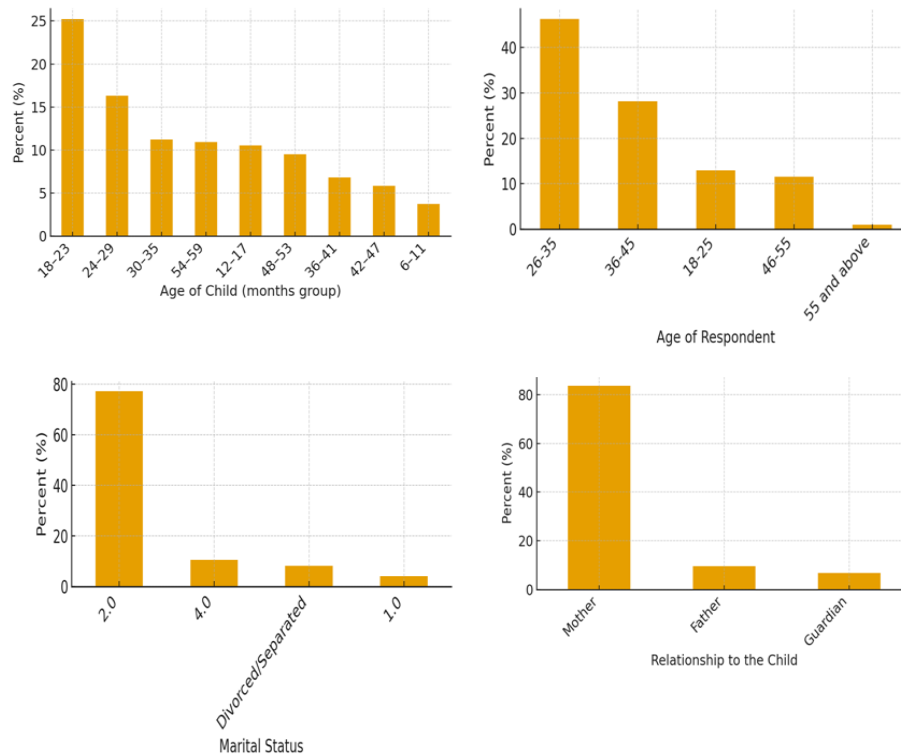


Figure 1. Present the (a) Age of Respondents, (b) Relationship to Child, (c) Age of Child (d) Marital Status of Respondents

Table 2. Distribution by Common Malaria Symptoms (Multi-Response)

Common malaria symptoms (multi-response)	Frequency	Percentage (%)
Fever, Vomiting, Loss of appetite	112	38.1
Fever, Vomiting, Weakness	31	10.5
Fever, Vomiting, Weakness, Loss of appetite	21	7.1
Fever, Weakness, Loss of appetite	20	6.8
Fever, Chills, Loss of appetite	17	5.8
Fever, Chills, Weakness	14	4.8
Fever, Weakness	11	3.7
Fever, Vomiting	7	2.4
Fever, Vomiting, Chills, Weakness	7	2.4
Fever, Vomiting, Chills, Weakness, Loss of appetite	7	2.4
Fever, Loss of appetite	5	1.7
Fever	5	1.7
Fever, Vomiting, Chills	5	1.7
Fever, Chills	4	1.4
Fever, Vomiting, Chills, Loss of appetite	4	1.4
Fever, Vomiting, Weakness, Diarrhoea	3	1
Fever, Chills, Weakness, Loss of appetite	3	1
Fever, Vomiting, Diarrhoea	3	1
Weakness	2	0.7
Fever, Weakness, diarrhoea	1	0.3
Fever, Vomiting, Chills, Weakness, Diarrhoea	1	0.3

Loss of appetite	1	0.3
Fever, Weakness, Diarrhoea	1	0.3
Vomiting, Chills, Loss of appetite	1	0.3
Fever, Chills, Diarrhoea	1	0.3
Vomiting, Weakness, Loss of appetite	1	0.3
Fever, Weakness, Loss of appetite, Diarrhoea	1	0.3
Fever, Vomiting, Loss of appetite, Diarrhoea	1	0.3
Fever, Vomiting, Loose stool	1	0.3
Vomiting	1	0.3
Fever, Weakness, Loss of appetite,	1	0.3
Fever, Vomiting, Chills, Loss of appetite, Diarrhoea	1	0.3

Figure 2 shows the educational attainment of the respondents, where most of the respondents had primary (1) or secondary education (2), with a small proportion attaining tertiary education (3 and 4). Statistically, lower

educational attainment has been associated in multiple Nigerian studies with reduced uptake of confirmed diagnostic testing and delayed treatment-seeking.

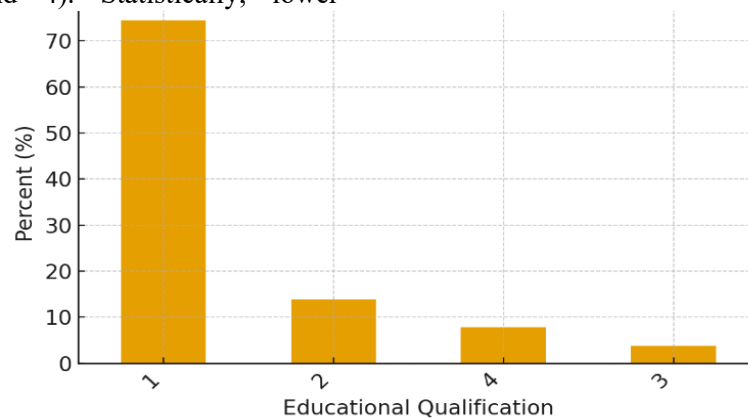


Figure 2. Shows the Educational Attainment of the Respondents

Figure 3, present the occupational status of the respondents, which revealed that 82.7% of respondents were engaged in informal or artisanal occupations. This occupational profile

suggests unstable income streams, which may constrain consistent access to healthcare and preventive commodities despite nominal availability through public programs.



Figure 3. Present the Occupational Status of the Respondents

Figure 4 shows a monthly household income distribution of the respondents, which lead to further contextualizes malaria vulnerability. A large proportion of households earned below the national minimum wage threshold, placing

them at heightened risk for malaria exposure due to substandard housing, overcrowding, and limited capacity to absorb recurrent healthcare costs.

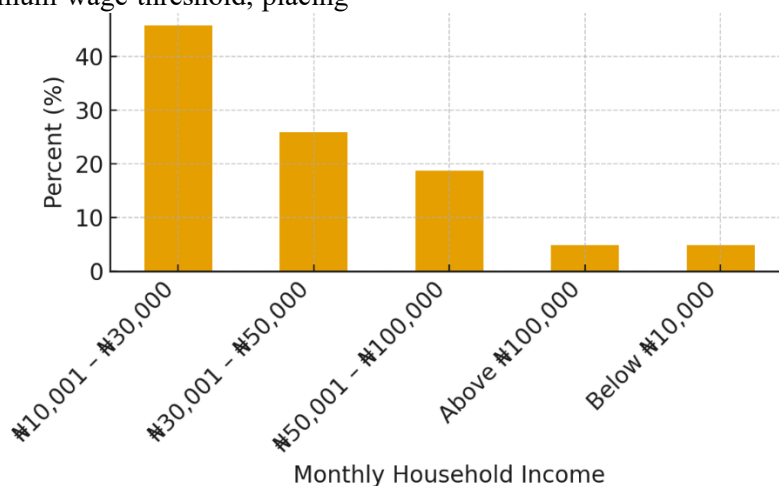


Figure 4. Shows a Monthly Household Income Distribution of the Respondents

Figure 5 shows the household size and number of under-five children indicate cumulative exposure risk, as households with

multiple young children experience repeated malaria episodes within short timeframes.

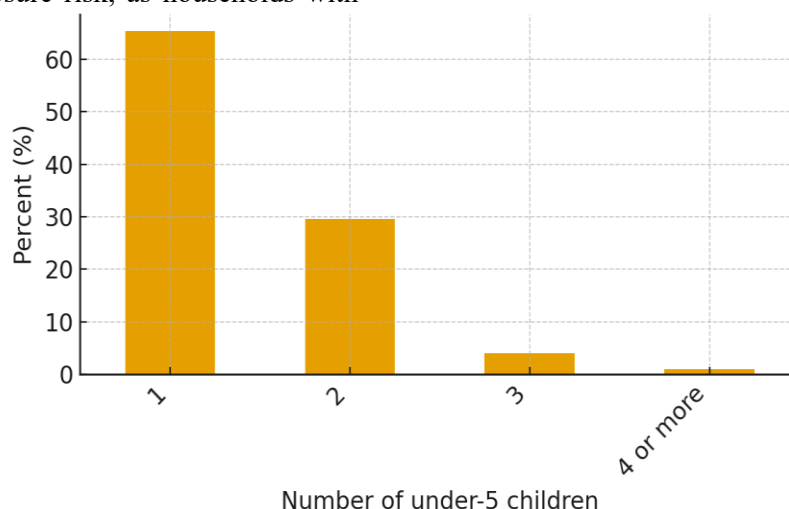


Figure 5. Shows the Household Size

Prevalence, Frequency, and Temporal Pattern of Malaria

Table 3 shows the association between monthly household income and malaria occurrence in the past six months. A statistically significant association was

observed ($\chi^2 = 15.20$, $p = 0.004$), indicating higher malaria incidence among lower-income households.

Figure 6, shows that the vast majority of children (95.9%) had experienced malaria within the past six months, while only 4.1% had not.

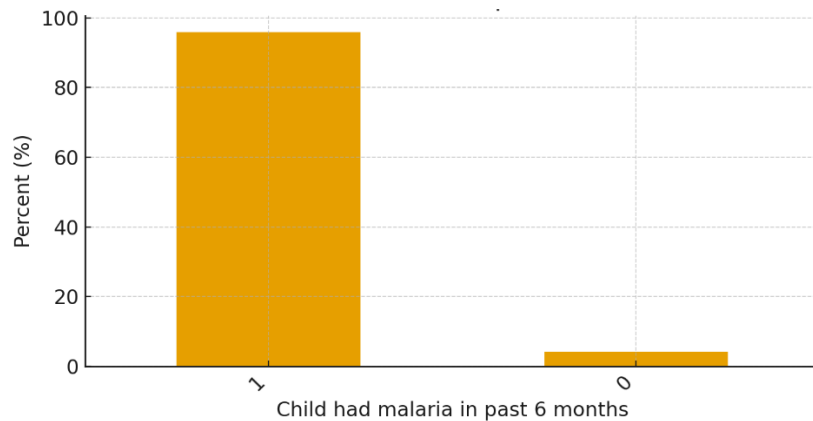


Figure 6. Child had Malaria in the Past 6 Months

Occupation significantly influenced malaria incidence. Farmers and traders reported higher incidence, while civil servants and salaried workers reported fewer cases.

Table 3. Association between Monthly Household Income and having had Malaria in the Past 6 Months

Monthly Household Income	0	1	Had malaria in the past 6 months
Above N100,000	3	11	
Below N10,000	1	13	
N10,001 - N30,000	3	132	
N30,001 - N50,000	1	75	
N50,001 - N100,000	4	51	
Chi2			15.20353
p-value			0.004297
CramerV			0.227404

Figure 7, reveals that 58.2% of the children had malaria one to two times per year, 40.5% experienced three to five episodes, and 1.4% had more than five attacks annually, which is determine to be one to two attacks per year however, a non-trivial proportion of children experienced three or more episodes annually.

From an epidemiological perspective, repeated episodes within short intervals suggest intense vector–human contact and limited interruption of transmission cycles. Such frequency also increases cumulative risks of anaemia, malnutrition, and developmental impairment.

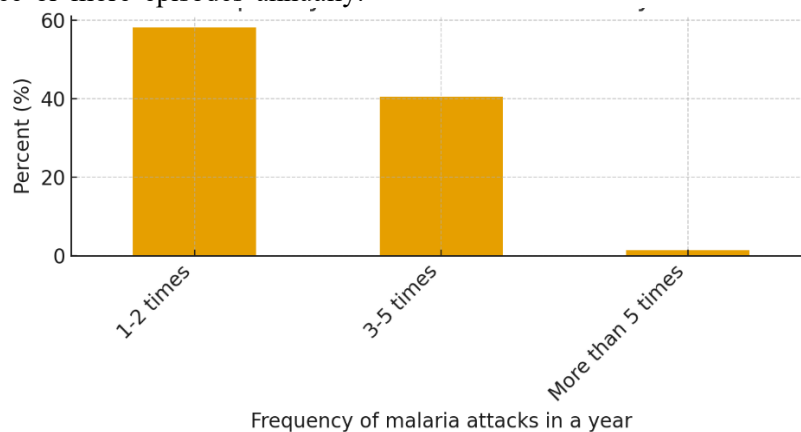


Figure 7. Frequency of Malaria Attacks in a Year

Diagnostic Modalities and Treatment-Seeking Behaviour

As indicated in Figure 8, 76.2% of caregivers relied on symptom-based diagnosis rather than laboratory confirmation. Statistically, this reliance significantly inflates reported malaria

incidence and reduces specificity in surveillance data. Symptom overlap with other febrile illnesses common in under-five children introduces misclassification bias, which undermines both individual case management and population-level surveillance accuracy.

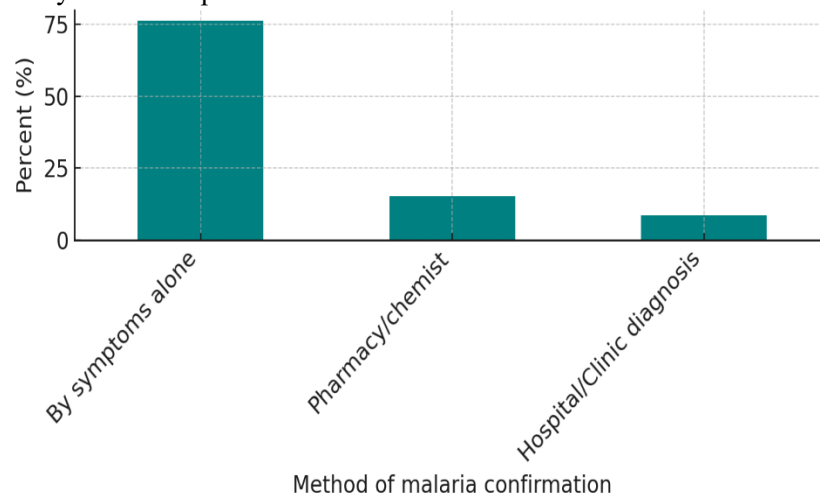


Figure 8. Method of Confirmation

The treatment-seeking patterns in Figure 9, reveal a mixed health-seeking pathway. While primary health centres were frequently utilized, a substantial proportion of caregivers sought care from patent medicine vendors. This duality reflects accessibility constraints, perceived

quality of care, and out-of-pocket cost considerations. The use of informal providers has implications for treatment quality, adherence to national guidelines, and antimicrobial resistance.

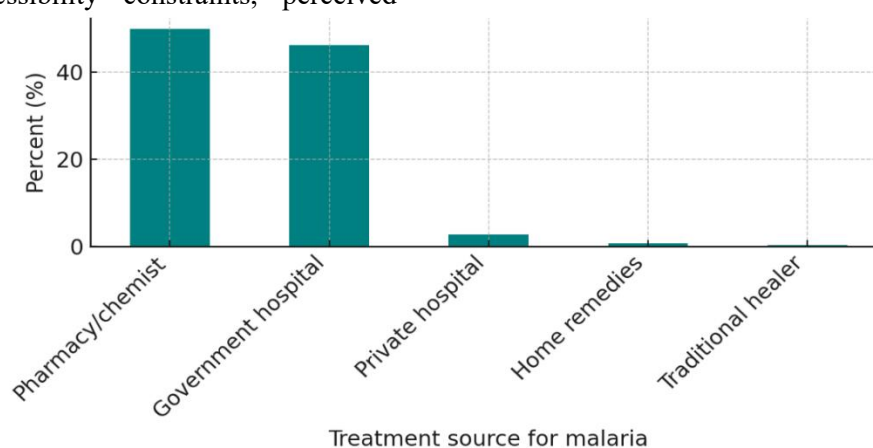


Figure 9. Treatment Source for Malaria

Ownership, Access, and Utilization of Insecticide-Treated Nets (ITNs)

Figure 10, reveals that 95.6% of children regularly slept under insecticide-treated nets (ITNs), 2.7% used them occasionally, while 1%

and 0.7% rarely or never used them, respectively. This is reflecting the impact of mass distribution campaigns. Chi-square analyses showed no statistically significant differences in reported ITN use by age,

education, marital status, occupation, or income, indicating equitable nominal coverage. However, statistical uniformity in reported use does not equate to uniform protective efficacy. High malaria prevalence despite high ITN coverage suggests gaps in correct usage,

physical condition of nets, sleeping arrangements, or vector resistance. These findings imply that ITN effectiveness in this setting is moderated by contextual and behavioural factors not captured by ownership metrics alone.

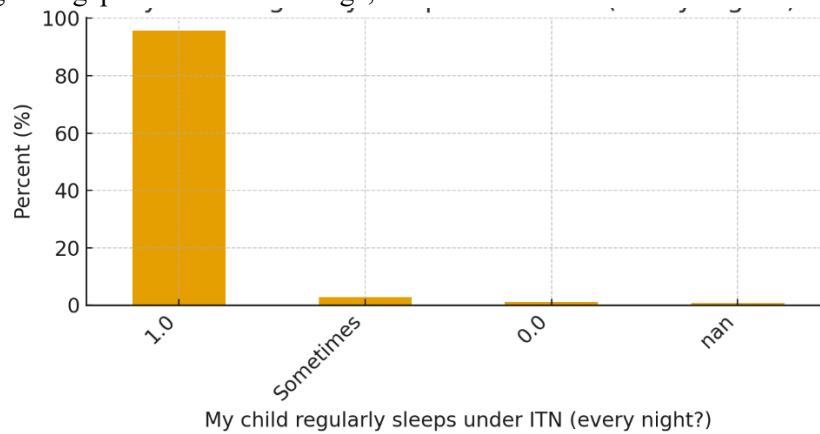


Figure 10. My child Regularly Sleeps under ITN

Table 4 summarizes other malaria preventive measures used by households. The most common combination was mosquito coil use and environmental sanitation (54.1%),

followed by mosquito coil use combined with insecticide sprays and environmental sanitation (20.7%).

Table 4. Other Preventive Measures (Multi-response)

Other preventive measures (multi-response)	Frequency	Percentage
Mosquito coil, Environmental sanitation	159	54.1
Mosquito coil, Insecticide sprays, Environmental sanitation	61	20.7
Mosquito coil	16	5.4
Mosquito coil, Window/door nets, Environmental sanitation	11	3.7
Environmental sanitation	8	2.7
Insecticide sprays, Environmental sanitation	5	1.7
Mosquito coil, Window/door nets	5	1.7
Mosquito coil, Herbal prevention	4	1.4
Mosquito coil, Insecticide sprays	4	1.4
Mosquito coil, Environmental sanitation, Herbal prevention	4	1.4
Insecticide sprays, Window/door nets, Environmental sanitation	3	1
Window/door nets	3	1
Mosquito coil, Insecticide sprays, Window/door nets, Environmental sanitation	3	1
Mosquito coil, Insecticide sprays, Window/door nets	2	0.7
Window/door nets, Environmental sanitation	2	0.7
9	2	0.7
Insecticide sprays, Window/door nets	1	0.3
Mosquito coil, Insecticide sprays, Herbal prevention	1	0.3

Indoor Residual Spraying (IRS) Coverage and Perceived Effectiveness

Figure 11, indicates that indoor residual spraying (IRS) was used in 93.9% of households, while 6.1% reported no IRS use. Similar to ITNs, IRS utilization showed

minimal sociodemographic differentiation. From a statistical standpoint, the lack of association between IRS coverage and reduced malaria incidence suggests either suboptimal implementation, limited residual efficacy, or rapid reinfestation due to environmental conditions and housing quality.

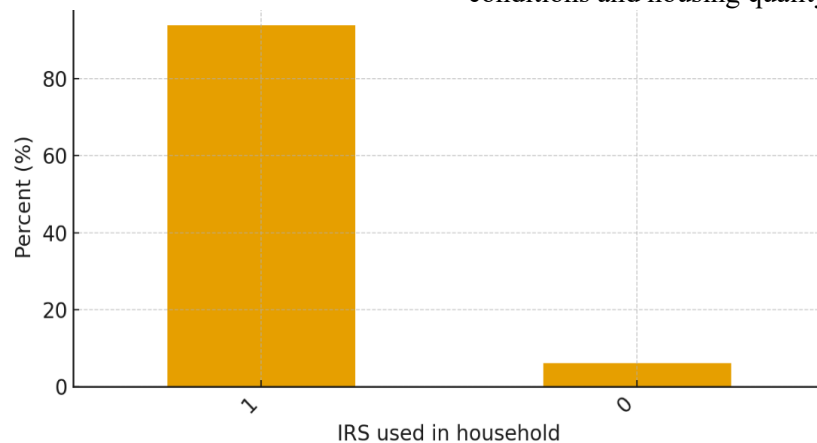


Figure 11. IRS used in the Household

Surveillance Awareness, Reporting, and Community Outreach

Figures 12 assess malaria surveillance performance which reveals that 80.6% agreed and 12.2% strongly agreed that public health officers conducted surveillance, while smaller

proportions disagreed or remained neutral. In contrast, 84.4% of households reported no visit by health or surveillance officers in the previous year. This discrepancy highlights a structural weakness in active surveillance and community-based case detection.

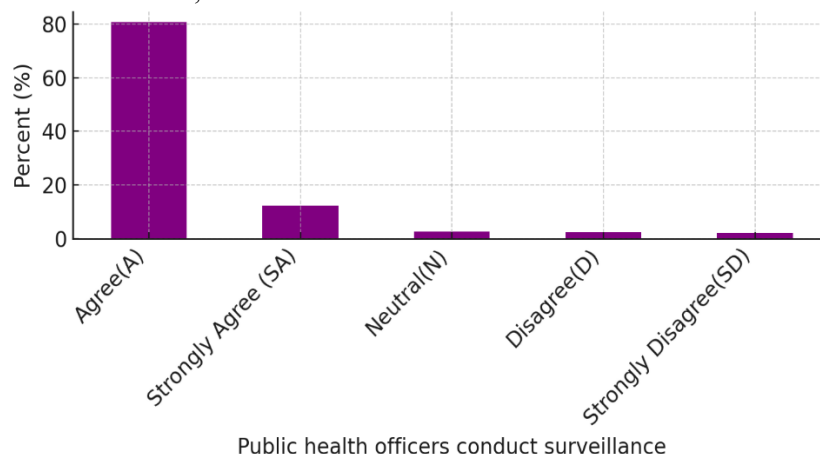


Figure 12. Public Health Officers Conduct Surveillance

Socio-Economic and Financial Burden of Malaria

Statistically, the absence of household visitation limits early case identification and contributes to reliance on passive, facility-

based reporting systems, which systematically underrepresent community burden. Figure 13, shows that the average spending per malaria episode was mainly between ₦1,000-₦3,000 (58.5%), while 31.3% spent ₦3,001-₦5,000, and smaller proportions spent above ₦5,000.

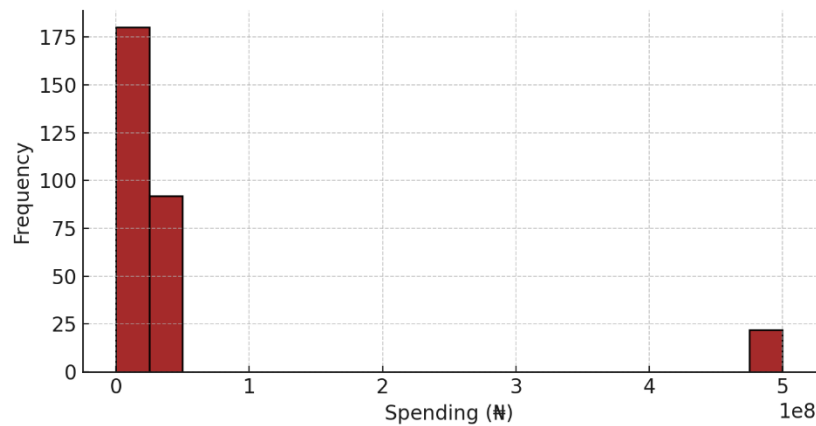


Figure 13. Average Spending on Malaria Treatment per Episode

Association Analyses and Statistical Inference

The Chi-square analysis in Table 5 shows no statistically significant association between caregiver age and malaria incidence among under-five children ($\chi^2 = 2.15$, $p = 0.708$), indicating generalized risk across age groups. Similar non-significant associations were observed for education, occupation, and income, suggesting that malaria risk in Jere LGA is generalized rather than confined to specific subgroups. This epidemiological pattern is characteristic of high-transmission settings, where universal exposure overwhelms

individual-level protective factors. Age of Respondent: Younger caregivers (18–35) reported higher malaria incidence among children than older caregivers. This suggests greater vulnerability in younger households, possibly due to limited resources or less experience with prevention. Older age groups (46+) reported relatively fewer malaria cases. $\chi^2 = 2.15$, $p = 0.708$. This test is not statistically significant ($p > 0.05$). Malaria incidence does not significantly differ across age groups of caregivers in this dataset. $V = 0.086$, this is a very weak association between the caregiver's age and malaria incidence. Age explains little to none of the variation in malaria occurrence.

Table 5. Association between Age and Malaria Incidence

Age	0	1	Had malaria in past 6 months
18-25	2	36	
26-35	7	129	
36-45	3	80	
46-55	0	34	
55and above	0	3	
Chi2			2.150558
p-value			0.708091
CramerV			0.085527

Discussion

Malaria Burden in Nigeria, Sub-Saharan Africa, and Conflict-Affected Settings

The near-universal malaria burden found in this study is significantly higher than national

prevalence estimates for Nigeria and more closely resembles patterns found in conflict-affected and humanitarian situations in the Lake Chad Basin. Despite continuous control efforts, studies from Borno, Yobe, South Sudan, and portions of the Democratic

Republic of the Congo show hyperendemic transmission in children under five [3-7]. Malaria continues to be the primary cause of death for children under five in sub-Saharan Africa, making for around 75% of all malaria deaths worldwide [1].

Socioeconomic Vulnerability and Structural Determinants

This study's high proportion of low-income, unemployed households supports the idea that structural factors have a significant influence on malaria transmission. Malaria risk is highly mediated by poverty, housing quality, and overcrowding, according to Nigerian research from Kano, Zamfara, and Niger States [8-10]. Displacement and informal settlements increase exposure in conflict-affected areas.

Preventive Coverage–Impact Disconnect

The high frequency of malaria that persists in Nigeria and SSA despite extensive ITN and IRS coverage is a well-documented phenomenon. Similar disconnects are reported in studies from Ghana, Tanzania, Uganda, and Ethiopia, which attribute them to vector behavioural adaptation, pesticide resistance, inconsistent net application, and net degradation [11-15]. Damaged house structures and outside evening activities further diminish the effectiveness of protection in northeastern Nigeria.

Diagnostic Practices and Surveillance Accuracy

This study's substantial emphasis on symptom-based diagnosis is consistent with findings from Sahelian and northern Nigerian contexts [16-18]. Presumptive treatment may improve access, but it also inflates malaria numbers and compromises the accuracy of diagnoses. The World Health Organization now strongly advises universal parasitological confirmation before starting therapy, highlighting its importance for the integrity of surveillance and responsible drug use.

Surveillance Gaps in Fragile and Insecure Contexts

This study's findings about inadequate community-level surveillance align with assessments of malaria surveillance systems in conflict environments. Insecurity, a lack of workers, and disjointed reporting systems are identified as the main obstacles in studies from Borno State, Somalia, and the northeastern Democratic Republic of the Congo [19-22]. Malaria control initiatives cannot react quickly to local transmission patterns in the absence of ongoing surveillance.

Economic Burden and Developmental Consequences

This study's financial burden is consistent with research from SSA and Nigeria showing that malaria causes disastrous medical costs for low-income households [23-25]. Intergenerational poverty is sustained by recurrent malaria episodes, which also cause anemia, poor cognitive development, and decreased school attendance.

Implications for Elimination Goals

Without focused initiatives for LGAs affected by violence, Nigeria's goals to eradicate malaria are unlikely to be achieved. Gains in controlling malaria are brittle and reversible in the absence of strong surveillance and resilient health systems, according to data from Rwanda, Senegal, and Zambia [26-28].

Conclusion

In Jere LGA, Borno State, malaria is still a widespread and unfair public health concern for children under five. The need for enhanced surveillance, better diagnostic confirmation, and context-sensitive control strategy execution is highlighted by the continuation of high transmission despite widespread awareness and reported preventive coverage.

Limitations

The cross-sectional design used in this investigation limited the ability to draw conclusions about the causal relationship between identified risk factors and malaria outcomes. When it comes to malaria episodes and preventive measures in particular, relying on caregiver self-report may introduce recollection and social desirability bias. Not all reported instances had independent diagnostic confirmation, and significant variables including housing quality and nutritional status were not completely controlled. When interpreting the results, these restrictions should be taken into account.

Policy Implications

The results have a number of policy ramifications. First, rather than depending exclusively on facility-based reporting, malaria control programs in LGAs affected by violence should give active community-based surveillance and diagnostic confirmation top priority. Second, actual utilization, housing conditions, and pesticide resistance must be monitored in addition to ITN and IRS techniques. Third, in order to address the multifactorial causes of transmission, malaria control must be integrated with nutrition, maternal and child health, and humanitarian services. Lastly, achieving equitable malaria reduction among children under five requires consistent investment in local monitoring capability.

In Jere LGA, Borno State, malaria is still a serious public health issue among children under five. The illness load has not decreased proportionately despite high awareness and reported preventative coverage. There is an urgent need to increase community-level participation, surveillance outreach, and diagnostic procedures.

Recommendations

In conflict-affected areas, it is necessary to scale up community-based diagnostic testing

using rapid diagnostic tests, bolster active surveillance through trained community health workers, improve monitoring of actual ITN utilization and the quality of IRS implementation, and integrate malaria control with nutrition and child health programs.

Ethical Approval

The study received ethical approval from the Borno State Ministry of Health Research Ethics Committee. Informed consent was obtained from all caregivers, and confidentiality of participants was maintained throughout the study.

Data Availability

The datasets generated and/or analyzed during this study are available from the Borno State Ministry of Health upon reasonable request.

Author Contributions

Mohammed Bala Aminu (M.B.A.) conceptualized and designed the study. Data collection and analysis were conducted by M.B.A. and the research team. The author contributed to the interpretation of results, drafting, and revision of the manuscript, and approved the final version for publication.

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This research was self-funded by the author.

Conflict of Interest

The author declares no conflict of interest in relation to this study.

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References

- [1]. World Health Organization, 2024, *World malaria report 2024*. WHO.
- [2]. World Health Organization, 2023, *World malaria report 2023*. WHO.
- [3]. National Malaria Elimination Programme (NMEP) [Nigeria], National Population Commission (NPC) [Nigeria], & ICF, 2022, Nigeria malaria indicator survey 2021. *NMEP, NPC, and ICF*.
- [4]. Snow, R. W., Sartorius, B., Kyalo, D., Maina, J., Amratia, P., Mundia, C. W., Bejon, P., Noor, A. M., & Rogers, D. J., 2017, The prevalence of *Plasmodium falciparum* in sub-Saharan Africa since 1900. *Nature*, 550(7676), 515–519.
- [5]. Oresanya, O. B., Hoshen, M., & Sofola, O. T., 2018, Utilization of insecticide-treated nets by under-five children in Nigeria: Assessing progress towards malaria control. *Malaria Journal*, 17(1), 1–9.
- [6]. United Nations Children's Fund, 2021, Malaria and child health in humanitarian settings. *UNICEF*.
- [7]. Bousema, T., Okell, L., Felger, I., & Drakeley, C., 2019, Asymptomatic malaria infections: Detectability, transmissibility and public health relevance. *PLoS Medicine*, 16(8), e1002922.
- [8]. Ambe, J. P., Balogun, S. T., Waziri, N. E., Dalhat, M. M., Nglass, I. N., & Umar, A. S., 2020, Malaria burden among internally displaced children in Borno State, Nigeria. *Malaria Journal*, 19(1), 1–10.
- [9]. Inuwa, M. S., Yakubu, A., & Musa, A., 2021, Determinants of malaria infection among under-five children in Maiduguri, northeastern Nigeria. *BMC Public Health*, 21, 112.
- [10]. Aregawi, M., Lynch, M., Bekele, W., Kebede, H., Jima, D., Taffesse, H. S., & Woldeyes, D., 2017, Time series analysis of trends in malaria cases and deaths in Ethiopia. *The Lancet Global Health*, 5(1), e67–e75.
- [11]. Bhatt, S., Weiss, D. J., Cameron, E., Bisanzio, D., Mappin, B., Dalrymple, U., Battle, K. E., Moyes, C. L., Henry, A., Eckhoff, P. A., Wenger, E. A., Briet, O., Penny, M. A., Smith, T. A., Bennett, A., Yukich, J., Eisele, T. P., Griffin, J. T., Fergus, C. A., & Gething, P. W., 2015, The effect of malaria control on *Plasmodium falciparum* in Africa between 2000 and 2015. *Nature*, 526(7572), 207–211.
- [12]. Okell, L. C., Ghani, A. C., Lyons, E., & Drakeley, C. J., 2016, Submicroscopic infection in *Plasmodium falciparum*-endemic populations: A systematic review and meta-analysis. *The Journal of Infectious Diseases*, 200(10), 1509–1517.
- [13]. Tusting, L. S., Willey, B., Lucas, H., Thompson, J., Kafy, H. T., Smith, R., & Lindsay, S. W., 2019, Socioeconomic development as an intervention against malaria: A systematic review and meta-analysis. *PLoS Medicine*, 16(3), e1002820.
- [14]. Worrall, E., Basu, S., & Hanson, K., 2018, Is malaria a disease of poverty? A review of the literature. *Tropical Medicine & International Health*, 10(10), 1047–1059.
- [15]. Adebayo, A. M., Akinyemi, O. O., & Cadmus, E. O., 2020, Household costs of malaria treatment in Nigeria. *African Health Sciences*, 20(1), 230–239.
- [16]. Yusuf, O. B., Adeoye, B. W., Oladepo, O., Peters, D. H., & Bishai, D., 2019, Poverty and fever vulnerability in Nigeria. *Malaria Journal*, 18, 45. <https://doi.org/10.1186/s12936-019-2673-1>.
- [17]. Gething, P. W., Elyazar, I. R. F., Moyes, C. L., Smith, D. L., Battle, K. E., Guerra, C. A., Patil, A. P., Tatem, A. J., Howes, R. E., Myers, M. F., George, D. B., Horby, P., Wertheim, H. F. L., Price, R. N., Mueller, I., Baird, J. K., & Hay, S. I., 2012, A long-neglected world malaria map. *Nature*, 465(7296), 342–345.
- [18]. World Health Organization, 2015, Guidelines for the treatment of malaria, 3rd ed. *World Health Organization*.
- [19]. Korenromp, E. L., Hosseini, M., Newman, R. D., & Cibulskis, R. E., 2020, Progress towards malaria elimination in Africa. *Malaria Journal*, 19, 1–12.
- [20]. Afolayan, D. O., Oloyede, O. O., & Afolabi, B. M., 2022, Insecticide resistance in malaria vectors in Nigeria: Implications for vector control. *Parasites & Vectors*, 15, 98.
- [21]. Yeka, A., Gasasira, A., Mpimbaza, A., Achan, J., Nankabirwa, J., Nsoby, S., Staedke, S. G., &

Kamya, M. R., 2012, Malaria in Uganda: Challenges to control on the long road to elimination. *Malaria Journal*, 11, 181.

[22]. Okorie, P. N., McKenzie, F. E., Ademowo, O. G., & Bockarie, M., 2021, Nigeria's malaria surveillance system: Performance, challenges, and prospects. *Global Health Action*, 14(1), 188–195.

[23]. Nankabirwa, J., Brooker, S. J., Clarke, S. E., Fernando, D., Gitonga, C. W., Schellenberg, D., Greenwood, B., & Brooker, S., 2020, Malaria surveillance and response systems in sub-Saharan Africa. *BMC Medicine*, 18, 1–12.

[24]. Wangdi, K., Gatton, M. L., Kelly, G. C., & Clements, A. C. A., 2018, Malaria elimination in fragile states: Evidence and challenges. *Malaria Journal*, 17, 256.

[25]. Tanner, M., Greenwood, B., Whitty, C. J. M., Ansah, E. K., Price, R. N., Dondorp, A. M., von Seidlein, L., Baird, J. K., Beeson, J. G., Fowkes, F.

J. I., Hemingway, J., Marsh, K., Osier, F., & Schellenberg, D., 2015, Malaria eradication and elimination: Views on how to translate a vision into reality. *Science*, 350(6264), 389–390.

[26]. Roca-Feltrer, A., Lalloo, D. G., Phiri, K., Terlouw, D. J., & Clarke, S. E., 2018, Household ownership and use of insecticide-treated nets in sub-Saharan Africa. *PLoS ONE*, 13(1), e0191113.

[27]. Pulford, J., Hetzel, M. W., Bryant, M., Siba, P. M., & Mueller, I., 2011, Reported reasons for not using mosquito nets in malaria-endemic areas. *Social Science & Medicine*, 72(7), 1035–1042.

[28]. Hemingway, J., Ranson, H., Magill, A., Kolaczinski, J., Fornadel, C., Gimnig, J., Coetzee, M., Simard, F., Roch, D. K., Hinzoumbe, C. K., Pickett, J., & Schellenberg, D., 2016, Averting a malaria disaster: Will insecticide resistance derail malaria control? *The Lancet*, 387(10029), 1785–1788.

Associations between Wildfire Smoke Exposure and Chronic Cardiovascular and Respiratory Conditions in Selected Provinces in Canada: A Retrospective Ecological Study

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Abstract

Wildfire smoke (PM_{2.5}) has been recognized as an environmental risk factor with severe adverse health outcomes. Exposure to PM_{2.5} can lead to severe cardiovascular and respiratory health conditions. The study aims to assess and examine the ecological associations between wildfire smoke exposure and the burden of chronic cardiovascular and respiratory conditions in Canada from 2010 to 2023, by integrating health outcome data with wildfire activity and air quality indicators across provinces. The study used a retrospective study design to collect secondary data from the Canadian Chronic Disease Surveillance System (CCDSS) for health outcomes (acute myocardial infarction, asthma, chronic obstructive pulmonary disease (COPD), heart failure, stroke) across the selected provinces, from the Canadian Wildland Fire Information System (CWFIS), for wildfire perimeters and their causes, and from the National Air Pollution Surveillance Program (NAPS), for air quality using PM_{2.5} concentration as a proxy for air pollution exposure. The correlation between average PM_{2.5} concentrations and incidence rates was weakly negative ($r = -0.106$, $p = 0.238$), and the wide confidence interval (95% CI: -0.6357 to 0.1593). Similarly, the correlation between high-risk air quality days (HRD) and incidence rates was also weak and negative ($r = -0.042$, $p = 0.643$), again failing to reach statistical significance. The findings indicate that wildfire smoke exposure, though an important environmental health concern, was not a statistically significant predictor of chronic cardiovascular and respiratory disease incidence across the studied provinces. This does not negate the potential health risks of wildfire smoke.

Keywords: Cardiovascular Diseases, Disease Surveillance, PM_{2.5}, Respiratory Diseases, Wildfire Smoke.

Introduction

Wildland fire smoke increasingly has been recognized as an environmental risk factor of serious impact, leading to acute and chronic illness, particularly to the respiratory and cardiovascular systems [1]. Canada has the privilege of owning one of the world's largest forest coverages, with nearly 40% of its land mass dominated by forest [2]. British Columbia, Alberta, Saskatchewan, and Ontario are the provinces most vulnerable to wildfires

due to high forest cover and hot, dry weather during summer [2]. Wildfire smoke is made up of a complex blend of gases and fine particulate matter (PM_{2.5}) that can pose serious health risks, even when the exposure has occurred far from the fire or at relatively low concentrations [3]. They can be categorized as atmospheric particles, which consist of suspended particulate matter, including thoracic and respirable particles. These are coarse and inhalable particles with a diameter of 10 micrometers, which is why they are designated

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PM₁₀, while the particles with a smaller diameter are designated PM_{2.5} [4]. Particulate matter (PM) or particulates are microscopic particles of solid or liquid matter suspended in the air, and the sources of particulate matter can be natural or man-made [5].

Fine particles (PM_{2.5}), with diameters less than 2.5 micrometers, are of particular concern because these microscopic particles can penetrate deep into the lungs, reaching the bronchioles and alveoli and enter the bloodstream, potentially impacting almost every organ in the body [3]. The wildfire smoke also contains gases such as carbon monoxide, carbon dioxide, nitrogen oxides, sulfur dioxide, and volatile organic compounds (VOCs). Additionally, hazardous air pollutants (HAPs) like benzene, formaldehyde, and polycyclic aromatic hydrocarbons (PAHs), known for their irritant and carcinogenic properties, are also composite of wildfire smoke. Other substances often detected in wildfire smoke include water vapor, black carbon (soot), and trace metals such as lead, copper, and zinc, especially when the fire is anthropogenic in nature [3]. Wildfire smoke contains high levels of fine particulate matter (PM_{2.5}), and it is deeply in the lungs and can reach the bloodstream, leading to systemic inflammation, oxidative stress, and vascular dysfunction [6]. All these biological processes are strongly associated with the etiology and aggravation of chronic respiratory and cardiovascular diseases [7]. Notwithstanding this, there is a paucity of retrospective studies from Canada exploring how repeated or prolonged exposure to wildfire smoke exacerbates chronic disease incidence, hospitalization, and death [8].

Wildfires are no longer a new phenomenon in Canada; however, the number and intensity of recent wildfires have increased. For example, in 2023, Canada saw its largest-ever wildfire season, and smoke traversed North America, even extending to Europe [9].

This study addresses a critical gap in Canadian public health literature. While most

studies have examined either acute respiratory events or cardiovascular diseases and their association with wildfire smoke as stand-alone investigations focused on short-term effects [10], few have integrated both disease categories to explore long-term associations with wildfire smoke exposure. This knowledge gap poses significant challenges for policy-making and public health preparedness. Without robust evidence on the long-term health implications of wildfire smoke, the development of evidence-based interventions, optimal resource allocation, and climate-resilient healthcare systems remains limited. Therefore, this study aims to address these research gaps by conducting a retrospective ecological analysis to assess the associations between wildfire smoke exposure and the burden of chronic cardiovascular and respiratory conditions in selected Canadian provinces from 2010 to 2023. The study integrates health outcome data with wildfire activity and air quality indicators to provide a comprehensive understanding of these relationships across provinces.

Materials and Methods

Research Design

This study employed a retrospective study design from 2010-2023 to examine the associations between exposure to wildfire smoke and chronic cardiovascular and respiratory diseases in selected provinces in Canada. The study integrated three primary data sources: wildfire activity indicators (area burned, number of fires), air quality measurements (PM_{2.5} concentrations, high-risk air quality days), and health outcome incidence rates (acute myocardial infarction, asthma, COPD, heart failure, and stroke). Data were aggregated at the provincial level for each calendar year, enabling temporal trend analysis and ecological correlation assessment.

Study Area

This study was carried out in selected provinces in Canada, which are: Alberta, British Columbia, Ontario, Quebec, and Saskatchewan. These provinces are of particular interest because they are provinces with high and frequent wildfire activities, they possess an established and comprehensive air quality monitoring system, which will enhance the reliability of the retrospective exposure assessment, and demographically diverse populations, which will allow for the examination of health effects across socio-demographic strata [2].

Study Population

Secondary data were used for this study, including all health records of focus from the five selected provinces in Canada, air quality records from the same provinces, and wildfire activities within them. The inclusion criteria are: All health records of the five health conditions of focus from the selected provinces (acute myocardial infarction, asthma, chronic obstructive pulmonary disease (COPD), heart failure, and stroke); all records of PM_{2.5} concentration within the selected province; and all records within the selected years for the study. Those excluded from the study were: Individuals who reside outside the five selected provinces, data records that did not match the pre-specified list of respiratory or cardiovascular outcomes as a result of wildfire smoke, and incidents of wildfire that occurred outside the 2010–2023 timeframe.

Sample and Sampling Techniques

For the secondary data, a convenience sampling technique was employed to aggregate and collect a total of 125 cases from 5 selected provinces.

Data Sources and Collection

Wildfire Activity Data were obtained from the Canadian Wildland Fire Information System (CWFIS) [11, 12], providing detailed

information on wildfire perimeters and causes. Only natural-origin, non-prescribed fires were included. Data were aggregated to estimate total area burned (hectares) and the number of wildfire events per province per year.

Air Quality Data were retrieved from the National Air Pollution Surveillance (NAPS) Program [13] using PM_{2.5} concentrations as a proxy for air pollution exposure. Hourly PM_{2.5} measurements were averaged to produce daily and annual provincial means. Days with PM_{2.5} concentrations exceeding 25 µg/m³ were classified as high-risk days, consistent with Air Quality Health Index values ≥ 7 under Canadian health guidelines.

Health Outcome Data were extracted from the Canadian Chronic Disease Surveillance System (CCDSS) [14] maintained by the Public Health Agency of Canada. Data provided by the fiscal year were harmonized to match the calendar years used in environmental datasets. Incidence rates were expressed per 100,000 population for standardized comparison across provinces and time periods.

Data Analysis Methods

Data were systematically coded, cleaned, and analyzed using Statistical Package for the Social Sciences (SPSS version 25) and R statistical software (version 4.4.1) for advanced visualization and regression modeling. Multiple analytical approaches were employed: Descriptive Statistics summarized wildfire activity, air quality indicators, and health outcomes through frequencies, percentages, means, standard deviations, medians, and interquartile ranges, while Temporal Trend Analysis employed time-series methods to assess changes in wildfire activity, air pollution, and chronic disease incidence from 2010 to 2023. Line graphs illustrated yearly variations, and percentage changes between baseline (2010) and endpoint (2023) quantified directional trends. Inferential Statistics included Analysis of Variance (ANOVA) to compare mean values across provinces, with

Kruskal-Wallis tests employed where data violated normality assumptions. Statistical significance was determined at $p \leq 0.05$. Furthermore, correlation analysis utilized Pearson's correlation coefficient to examine linear relationships between wildfire activity indicators and air quality measures, as well as associations between exposure variables and health outcomes. Correlation strength was interpreted using conventional thresholds (weak: $r < 0.3$, moderate: $0.3-0.6$, strong: >0.6). Graphical Visualization included scatter plots with regression lines, heat maps illustrating spatiotemporal variations, and trend line graphs highlighting longitudinal shifts in incidence rates and air quality metrics.

Results

A total of 125 cases were included in the study, Table 1. Distribution by year showed an equal representation in 2010, 2011, 2012, and 2021, with 25 cases each (20.0%). The year 2022 contributed 20 cases (16.0%), while 2023

accounted for the least with only 5 cases (4.0%).

In terms of provincial distribution, each of the five provinces contributed equally to the study population. Alberta, British Columbia, Ontario, Quebec, and Saskatchewan all had 25 cases each (20.0%), ensuring balanced geographical representation.

With respect to health conditions, the study also maintained an even distribution. Each of the five conditions—acute myocardial infarction, asthma, chronic obstructive pulmonary disease (COPD), heart failure, and stroke—contributed 25 cases (20.0%), reflecting an intentional design to allow for balanced comparisons across disease groups. The age group analysis revealed that the largest proportion of cases was in the 20-34 years category (50; 40.0%). The remaining groups were equally distributed, with 25 cases each (20.0%) in the 1–19 years, 35-39 years, and ≥ 40 years categories. This indicates a skew towards early adulthood, while still capturing both younger and older populations.

Table 1. Socio-demographic Characteristics

Variables	Frequency	Percent (%)
Year		
2010	25	20.0
2011	25	20.0
2012	25	20.0
2021	25	20.0
2022	20	16.0
2023	5	4.0
Province		
Alberta	25	20.0
British Columbia	25	20.0
Ontario	25	20.0
Quebec	25	20.0
Saskatchewan	25	20.0
Condition		
Acute myocardial infarction	25	20.0
Asthma	25	20.0
Chronic obstructive pulmonary disease	25	20.0
Heart failure	25	20.0

Stroke	25	20.0
Age Group		
1-19	25	20.0
20-34	50	40.0
35-39	25	20.0
≥ 40	25	20.0

Table 2 shows the analysis of Temporal Trends in Chronic Cardiovascular and Respiratory Conditions. Across all five provinces, considerable variations were observed in the mean and median rates of the selected conditions. In Ontario, the highest mean incidence rate was recorded for chronic obstructive pulmonary disease (COPD) at 722.40 ± 246.05 per 100,000, with significant variation over time (ANOVA = 15.32, $p < 0.0001$; Kruskal-Wallis = 18.93, $p = 0.008$). Asthma also showed a relatively high incidence (494.60 ± 79.68), while heart failure (499.60 ± 14.60), stroke (302.60 ± 16.74), and acute myocardial infarction (188.40 ± 36.34) remained comparatively stable without statistically significant variation.

In Quebec, COPD similarly showed significant temporal variation (ANOVA = 53.02, $p < 0.00001$; Kruskal-Wallis = 22.40, $p = 0.0002$), with a mean incidence of 684.80 ± 101.57 . Other conditions, such as asthma (397.40 ± 68.27), heart failure (506.00 ± 7.45), stroke (267.40 ± 9.61), and myocardial infarction (252.40 ± 11.28), did not show significant fluctuations over the study period.

In Alberta, COPD again presented the highest mean incidence rate at 863.80 ± 317.75 , with strong statistical significance (ANOVA = 15.58, $p < 0.00001$; Kruskal-Wallis = 20.95, $p = 0.0003$). Asthma (474.20 ± 82.44) and heart failure (600.60 ± 35.91) followed closely, while myocardial infarction (193.00 ± 42.92) and stroke (294.20 ± 30.03) remained comparatively lower and non-significant. In British Columbia, COPD also dominated with a mean incidence of 896.60 ± 305.32 and significant variation (ANOVA = 19.26, $p < 0.00001$; Kruskal-Wallis = 21.97, $p = 0.0002$). Heart failure (604.60 ± 11.26) and asthma (466.60 ± 72.79) were common, while stroke (321.80 ± 18.38) and myocardial infarction (174.80 ± 22.42) exhibited comparatively lower rates.

In Saskatchewan, COPD again demonstrated significantly high variability with a mean rate of 837.80 ± 165.28 (ANOVA = 39.76, $p < 0.00001$; Kruskal-Wallis = 22.55, $p = 0.0002$). Other conditions, such as asthma (447.60 ± 67.89), heart failure (568.80 ± 69.61), stroke (295.40 ± 31.50), and myocardial infarction (203.60 ± 32.51), showed no significant changes across the study period.

Table 2. Temporal Trends and Statistical Significance of Incidence Rates of Chronic Cardiovascular and Respiratory Conditions Across Selected Canadian Provinces, 2010–2023

Condition	Mean Rate (per 100,000)±SD	ANOVA (p-value)	Median Rate (IQR)	Kruskal-Wallis (p-value)
Ontario				
Acute Myocardial Infarction	188.40 ± 36.34		207 (155–211)	
Asthma	494.60 ± 79.68		508 (500–539)	
Chronic Obstructive Pulmonary Dz	722.40 ± 246.05	15.32 (<0.0001)*	868 (492–901)	18.93 (0.008)*
Heart Failure	499.60 ± 14.60		498 (495–505)	

Stroke	302.60 ± 16.74		304 (287–313)	
Quebec				
Acute Myocardial Infarction	252.40 ± 11.28		256 (246–261)	
Asthma	397.40 ± 68.27		425 (343–446)	
Chronic Obstructive Pulmonary Dz	684.80 ± 101.57	53.02 (<0.00001)*	707 (600–740)	22.40 (0.0002)*
Heart Failure	506.00 ± 7.45		506 (502–508)	
Stroke	267.40 ± 9.61		271 (259–272)	
Alberta				
Acute Myocardial Infarction	193.00 ± 42.92		221 (155–224)	
Asthma	474.20 ± 82.44		519 (415–525)	
Chronic Obstructive Pulmonary Dz	863.80 ± 317.75	15.58 (<0.00001)*	1061 (553–1087)	20.95 (0.0003)*
Heart Failure	600.60 ± 35.91		608 (604–624)	
Stroke	294.20 ± 30.03		307 (267–312)	
British Columbia				
Acute Myocardial Infarction	174.80 ± 22.42		190 (155–191)	
Asthma	466.60 ± 72.79		474 (409–500)	
Chronic Obstructive Pulmonary Dz	896.60 ± 305.32	19.26 (<0.00001)*	1023 (574–1094)	21.97 (0.0002)*
Heart Failure	604.60 ± 11.26		608 (596–612)	
Stroke	321.80 ± 18.38		322 (304–337)	
Saskatchewan				
Acute Myocardial Infarction	203.60 ± 32.51		221 (177–224)	
Asthma	447.60 ± 67.89		446 (445–474)	
Chronic Obstructive Pulmonary Dz	837.80 ± 165.28	39.76 (<0.00001)*	915 (715–931)	22.55 (0.0002)*
Heart Failure	568.80 ± 69.61		583 (504–607)	
Stroke	295.40 ± 31.50		307 (264–317)	

*Statistically Significant ($p < 0.05$); **SD**=Standard Deviations; **IQR**=Inter-quartile Range

Figure 1 shows that overall, all five conditions demonstrated a general declining trend in incidence rates over the study period, although the magnitude and patterns of decline varied across conditions. Chronic obstructive pulmonary disease (COPD) consistently had the highest incidence rates throughout the study, starting at above 1,000 per 100,000 in 2010 and showing a marked reduction over time to below 600 per 100,000 by 2021. A

slight increase was observed between 2022 and 2023, suggesting a recent uptick in COPD cases. Heart failure maintained relatively stable incidence rates across the years, with only a modest decline from around 580 per 100,000 in 2010 to approximately 540 per 100,000 in 2021. Similar to COPD, a minor increase was seen after 2021.

Asthma showed a steady decline from over 500 per 100,000 in 2010 to its lowest point

around 2021, followed by a rebound in 2022–2023. This suggests possible fluctuations in environmental or healthcare-related factors influencing asthma incidence.

Stroke incidence remained comparatively stable, with a gradual downward slope from about 300 per 100,000 in 2010 to approximately 270 per 100,000 in 2023,

indicating slower changes relative to other conditions.

Acute myocardial infarction (AMI) recorded the lowest incidence rates among the five conditions. It showed a consistent downward trend, reducing from about 220 per 100,000 in 2010 to below 180 per 100,000 by 2023, with no evidence of major fluctuations.

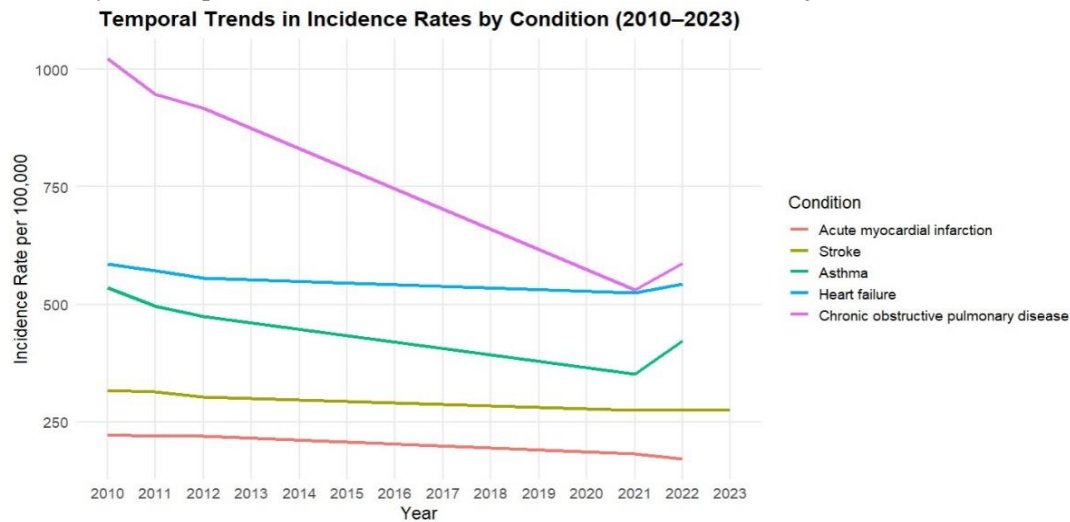


Figure 1. Temporal Trends in Incidence Rates of Chronic Cardiovascular and Respiratory Conditions, Canada, 2010–2023

The pattern in Figure 2 shows marked variability over time, with alternating periods of decline, stability, and sharp increases. Between 2010 and 2012, the total area burned dropped substantially, from over 350,000 hectares in 2010 to below 200,000 hectares in 2012, indicating a significant early decline. From 2013 to 2021, there was a gradual but steady increase, with total burned area rising from just

under 200,000 hectares in 2012 to nearly 450,000 hectares in 2021.

A noticeable dip occurred in 2022, when the total area burned fell sharply to its lowest point in the observed period, under 150,000 hectares. However, this was immediately followed by a dramatic surge in 2023, when the total burned area exceeded 1.6 million hectares, the highest recorded across the entire study period.

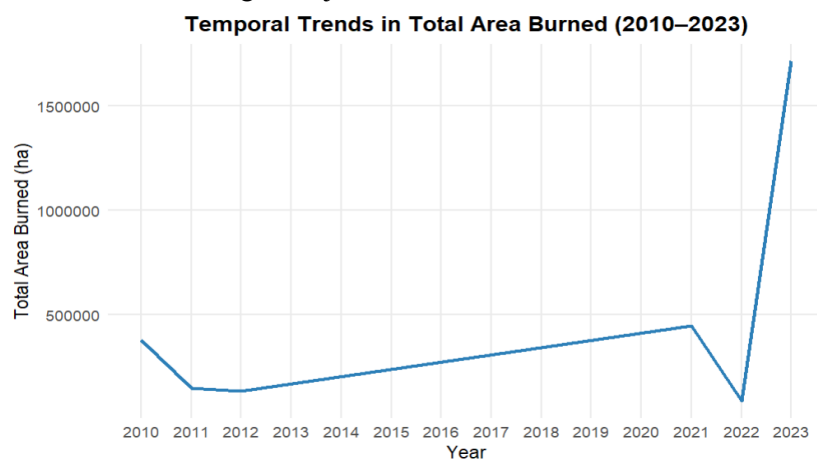


Figure 2. Temporal Trends in the Total Area Burned (2010–2023)

Figure 3 presents a heat map visualization of the total area burned across provinces between 2010 and 2023.

The colour intensity reflects the scale of burned area, ranging from lighter shades (smaller areas burned) to darker shades (larger areas burned).

The results show strong inter-provincial and temporal variation. Quebec stands out with the darkest shade in 2023, indicating the largest area burned nationally, surpassing 4 million hectares. British Columbia and Alberta also showed very dark shading in 2023, reflecting substantial wildfire activity exceeding 1 million hectares each. In contrast, Ontario and

Saskatchewan exhibited lighter shades in 2023, indicating comparatively smaller but still significant burned areas.

Earlier years reveal more moderate wildfire patterns across provinces. For instance, Saskatchewan had relatively darker shading in 2010–2011, consistent with its historically higher burned areas during that period. Quebec displayed recurrent moderate-to-dark shading throughout the timeline, reflecting frequent large-scale wildfires, even before the 2023 spike. Ontario, in contrast, was characterized by lighter shades across most years, signifying smaller areas burned relative to western provinces.

Heat Map of Total Area Burned by Province (2010–2023)

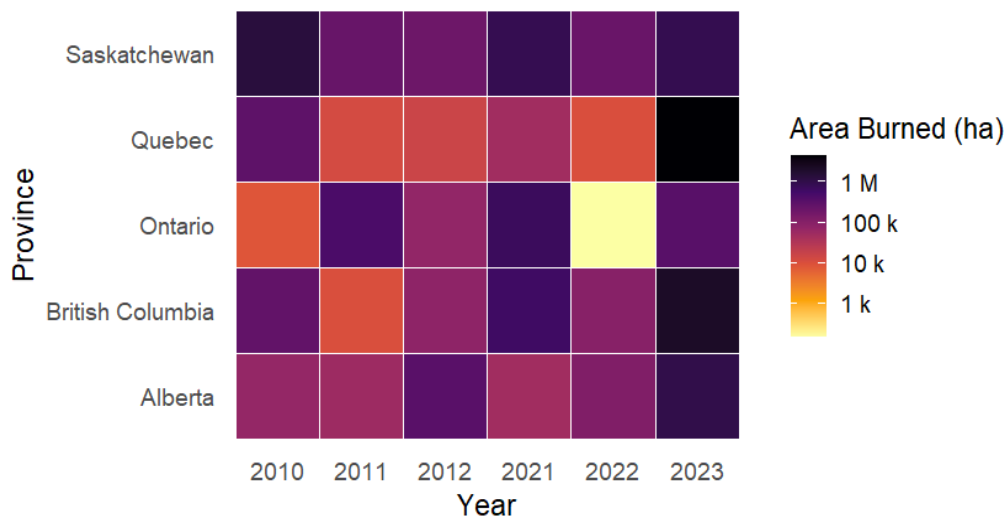


Figure 3. Heat Maps showing the Total Area Burned by Provinces (2010-2023)

Table 3 presents the correlation analysis between wildfire activity (measured as total area burned and number of fires) and high-risk air quality days (HRD) across Canadian provinces between 2010 and 2023.

The correlation between area burned and HRD was weakly positive ($r = 0.214$), indicating that larger burned areas were modestly associated with more high-risk days. However, this association did not reach statistical significance ($p = 0.257$). This suggests that while severe fire seasons tended to coincide with periods of poor air quality, the relationship was inconsistent, likely influenced

by meteorological dispersion, topography, and smoke transport across provincial boundaries.

The relationship between the number of fires and HRD was similarly weak ($r = 0.190$) and statistically non-significant ($p = 0.841$). The wide confidence interval further illustrates the lack of precision in this association. This indicates that fire frequency alone was not a reliable predictor of the duration of poor air quality conditions. In other words, a high number of smaller or less intense fires did not necessarily translate into more high-risk days compared to a few but larger and more intense wildfire events.

Table 3. Correlation Between Number of Fires and High-Risk Days (HRD) (2010–2023)

Province	Pearson's Correlational Coefficient, r, (Area Burned vs. HRD [95%CI])	P-Value	Pearson's Correlational Coefficient, r, (Number of Fires vs. HRD [95%CI])	P-Value
All provinces	0.214 (weak positive) [0.00-0.00]	0.257	0.190 (weak positive) [-0.820-2.46]	0.841

Table 4. presents the provincial comparison of average fine particulate matter (PM_{2.5}) concentrations between 2010 and 2023.

In Alberta, the mean PM_{2.5} concentration was $8.64 \pm 3.64 \mu\text{g}/\text{m}^3$, with median values ranging between 6.88–8.37 $\mu\text{g}/\text{m}^3$. Levels rose markedly from 8.37 $\mu\text{g}/\text{m}^3$ in 2010 to 15.93 $\mu\text{g}/\text{m}^3$ in 2023, representing the steepest proportional increase (+90%) among all provinces.

British Columbia recorded a relatively lower mean of $6.11 \pm 0.90 \mu\text{g}/\text{m}^3$, with a modest increase from 5.81 $\mu\text{g}/\text{m}^3$ in 2010 to 7.32 $\mu\text{g}/\text{m}^3$ in 2023 (+26%). While lower in magnitude compared to Alberta and Saskatchewan, this still reflects a consistent upward trajectory, coinciding with the province's high wildfire frequency.

In Ontario, the average PM_{2.5} was $6.69 \pm 1.19 \mu\text{g}/\text{m}^3$, with concentrations increasing

from 5.79 $\mu\text{g}/\text{m}^3$ in 2010 to 8.93 $\mu\text{g}/\text{m}^3$ in 2023 (+54%). Although the ANOVA and Kruskal–Wallis tests did not indicate statistically significant differences over time ($p>0.05$), the increase points to a gradual but steady deterioration in air quality.

Quebec exhibited a higher baseline, with a mean PM_{2.5} of $7.68 \pm 0.73 \mu\text{g}/\text{m}^3$, rising slightly from 7.83 $\mu\text{g}/\text{m}^3$ in 2010 to 8.50 $\mu\text{g}/\text{m}^3$ in 2023 (+8.5%). While the overall percentage change was modest compared to other provinces, Quebec remained one of the provinces with consistently elevated PM_{2.5} levels throughout the period.

Saskatchewan recorded an average PM_{2.5} concentration of $8.14 \pm 3.82 \mu\text{g}/\text{m}^3$, increasing sharply from 6.19 $\mu\text{g}/\text{m}^3$ in 2010 to 15.28 $\mu\text{g}/\text{m}^3$ in 2023 (+147%), the largest relative increase observed.

Table 4. Provincial Comparison of Average PM_{2.5} (2010–2023)

Provinces	Mean Number of Fires (+SD)	ANOVA (p-value)	Median Number of Fires (IQR)	Kruskal-Wallis (p-value)	Number of Fires in 2010	Number of Fires in 2023	% Change (2010–2023)	Trend Direction
Alberta	8.64 ± 3.64		7.18 (6.88–8.37)		8.37	15.93	0.90	↑ Increasing
British Columbia	6.11 ± 0.90		6.19 (5.20–6.69)		5.81	7.32	0.26	↑ Increasing
Ontario	6.69 ± 1.19	1.06 (0.395)	6.25 (5.89–7.01)	7.02 (0.135)	5.79	8.93	0.54	↑ Increasing
Quebec	7.68 ± 0.73		7.90 (7.00–8.16)		7.83	8.50	0.085	↑ Increasing
Saskatchewan	8.14 ± 3.82		6.66 (5.59–9.47)		6.19	15.28	1.47	↑ Increasing

*Statistically Significant ($p<0.05$); **SD**=Standard Deviations; **IQR**=Inter-quartile Range

Table 5 presents the results of the correlation analysis examining the relationship between wildfire smoke exposure indicators—average PM_{2.5} concentrations and high-risk air quality days (HRD), and the incidence rates of cardiovascular and respiratory conditions across all Canadian provinces during the period 2010–2023. The correlation between average

PM_{2.5} concentrations and incidence rates was weakly negative ($r = -0.106$, $p = 0.238$), and the wide confidence interval (95% CI: -0.6357 to 0.1593).

Similarly, the correlation between high-risk air quality days (HRD) and incidence rates was also weak and negative ($r = -0.042$, $p = 0.643$), again failing to reach statistical significance.

Table 5. Correlation Between Wildfire Smoke Exposure Indicators (PM_{2.5}, high-risk days) and Incidence Rates of Cardiovascular and Respiratory Conditions (2010–2023)

Province	Pearson's Correlational Coefficient, r, (PM _{2.5} vs. Incidence rates) [95% CI]	P-Value	Pearson's Correlational Coefficient, r, (High risk days vs. Incidence rates) [95% CI]	P-Value
All provinces	-0.106 (weak negative) [-63.57-15.93]	0.238	-0.042 (weak negative) [-0.345-0.214]	0.643

Figure 4 illustrates the relationship between average PM_{2.5} concentrations ($\mu\text{g}/\text{m}^3$) and the incidence rates of cardiovascular and respiratory conditions across Canadian provinces between 2010 and 2023. Each point represents provincial-level observations over the study period, with the red dashed line depicting the fitted linear regression trend and the grey shaded area denoting the 95% confidence interval around the estimate. The

scatter plot reveals a weak and slightly negative association between PM_{2.5} concentrations and incidence rates. As PM_{2.5} levels increase, the incidence rate of cardiorespiratory conditions shows a marginal downward trend. However, the dispersion of points around the regression line is wide, and there is no clear clustering pattern, suggesting substantial variability across provinces and years.

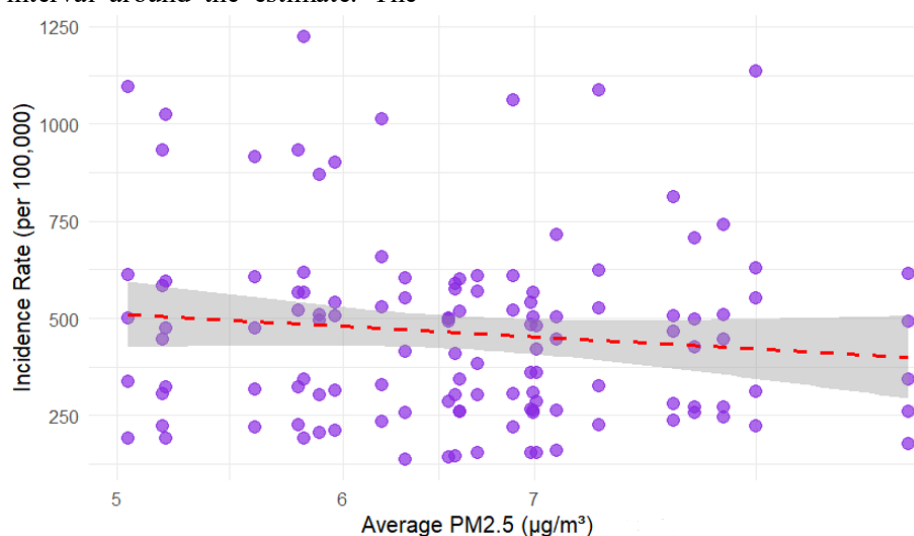


Figure 4. Scattered Plot of PM_{2.5} and the Incidence Rates of Cardiovascular and Respiratory Conditions in all Provinces (2010-2023)

Discussion

The sociodemographic distribution of this study indicated that the age category of 20+, which accounted for more than 40% of the study population, had the largest number of cases of exposure to wildfire smoke across the five selected provinces. This could be as a result of this age category being an active population that is more engaged in activities that expose them to wildfire smoke, such as bush burning, biomass burning, farming, etc. The sociodemographic gap plays a pivotal role in the formation of health complications, which aligns with previous research [15], revealing that repeated exposure to wildfire PM_{2.5} could have an adverse effect in the development of respiratory function in children, which suggests that infant exposure to ambient wildfire smoke correlates with significantly reduced lung functions later in adolescence, that is, early exposure to wildfire smoke is associated with immune dysregulation and lung function decrements in adolescence [15].

Across all provinces, the incidence rates of the five major conditions studied, acute myocardial infarction, stroke, asthma, chronic obstructive pulmonary disease (COPD), and heart failure, generally demonstrated a downward trend between 2010 and 2023. COPD consistently exhibited the highest incidence rate, followed by asthma, while myocardial infarction had the lowest. These declines, although varying by condition and province, suggest improvements in disease prevention, diagnosis, and management strategies over time [16]. The findings revealed that the decline was most prominent in COPD and asthma cases, both of which are highly sensitive to environmental triggers such as air pollution and wildfire smoke. The downward trajectory may reflect the cumulative effect of improved public awareness, smoking cessation policies, and healthcare interventions. The slight resurgence in COPD and asthma rates observed in 2022–2023 could, however, indicate renewed exposure to environmental

pollutants following severe wildfire events during those years. Similar cyclical patterns have been reported in prior research, emphasizing that periods of intensified wildfire activity often correspond with temporary reversals in respiratory health gains [17, 18].

The analysis of wildfire activity revealed a complex and dynamic pattern across the provinces. Overall, wildfire events exhibited significant inter-annual variability, with both the total area burned and the number of fires fluctuating widely over the study period. Alberta, British Columbia, and Quebec recorded sharp increases in total area burned, particularly in 2023, which marked the most severe wildfire season within the observation window. Saskatchewan, in contrast, experienced a slight decline, while Ontario showed a moderate but steady increase. The findings support earlier observations [19], which emphasized that human activities and climate variability have significantly altered the temporal and spatial patterns of wildfire occurrence. The marked spikes in wildfire activity in 2023 align with documented national wildfire crises that produced transboundary smoke plumes, affecting not only local but also regional air quality. These patterns demonstrate the interplay between environmental, meteorological, and anthropogenic factors in shaping wildfire dynamics across Canada. All provinces demonstrated upward trends in PM_{2.5} concentrations between 2010 and 2023, though with differing magnitudes. Alberta recorded the steepest rise, reaching the highest concentrations in 2023, while British Columbia and Ontario showed moderate increases. Saskatchewan's PM_{2.5} levels nearly doubled within the same period, reflecting its vulnerability to large-scale wildfire smoke exposure. Conversely, Quebec exhibited relatively stable PM_{2.5} levels with only modest increases. The findings further suggested that escalating wildfire activity is a key driver of deteriorating air quality, particularly in provinces with extensive forest coverage and

frequent fires. However, PM_{2.5} levels are also influenced by industrial emissions and meteorological conditions, such as wind direction and temperature inversions, that affect pollutant dispersion. These results align with the conclusions of a previous report [18], which reported that wildfire-related PM_{2.5} exposure varies significantly depending on topography and urban proximity.

High-risk air quality days also showed heterogeneous patterns across provinces. Ontario and British Columbia experienced significant increases in the number of such days, while Alberta and Saskatchewan recorded irregular fluctuations. The strong rise in high-risk days underscores the cumulative impact of recent extreme wildfire seasons. Nevertheless, the weak correlation between wildfire activity and air quality indicators suggests that the intensity and duration of fires, rather than their frequency alone, are more influential in shaping exposure levels [20]. The correlation analyses further showed weak and statistically non-significant associations between wildfire smoke exposure indicators (PM_{2.5} and high-risk air quality days) and the incidence rates of cardiovascular and respiratory diseases. Specifically, the relationship between PM_{2.5} and disease incidence was slightly negative ($r = -0.106$, $p = 0.238$), while the association between high-risk air quality days and incidence rates was also negative but negligible ($r = -0.042$, $p = 0.643$). These findings indicate that short-term variations in wildfire smoke exposure did not correspond to observable increases in annual disease incidence during the study period. This weak correlation suggests that the health impacts of wildfire smoke may be delayed, cumulative, or localized rather than immediately reflected in annual population-level statistics. Such temporal lags between exposure and disease manifestation have been highlighted in an earlier report [21], which agrees that short-term exposures tend to affect acute symptoms more than chronic incidence rates. The results also imply that other factors,

such as aging, pre-existing conditions, occupational exposures, and healthcare disparities, may confound or obscure the direct association between wildfire smoke and chronic disease outcomes.

The findings highlight several implications for environmental health governance in Canada. The uneven distribution of wildfire impacts underscores the need for province-specific strategies that consider both environmental vulnerability and population density. While the overall disease incidence has declined, the increasing frequency of high-risk air quality days indicates growing exposure potential, particularly for vulnerable groups such as children, older adults, and individuals with pre-existing respiratory conditions.

The results also suggest that policy emphasis should shift from general surveillance to integrated environmental–health data systems capable of linking specific exposure events to health outcomes in real time. Enhanced predictive modeling using artificial intelligence and satellite-based monitoring could improve early warning systems for wildfire smoke episodes. Moreover, targeted health education, community preparedness, and equitable access to healthcare in remote and local communities remain critical to mitigating long-term impacts.

Future studies should explore the temporal lag effects between wildfire smoke exposure and disease manifestation using finer temporal resolution data (e.g., monthly or weekly). Incorporating meteorological variables, population mobility patterns, and socioeconomic indicators would enhance model precision. Additionally, employing spatial regression or exposure modeling approaches could help delineate localized health impacts more accurately. Such efforts would deepen understanding of the complex interplay between environmental hazards and population health in the context of climate change.

Conclusions

The findings indicate that wildfire smoke exposure, though an important environmental health concern, was not a statistically significant predictor of the incidence of chronic cardiovascular and respiratory diseases across the provinces studied. This does not negate the potential health risks of wildfire smoke but rather underscores the complexity of exposure–disease relationships in population-level data.

The study highlights that health outcomes are influenced by multiple interacting determinants, ranging from biological susceptibility and healthcare access to environmental policies and meteorological factors. The apparent absence of strong statistical associations may reflect data aggregation, temporal lags, and unmeasured confounding. Nonetheless, the evidence supports the need for proactive environmental monitoring and targeted interventions to reduce exposure during high-risk wildfire periods.

Recommendations

- 1. Integration of Environmental and Health Data Systems:** Health and environmental agencies should establish interoperable systems linking health surveillance with environmental monitoring data. Such integration would enable the real-time tracking of health effects associated with specific exposure events and facilitate evidence-based interventions.
- 2. Equity in Healthcare Access:** Governments should prioritize improving healthcare accessibility among vulnerable and rural populations, particularly Indigenous communities, who may experience disproportionate exposure and limited healthcare infrastructure during wildfire events.
- 3. Enhancement of Air Quality Monitoring and Predictive Modeling:** Expansion of air quality monitoring networks and adoption of remote sensing, artificial

intelligence, and geospatial modeling can enhance early detection of wildfire smoke and support targeted public health responses.

- 4. Public Health Education and Risk Communication:** Health authorities should intensify public education campaigns emphasizing the risks of air pollution and the protective measures that can reduce exposure, including the use of air filtration systems and personal protective equipment.
- 5. Investment in Research and Climate Adaptation Strategies:** Further research should focus on longitudinal, individual-level analyses to assess delayed and cumulative health effects of wildfire smoke exposure. Policy frameworks should incorporate climate adaptation measures aimed at mitigating wildfire risks through sustainable land management and urban planning. And also, there is a need for the government to strengthen regulations and implement more stringent guidelines to regulate the emission of this fine particulate (PM_{2.5}).

Conflict of Interest

The authors hereby declare that there is no conflict of interest.

Financial Disclosure

This study has received no financial support.

Data Availability

The data for this study is available on direct request from the authors

Authors' Contribution

- **Conceptualization:** Chukwubuikem Cornelius Okafor, Afusat Adesina.
- **Study Design:** Chukwubuikem Cornelius Okafor, Afusat Adesina.
- **Definition of intellectual content:** Chukwubuikem Cornelius Okafor, Afusat Adesina.

- Literature Search: Chukwubuikem Cornelius Okafor, Afusat Adesina.
- Data Acquisition: Chukwubuikem Cornelius Okafor, Afusat Adesina.
- Data Analysis: Chukwubuikem Cornelius Okafor, Afusat Adesina.
- Manuscript Preparation: Chukwubuikem Cornelius Okafor, Afusat Adesina.

- Manuscript editing: Chukwubuikem Cornelius Okafor, Afusat Adesina.

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References

- [1]. Franchini, M., & Mannucci, P. M., 2012, Air pollution and cardiovascular disease. *Thrombosis Research*, 129(3), 230–234. <https://doi.org/10.1016/j.thromres.2011.10.030>.
- [2]. Canadian Interagency Forest Fire Centre. 2024, *Annual report 2024*. <https://ciffc.ca>.
- [3]. Delaney, E. J., 2023, The chemistry of fires at the wildland–urban interface. *CHOICE: Current Reviews for Academic Libraries*, 60(10), 1014–1015.
- [4]. United States Environmental Protection Agency, 2024, *Particulate matter (PM) basics*. <https://www.epa.gov/pm-pollution>.
- [5]. Seinfeld, J. H., & Pandis, S. N., 1998, Atmospheric chemistry and physics: From air pollution to climate change (2nd ed.). *John Wiley & Sons*.
- [6]. Liu, J. C., Pereira, G., Uhl, S. A., Bravo, M. A., & Bell, M. L., 2015, A systematic review of the physical health impacts from non-occupational exposure to wildfire smoke. *Environmental Research*, 136, 120–132. <https://doi.org/10.1016/j.envres.2014.10.015>.
- [7]. Brook, R. D., Rajagopalan, S., Pope, C. A., Brook, J. R., Bhatnagar, A., Diez-Roux, A. V., et al., 2010, Particulate matter air pollution and cardiovascular disease: An update to the scientific statement from the American Heart Association. *Circulation*, 121(21), 2331–2378. <https://doi.org/10.1161/CIR.0b013e3181d8bec>.
- [8]. Jones, C. G., Rappold, A. G., Vargo, J., Cascio, W. E., Kharrazi, M., McNally, B., et al., 2020, Out-of-hospital cardiac arrests and wildfire-related particulate matter during 2015–2017 California wildfires. *Journal of the American Heart Association*, 9(8), e014125. <https://doi.org/10.1161/JAHA.119.014125>
- [9]. Jain, P., Barber, Q. E., Taylor, S. W., Whitman, E., Castellanos Acuna, D., Boulanger, Y., et al., 2024, Drivers and impacts of the record-breaking 2023 wildfire season in Canada. *Nature Communications*, 15, 6764. <https://doi.org/10.1038/s41467-024-51154-7>
- [10]. Reid, P. T., & Innes, J. A., 2014, Respiratory diseases. In B. R. Walker, N. R. Colledge, S. H. Ralston, & I. Penman (Eds.), *Davidson's principles and practice of medicine* (22nd ed., pp. 661–730). *Elsevier*.
- [11]. Canadian Wildland Fire Information System. (n.d.). *Data Mart*. <https://cwfis.cfs.nrcan.gc.ca/datamart>
- [12]. [Canadian Wildland Fire Information System. (n.d.). *NBAC Downloads*. <https://cwfis.cfs.nrcan.gc.ca/downloads/nbac/>
- [13]. Environment and Climate Change Canada. (n.d.). *Air quality indicators*. <https://www.canada.ca/en/environment-climate-change/services/environmental-indicators/air-quality.html>
- [14]. Public Health Agency of Canada. (n.d.). Chronic Disease and Surveillance System (CCDSS) data tool. <https://health-infobase.canada.ca/ccdss/data-tool/>
- [15]. Black, C., Gerriets, J. E., Fontaine, J. H., Harper, R. W., Kenyon, N. J., Tablin, F., et al., 2017, Early life wildfire smoke exposure is associated with immune dysregulation and lung function decrements in adolescence. *American Journal of Respiratory Cell and Molecular Biology*, 56(5), 657–666. <https://doi.org/10.1165/rcmb.2016-0380OC>.

- [16]. Haydon, E., Roerecke, M., Giesbrecht, N., Rehm, J., & Kobus-Matthews, M., 2006, Chronic disease in Ontario and Canada: Determinants, risk factors and prevention priorities. *Ontario Chronic Disease Prevention Alliance*.
- [17]. Dai, H., Younis, A., Kong, J. D., Bragazzi, N. L., and Wu, J., 2021, Wildfire smoke exposure and health outcomes: A review. *Environmental Research*, 198, 111239. <https://doi.org/10.1016/j.envres.2021.111239>
- [18]. Yu, M., Zhang, S., Ning, H., Li, Z., & Zhang, K., 2024, Assessing the 2023 Canadian wildfire smoke impact in the Northeastern US: Air quality, exposure, and environmental justice. *Science of the Total Environment*, 926, 171853. <https://doi.org/10.1016/j.scitotenv.2024.171853>
- [19]. Campos-Ruiz, R., Parisien, M. A., & Flannigan, M. D., 2018, Temporal patterns of wildfire activity in areas of contrasting human influence in the Canadian boreal forest. *Forests*, 9(4), 159. <https://doi.org/10.3390/f9040159>
- [20]. Renouf, R., 2021, Vancouver's air quality worst of any 'major city' in the world due to wildfire smoke, heat. *CityNews*. <https://vancouver.citynews.ca/2021/08/13/vancouver-air-quality-wqorst-wildifres/>
- [21]. Henderson, S. B., Brauer, M., & Vedanthan, R., 2022, Wildfire smoke as a global health issue. *The Lancet Planetary Health*, 6(4), e302–e313. [https://doi.org/10.1016/S2542-5196\(22\)00044-0](https://doi.org/10.1016/S2542-5196(22)00044-0).

From Ward to Policy: Nurses' Views on Breastmilk Donation and Banking in Selected Hospitals in Bono Region, Ghana

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Abstract

Breast milk donation and banking provide lifesaving nutrition for preterm and vulnerable infants. However, the success of such programs depends largely on the knowledge, perceptions, and acceptability among frontline health professionals. This study assessed nurses' views on breast milk donation and banking in Bono regional hospitals, Ghana. A cross-sectional descriptive study was conducted among nurses across three selected referral hospitals in the Bono region of Ghana. Data were collected using structured questionnaires covering knowledge, perceptions, and acceptability of breast milk donation and banking. Four hundred and twenty-two (422) nurses were randomly selected for data collection. Descriptive and inferential statistics were used to analyze responses, with associations tested between socio-demographic factors and acceptability. Nurses demonstrated moderate knowledge of breast milk donation, with notable gaps in conceptual understanding and safety protocols. Perception toward breastmilk donation and banking were neutral, with recognition of donor milk's role in improving neonatal survival, though concerns about affordability and disease transmission persisted. Acceptability was high, with many nurses expressing willingness to donate or encourage donation. Age, workplace, and religion significantly influenced acceptance levels. The study concludes that while nurses in Bono regional hospitals show readiness to support breast milk donation and banking, targeted education, cultural and religious engagement, clear safety and financing frameworks are needed to address existing concerns.

Keywords: Acceptability, Breast Milk Banking, Donation, Ghana, Nurses' Perception.

Introduction

Breast milk remains the safest and most protective source of nutrition for infants, particularly during the first 6 months of life, as it provides the full complement of nutrients, along with immunological and developmental benefits vital for child survival and growth [2]. Beyond meeting nutritional needs, its non-nutrient components such as immunoglobulins and lactoferrin support intestinal maturation, immunity, and protection against infectious and

inflammatory diseases [1]. The World Health Organization (WHO) recommends exclusive breastfeeding for the first six months of life and continued breastfeeding with complementary foods up to two years or beyond [2]. Exclusive breastfeeding (EBF) is one of the most effective health behaviours to reduce infant mortality and enhance health outcomes, yet global rates remain suboptimal, with only 38% of mothers achieving six months of exclusive

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breastfeeding and 58% sustaining breastfeeding to two years [3].

Although nearly all women report ever breastfeeding in Ghana, exclusive breastfeeding and appropriate complementary feeding practices remain inconsistent across regions, contributing to malnutrition, stunting, diarrheal diseases, and high neonatal mortality [4]. These challenges highlight the need for safe, alternative feeding options when mothers are unable to provide sufficient milk due to medical, psychological, or socioeconomic constraints [5]. While informal milk sharing has historically been practiced, particularly among women with close social ties, the practice carries risks when not screened or regulated, as it may expose infants to transmissible infections such as HIV, hepatitis, and syphilis [6]. The best solution endorsed by global health authorities is donor human milk banking, which involves structured systems of collection, screening, processing, and distribution of breast milk to infants in need [7].

Donor human milk banking has demonstrated remarkable achievements in improving infant survival worldwide. For instance, Brazil's national human milk banking network contributed to a 73% reduction in neonatal mortality between 1990 and 2013 [8]. African countries such as Kenya and South Africa have also piloted milk banks despite challenges of infectious disease burden and sociocultural concerns [9]. These successes underline the potential of donor milk banking to reduce preventable neonatal deaths and promote child health [10]. However, in low and middle-income countries such as Ghana, implementation is still at an early stage, with significant barriers to acceptance due to limited awareness, cultural and religious beliefs, mistrust of health systems, and concerns about safety and hygiene [11].

While exclusive breastfeeding is widely promoted in Ghana, the absence of formal milk banking systems means infants deprived of

maternal milk often rely on suboptimal alternatives such as early introduction of porridges, semisolids, or infant formulas, which can increase risks of infection and malnutrition [12]. A safe and regulated donor breast milk bank presents the most viable and protective alternative [13]. Yet, successful adoption depends on acceptability, particularly among healthcare providers who are both advocates and implementers of maternal and newborn health policies [14]. Nurses, as frontline caregivers in maternity and neonatal wards, play a critical role in shaping public perceptions and ensuring adherence to safe infant feeding practices [2]. Despite their central role, little is known about nurses' knowledge, perceptions, willingness to accept breast milk donation and banking in Ghana, and the association between sociodemographic factors and the acceptability of donor breast milk banking [7]. Without this understanding, efforts to establish donor milk banks risk resistance and underutilization, which may compromise their potential benefits [12].

This study, therefore, seeks to bridge that gap by exploring nurses' views on breast milk donation and banking in Bono regional hospitals. Specifically, it examines nurses' knowledge, perceptions, acceptability and association between sociodemographic factors and acceptability of donor breastmilk banking, thereby generating evidence to inform both practice and policy.

The novelty of this work lies in situating nurses' voices at the center of discourse on donor milk banking in Ghana, moving the conversation 'from ward to policy.' By doing so, the study contributes to understanding the feasibility of implementing milk banking in a culturally diverse setting while aligning with Sustainable Development Goals 2 and 3 on nutrition, health, and wellbeing [15]. Ultimately, findings will provide actionable insights to guide policy formulation, capacity

building, and strategies to improve neonatal survival in Ghana.

Materials and Methods

Study Design

The study was a cross-sectional study conducted among health workers in the Bono region of Ghana. It aimed to document their views and perceptions regarding the acceptability of breast milk donation and banking. Health workers were selected as the study population because they play a critical role in maternal and child health service delivery and are key influencers in shaping community attitudes and practices toward breast milk banking. Understanding their perspectives is essential for assessing the feasibility of introducing or scaling up human milk banking initiatives in Ghana, as their support and acceptance are pivotal for successful implementation and public trust.

Study Area

The study was conducted in three health facilities in the Bono Region of Ghana; Sunyani Teaching Hospital, Sunyani Municipal Hospital, and Tain District Hospital, Nsawkaw. These facilities were selected because they serve as referral centres under the Ghana Health Service and have a high population of nurses and midwives, making them suitable for reflecting the target population. Sunyani Teaching Hospital, established in 1927, has been transformed into a modern tertiary facility with a 330-bed capacity, 15 wards, and a 24-hour emergency unit, serving as the main referral hospital for the region. Sunyani Municipal Hospital, also established in 1927 and later upgraded to municipal status in 2004, has a 95-bed capacity and a staff strength of over 800, providing both general and specialized services including medical, surgical, obstetric, pediatric, diabetic, asthma, eye, ENT, and dental care. Tain District Hospital, which began as a health center in

1965 and was upgraded in 2010, operates as a referral facility for the Tain district with a 32-bed capacity, providing services such as diabetes, hypertension, physiotherapy, and eye care.

Study Population

The study population consisted of 1,128 nurses drawn from three major hospitals in the Bono region of Ghana. These hospitals were purposively selected because they serve as key referral centres and represent different levels of the healthcare system, thus providing a comprehensive overview of nurses' experiences and perspectives. Nurses were chosen as the study population because they constitute the largest proportion of the healthcare workforce and are directly involved in maternal, neonatal, and child health services, where breast milk donation and banking are most relevant.

Their close interactions with mothers and infants place them in a unique position to influence attitudes and practices related to breastfeeding and human milk banking. Documenting their views, therefore, provide valuable insight into the potential facilitators and barriers to implementing breast milk donation and banking within healthcare settings. The inclusion of a large and diverse group of nurses from multiple hospitals also enhances the generalizability of the findings and ensures that the results reflect a range of institutional and professional perspectives.

Sample Size Determination

The sample size for the study was determined using Yamane's formula for sample size calculation [16]. This formula is commonly applied in survey research when the total population size is known, as it provides a simplified yet statistically sound method for determining an appropriate sample size. Yamane's formula takes into account the desired level of precision and the acceptable

margin of error, thereby ensuring that the selected sample adequately represents the target population.

This approach was appropriate for the current study because the total population of nurses (1,128) across the three hospitals was known. Using Yamane's formula allowed the researchers to determine a manageable yet statistically reliable sample size that balances accuracy with practical considerations such as time and resource constraints. By applying this method, the study a sample size of 422 was calculated.

Data Collection Tool

Data collection tool was a structured questionnaire. The questionnaire comprised of sections covering socio-demographic characteristics, knowledge, perceptions, and acceptability of breastmilk donation and banking. Responses were measured using binary, categorical, and Likert-type scales.

Data Analysis

Collected data were cleaned, coded, and analyzed using the Statistical Package for the

Social Sciences (SPSS) version 26. Descriptive statistics such as frequencies, percentages, means, standard deviation and 95% confidence interval were used to summarize the data. Composite mean scores were computed for each domain (knowledge, perception and acceptability), and interpretation benchmarks were applied to classify responses as high/positive, neutral/average, or low/negative. Association between respondents' sociodemographic factors and acceptability of donor breastmilk banking employed Chi-square test of independence with $p\text{-value} \leq 0.05$ as statistically significant. Ethical approval for the study was obtained from the Kwame Nkrumah University of Science and Technology Ethics Review Board, Ghana.

Results

Sociodemographic characteristics of Respondents

Table 1 below shows respondents sociodemographic characteristics.

Table 1. Sociodemographic Characteristics (N= 422)

Sociodemographic characteristics of Respondents	Frequency (N=422)	Percent (%)
Age (in years)		
20-29 years	188	44.5
30-39 years	222	52.7
40-49 year	12	2.8
Mean $\pm$ SD 33.33% $\pm$ 0.27		
Gender		
Female	334	79.2
Male	88	20.8
Health facility		
Sunyani Teaching Hospital	261	61.8
Sunyani Municipal Hospital	97	23.0
Tain District Hospital	64	15.2
Professional category		
RGN	224	53.1
Midwife	111	26.3
Enrolled Nurse (EN)	72	17.1

Community Health Nurse (CHN)	15	3.5
Educational attainment		
Masters	2	0.5
Degree	87	20.6
Diploma	255	60.4
Certificate	78	18.5
Marital Status		
Married	192	45.5
Single	212	50.2
Widow	18	4.3
Number of children		
0	246	58.3
1-2	126	29.9
3-4	49	11.6
≥5	1	0.2
Religion		
Christian	290	68.7
Muslim	108	25.6
Traditional	15	3.6
Others	9	2.1
Tribe of respondent		
Ashanti	195	46.2
Bono	203	48.1
Others	24	5.7

A total of 422 respondents participated in the study representing a 100% response rate. The respondents were aged between 20 and 49 years, with a mean age of 33.33 ± 0.27 years. Majority (52.7%) were within the age group 30-39 years, indicating a predominantly youthful workforce.

A significant majority of the respondents were females (79.2%), while males constituted (20.8%), reflecting the female-dominated nature of the Nursing and Midwifery profession in Ghana. Most respondents (61.8%) worked at Sunyani Teaching Hospital, followed by Sunyani Municipal Hospital (23.0%) and Tain District Hospital (15.2%). Over half (53.1%) were Registered General Nurses (RGNs), (26.3%) were midwives, (17.1%) enrolled nurses, and (3.5%) community health nurses. In terms of educational attainment, (60.4%) held

diploma qualifications, (20.6%) had degree, (18.5%) had certificate, and only (0.5%) had a master's degree. Marital status showed (50.2%) single, (45.5%) married, and (4.3%) widowed. Regarding family size, (58.3%) had no children, (29.9%) had 1-2 children, (11.6%) had 3-4 children, and just (0.2%) had five or more. Christianity was the dominant religion (68.7%), followed by Islam (25.6%), traditional beliefs (3.6%), and other faiths (2.1%). Ethnically, respondents were mainly Bono (48.1%) and Ashanti (46.2%), with other tribes accounting for (5.7%).

Knowledge on Breastmilk Donation and Breastmilk Banking

Table 2 below indicates respondents' knowledge on breastmilk donation and banking.

Table 2. Knowledge on Breastmilk Donation and Banking (N = 422)

Variable	Frequency N = 422	Percentage (%)	Mean ± SD	95% Conf. Interval
Awareness of human breastmilk donation and breastmilk banking				
Yes	205	48.6	0.486±0.500	0.438-0.534
No	217	51.4		
Source of information on breastmilk donation and banking				
Health workers	79	38.5	2.0±1.034	1.86-2.14
Internet	72	35.1		
Media	34	16.6		
Formal education	15	7.3		
Others	5	2.5		
Definition of human breastmilk donation and banking				
A recognized service which is responsible for collecting, screening, processing and dispensing of human milk through prescription. The breast milk is donated by nursing mothers who are not the biological mothers of the recipient infants	285	67.5	3.20±1.24	3.08-3.31
The practice of breastfeeding another person’s child	21	4.9		
Expressing breast milk and storing in fridge to feed your baby	30	7.1		
No idea	86	20.5		
Should donor breast milk be processed before giving to babies?				
Yes	350	82.9	1.170±0.377	1.134-1.206
No	72	17.1		
Is breastmilk banking beneficial to babies who have lost their mothers				
Yes	366	86.7	1.206±0.558	1.153-1.259
No	25	5.9		
No Idea	31	7.4		
Can breastmilk banking contribute to reduction in infant mortality				
Yes	323	76.5	1.377±0.721	1.308-1.446
No	39	9.2		
No Idea	60	14.3		
Will there be any cultural, religious and ethical concerns from Ghanaians				
Yes	280	66.4	1.337±0.473	1.292-1.382
No	142	33.6		
Will the activities of some religious and traditional leaders influence breastmilk donation and banking				
Yes	233	55.2	1.510±0.612	1.452-1.568

No	163	38.6		
No Idea	26	6.2		
Will the regulation of certain religious churches be useful at promoting breastmilk donation and banking				
Yes	217	51.4	1.571±0.645	1.509-1.633
No	169	40.0		
No Idea	36	8.6		
Will breastmilk banking have negative effects on the Ghanaian environment				
Yes	66	15.6	1.846±0.364	1.811-1.881
No	356	84.4		
Reasons for processing donor breastmilk before banking and consumption				
To make it safe for consumption				
Yes	323	76.5	1.483±0.774	1.409-1.557
No	12	2.8		
No Idea	87	20.7		
To prevent infection and microbial growth				
Yes	317	75.1	1.477±0.767	1.404-1.550
No	20	4.7		
No Idea	85	20.2		
To increase the quantity of the milk				
Yes	178	42.2	1.590±0.783	1.515-1.665
No	141	33.4		
No Idea	103	24.4		
To prolong its life span				
Yes	290	68.7	1.490±0.782	1.415-1.565
No	38	9.0		
No Idea	94	22.3		
To improve upon the taste of the milk				
Yes	165	39.1	1.626±0.796	1.550-1.702
No	145	34.4		
No Idea	112	26.5		
To preserve the nutrient content of the milk				
Yes	292	69.2	1.501±0.784	1.426-1.576
No	36	8.5		
No Idea	94	22.3		
Overall knowledge of respondents was average with mean score 1.617				

The knowledge assessment on breastmilk donation and banking revealed mixed results across the 16 knowledge indicators. Mean scores ranged from 0.486 (awareness of human breastmilk donation and banking) to 3.200

(definition of breastmilk donation and banking).

Items such as ‘Should breastmilk be processed before giving to babies’ (M = 1.170, SD = 0.377, CI = 1.134-1.206) and “Is breastmilk banking beneficial to babies who

have lost their mothers” (M = 1.206, SD = 0.558, CI = 1.153-1.259) fell within the good knowledge range, indicating strong awareness on these aspects.

However, higher mean values were recorded for questions asked on the definition of breastmilk donation and banking (M = 3.200, SD = 1.240, CI = 3.080-3.310) and awareness sources (M = 2.000, SD = 1.034, CI = 1.860-2.140), indicating limited or poor knowledge in those domains.

Knowledge on the cultural, religious, and environmental implications of breastmilk banking varied, with mean scores between 1.337 and 1.846, generally falling within the average knowledge category.

The overall weighted mean score for all knowledge items was 1.617, placing respondents in the ‘average knowledge’ category according to the study’s benchmarks

(1.50-2.49). The 95% confidence intervals for most of the knowledge questions were narrow, reflecting high precision of the estimates, although some items with higher standard deviations showed more variability in responses. This pattern suggests that while respondents demonstrated good knowledge in certain practical and health-related aspects of breastmilk banking, there were substantial knowledge gaps in conceptual definition of breastmilk donation and banking, sources of information, and broader socio-cultural implications.

Perception towards Breastmilk Donation and Breastmilk Banking

Table 3 below presents respondents perception towards breastmilk donation and banking.

Table 3. Perception towards Breastmilk Donation and Banking

Perception towards breastmilk donation and banking (N= 422)	N (%)	Mean ± SD	95% Conf. Interval
Breastmilk banks has safe breastmilk			
Yes	316(74.9)	1.430±0.732	1.360-1.500
No	38(9.0)		
No Idea	68(16.1)		
It helps reduce morbidity and mortality of pre-terms and orphans in hospital			
Yes	349(82.7)	1.371±0.675	1.307-1.435
No	28(6.6)		
No Idea	45(10.7)		
Breastmilk banks are effective in removing all risk of disease or infection including HIV			
Yes	237(56.2)	1.541±0.724	1.471-1.611
No	121(28.7)		
No Idea	64(15.1)		
Breastmilk banks are affordable			
Yes	187(44.3)	1.682±0.796	1.605-1.759
No	106(25.1)		
No Idea	129(30.6)		
Overall perception of the respondents was neutral with mean score 1.506			

The perception assessment of breastmilk donation and banking yielded mean scores ranging from 1.371 to 1.682. Respondents expressed the most positive perception towards the statement “It helps reduce morbidity and mortality of pre-terms and orphans in hospitals” (M = 1.371, SD = 0.675, CI = 1.307-1.435), indicating strong agreement with the health benefits of breastmilk banking. Similarly, the perception that “A breastmilk bank has safe breastmilk” was rated positively (M = 1.430, SD = 0.732, CI = 1.360-1.500).

However, perceptions were less positive regarding affordability (M = 1.682, SD = 0.796, CI = 1.605-1.759) and the belief that breastmilk banks can eliminate all risks of disease or infection (M = 1.541, SD = 0.724, CI = 1.471-1.611). These results suggest uncertainty or skepticism among respondents about the full

safety and cost-effectiveness of breastmilk banks.

The overall mean score of 1.506 recoded, places respondents’ perceptions in the ‘neutral category’ according to the set benchmarks (1.50-2.49). This implies that while there is general recognition of the benefits and safety of breastmilk banking, concerns remain regarding affordability and complete disease risk removal. The relatively narrow 95% confidence intervals for all items indicate precise estimates, although the moderate standard deviations suggested variability in individual perceptions.

Acceptability of Breastmilk Donation and Breastmilk Banking

Results obtained from respondents’ acceptability of breastmilk donation and banking is indicated in table 4 below.

Table 4. Acceptability of Breastmilk Donation and Banking

Acceptability of breastmilk donation and banking (N= 422)	N (%)	Mean ± SD	95% Conf. Interval
Would you accept donor breastmilk to feed your own baby?			
Yes	245(58.1)	1.422±0.494	1.374-1.470
No	177(41.9)		
Would you agree to donate or allow a relative/partner to donate breastmilk to milk banks?			
Yes	350(82.9)	1.171±0.377	1.135-1.207
No	72(17.1)		
Should it be donated free?			
Yes	255(60.4)	1.396±0.490	1.348-1.444
No	167(39.6)		
Does your religion support breastmilk donation and breastmilk banking			
Yes	321(76.1)	1.239±0.427	1.198-1.280
No	101(23.9)		
Does your tribe support breastmilk donation and breastmilk banking			
Yes	308(72.9)	1.270±0.444	1.227-1.313
No	114(27.1)		
Do you understand how this intervention will work			
Yes	267(63.3)	1.367±0.483	1.321-1.413
No	155(36.7)		

Do you feel excited about this intervention			
Yes	359(85.1)	1.146±0.354	1.112-1.180
No	63(14.9)		
Will this intervention be a good fit with the cultural values of your community			
Yes	335(79.4)	1.206±0.405	1.167-1.245
No	87(20.6)		
Will this intervention take too much time to implement			
Yes	351(83.2)	1.168±0.372	1.130-1.202
No	71(16.8)		
Will you be confident in delivering this intervention			
Yes	352(83.4)	1.166±0.372	1.130-1.202
No	70(16.6)		
Will you lose anything valuable whilst engaging in this intervention			
Yes	161(38.2)	1.618±0.487	1.571-1.665
No	261(61.8)		
Is this intervention likely to improve exclusive breastfeeding			
Yes	367(86.9)	1.130±0.337	1.098-1.162
No	55(13.1)		
Overall acceptability by respondents was high with mean score 1.192			

Acceptability of breastmilk donation and banking was assessed using 12 close ended questions, each measured on a yes or no response framework coded numerically to determine mean scores. The results indicate ‘high acceptance’ with an overall mean score of 1.192, placing it within the positive acceptability benchmark.

The question “Is this intervention likely to improve exclusive breastfeeding” recorded the lowest mean score ($M = 1.130$, $SD = 0.337$, $CI = 1.098-1.162$), suggesting the strongest agreement among respondents. Similarly, “Do you feel excited about this intervention” ($M = 1.146$, $SD = 0.354$, $CI = 1.112-1.180$) and “Would you agree to donate or allow a relative/partner to donate breastmilk to a milk bank” ($M = 1.171$, $SD = 0.377$, $CI = 1.135-1.207$) also ranked highly positive.

However, the statement “Will you lose anything valuable whilst engaging in this intervention” recorded the highest mean score ($M = 1.618$, $SD = 0.487$, $CI = 1.571-1.665$), still within the positive range but indicating some concerns about potential personal costs.

The low standard deviations recoded across most questions reflect minimal variability, meaning respondents generally shared similar opinions. Furthermore, the narrow 95% confidence intervals demonstrate high precision in the estimates, implying that the sample mean values are close to the true population means.

Category of Babies that Requires Breastmilk Donation and Breastmilk Banking

Table 5 below illustrate babies that require breastmilk donation and banking.

Table 5. Babies that Require Breastmilk Donation and Banking

Babies that require breastmilk donation and banking (N= 422)	N (%)	Mean ± SD	95% Conf. Interval
Babies from mothers with maternal infections			
Agree	290(68.7)	1.420±0.692	1.355-1.485
Neutral	87(20.6)		
Disagree	45(10.7)		
Babies with infections and or congenital abnormalities			
Agree	230(54.5)	1.512±0.770	1.439-1.585
Neutral	105(24.9)		
Disagree	87(20.6)		
Babies whose mothers died after giving birth			
Agree	373(88.4)	1.161±0.437	1.119-1.203
Neutral	41(9.7)		
Disagree	8(1.9)		
Babies born to mothers who are not willing to breastfeed			
Agree	282(66.8)	1.447±0.788	1.371-1.523
Neutral	67(15.9)		
Disagree	73(17.3)		
As a prescription for babies			
Agree	245(58.1)	1.509±0.788	1.433-1.585
Neutral	95(22.5)		
Disagree	82(19.4)		
Overall acceptability for babies was also high with mean score 1.410			

Results of the five questions measuring the ‘category of babies that requires breastmilk donation and breastmilk banking’ showed mean scores ranging from 1.161 to 1.512 on a 3-point Likert scale (1=Agree, 2=Neutral, 3=Disagree). The computed overall weighted mean was 1.410, which falls within the 1.00-1.49 benchmark, indicating a ‘good level of acceptance’ among respondents. This suggests that the majority of nurses agree with breastmilk donation and banking for babies with infections and congenital abnormalities,

babies whose mothers died after delivery and others. The low standard deviations recorded indicates relatively consistent responses given by the respondents. The 95% confidence interval recorded ranges from ± 0.046 to ± 0.077 around the mean. This narrow spread shows high precision and reliability in the responses.

Table 6 below presents the association between sociodemographic factors and acceptability of donor breastmilk banking.

Table 6. Association between Sociodemographic Factors and Acceptability of Donor Breastmilk Banking

Socio-Demographic characteristics of respondents	Acceptability of Breastmilk Donation and Banking (N= 422)		X ²	P-value	df	Interpretation
	Yes N (%)	No N (%)				
Age (In years)						
≤30 years	101(51.8)	92(48.2)	4.364	0.037	1	Significant: Age is associated with acceptability. Older nurses (>30 years) were more likely to accept breastmilk donation and banking
>30 years	144(62.9)	85(37.1)				
Gender						
Female	195(58.4)	139(41.6)	0.021	0.886	1	Not Significant: No difference between males and females in acceptability
Male	50(56.8)	38(43.2)				
Health facility						
Sunyani Teaching Hospital	141(45.0)	120(46.0)	6.883	0.032	2	Significant: Acceptability differ across facilities with highest at Tain District Hospital
Sunyani Municipal Hospital	58(59.8)	39(40.2)				
Tain District Hospital	46(71.9)	18(28.1)				
Professional category						
Registered nurses	194(57.9)	141(42.1)	0.000	1.000	1	Not Significant: Registered vs non-registered nurses showed no difference in acceptability
Non registered nurses	51(58.6)	36(41.4)				
Educational level						
Tertiary	50(56.2)	39(43.8)	0.080	0.777	1	Not Significant
Non-tertiary	195(58.6)	138(41.4)				
Marital status						
Married	104(54.2)	88(45.8)	1.361	0.243	1	Not Significant
Unmarried	141(61.3)	89(38.7)				
Number of children						
Nurse with no child	153(62.2)	93(37.8)	3.751	0.053	1	Borderline (p=0.05): Nurses with children were slightly less likely to accept but it was not statistically significant
Nurses with child	92(52.3)	84(47.4)				
Religion						
Christian	178(53.9)	152(46.1)	11.999	0.002	2	Significant: Acceptability differs by religion with highest among ‘others’
Islam	22(64.7)	12(35.3)				
Others	45(77.6)	13(22.4)				
Tribe of respondents						
Ashanti	108(55.4)	87(44.6)	2.274	0.321	2	

Bono	120(59.1)	83(40.9)				Not Significant: There were no difference across tribes with regards to breastmilk donation and banking acceptability
Others	17(70.8)	7(29.2)				

A statistically significant association was found between age of respondents and acceptability of donor breastmilk ($\chi^2 = 4.364$, $df = 1$, $p = 0.037$). Respondents aged above 30 years were more likely to accept breastmilk donation compared to those aged 30 years or younger. Similarly, there was a significant relationship between health facility of practice and acceptability ($\chi^2 = 6.883$, $df = 2$, $p = 0.032$). The highest proportion of acceptability was reported among nurses from Tain District Hospital compared to Sunyani Teaching Hospital and Sunyani Municipal Hospital. Religion was also found to be significantly associated with acceptability ($\chi^2 = 11.999$, $df = 2$, $p = 0.002$). Nurses who belonged to “other” religions (non-Christian and non-Islamic) expressed the highest acceptance of donor

breastmilk, compared to their Christian and Muslim counterparts.

However, gender ($\chi^2 = 0.021$, $p = 0.886$), professional category ($\chi^2 = 0.000$, $p = 1.000$), educational level ($\chi^2 = 0.080$, $p = 0.777$), marital status ($\chi^2 = 1.361$, $p = 0.243$), and tribe ($\chi^2 = 2.274$, $p = 0.321$) showed no significant association with acceptability of breastmilk donation.

Although the relationship between number of children and acceptability did not reach statistical significance ($\chi^2 = 3.751$, $df = 1$, $p = 0.053$), the result was at the borderline, suggesting that nurses with children were slightly less likely to accept breastmilk donation compared to those without children.

Also, the summary of the finding is represented in figure 1 below.

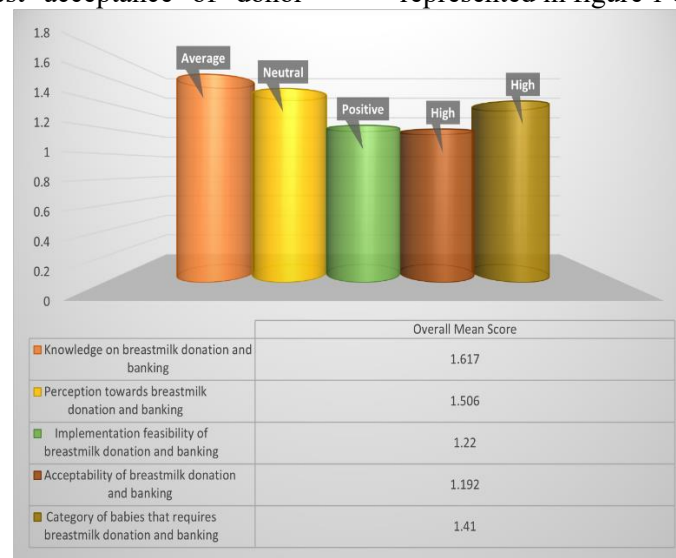


Figure 1. Summary of results

Discussion

The findings of this study address the objectives set out in the introduction by documenting nurses' knowledge, perceptions,

and acceptability of breastmilk donation and banking in Bono regional hospitals, and by identifying socio-demographic factors associated with acceptability.

Regarding objective one (knowledge), respondents demonstrated an overall average knowledge level (overall weighted mean = 1.617) with relatively strong understanding of practical, health-related items (for example, that milk should be processed and that donor milk benefits infants who have lost their mothers), yet clear gaps in core conceptual areas such as the formal definition of milk banking and common sources of information were observed. This mixed profile practical/clinical awareness paired with weaker conceptual and information on breastmilk banking knowledge mirrors findings from several recent studies in similar settings, which report that health workers often recognize the clinical value of donor milk but lack comprehensive, standardized knowledge about milk bank processes and governance [17]. For example, cross-sectional and qualitative work in African settings and in Ghana specifically has documented reasonable awareness of the value of donor milk alongside confusion about screening, safety and operational details [4].

On the second objective (perceptions), nurses in this study expressed neutral perceptions toward key health benefits of milk banking (overall mean = 1.506). Particularly agreement that donor milk reduces morbidity and mortality among pre-terms and orphans and that bank can provide safely processed milk. However, nurses were less confident about affordability and the complete elimination of disease risk. This ambivalence is consistent with recent literature indicating that health professionals and community members tend to endorse the conceptual health advantages of donor human milk yet remain cautious due to residual safety concerns and uncertainty about costs and logistics [1]. Several recent syntheses and field studies stress that perceived safety (screening, pasteurization, traceability) and cost are central determinants of acceptability [13].

The third objective (acceptability) found a generally high willingness to accept and support donor milk banking (overall mean = 1.192), with particularly strong agreement that the intervention would support exclusive breastfeeding and with many respondents indicating personal willingness to donate or to permit relatives to donate. Low variability and narrow confidence intervals indicate this acceptability is fairly consistent across respondents. These results align with Ghanaian and other African reports where health workers commonly express conditional acceptability [15]. That is, acceptance is provided that safety procedures and public education are in place and are similar to those in multi-site studies in Zimbabwe [9]. Uganda and elsewhere that document comparable willingness among health professionals to promote or use banked milk when assured of safety and governance [9].

The observed associations between acceptability and socio-demographic characteristics (older age >30 years, place of work, and religious affiliation) provide useful nuance for targeted implementation. The greater acceptance among nurses older than 30 years may reflect greater clinical experience, exposure to neonatal care, or familiarity with the harms of suboptimal substitutes for breastmilk. Patterns reported in other studies where experience and professional exposure predicted greater willingness to support donor milk initiatives [11]. Differences by facility (highest acceptability at the Tain District Hospital) likely reflect local institutional culture, prior exposures or differences in patient case-mix (e.g., a busier neonatal unit) [18]. The strong association with religion (higher acceptance among respondents in the “other” religions category) highlights the well-documented role of cultural and religious beliefs, including concerns about kinship / milk-sibling relationships in some faiths in shaping both donation and receipt of donor milk

[3]. These findings comport with reviews and primary studies showing religion and cultural norms as recurrent barriers or facilitators depending on how milk-banking is framed and regulated [10].

Taken together, the pattern of results has several practical implications. First, the combination of reasonable practical knowledge but weaker conceptual understanding suggests that capacity-building for nurses should prioritize standardized education on definitions, screening algorithms, pasteurization and traceability protocols, and on sources of validated information and not only clinical benefits [5].

Training curricula and in-service modules developed for Ghanaian contexts (and used successfully in other African settings) could close these gaps and strengthen frontline advocacy for banks [19]. Second, the neutral perceptions about affordability and residual risk indicate the need for transparent communication about safety measures (serological screening, pasteurization, storage standards) and about funding models (public subsidization, integration into maternal-newborn care budgets or insurance coverage) [17]. Evidence from countries with established HMBs shows that embedding milk banks within national newborn care policies and financing frameworks reduces cost barriers and increases uptake [7].

The study's results are largely consistent with other recent work but also add local specificity. For example, Tende et al., found that Ghanaian health workers generally accepted the concept of donor milk banking but reported misconceptions about safety and the need for prior education, which is a close parallel to this study perception and knowledge findings [11]. Chagweni et al. similarly reported that acceptability among health workers in Zimbabwe correlated with knowledge level and professional cadre, again echoing this study's results that knowledge and

context (facility) matter for acceptance [9]. International reviews and global snapshots further corroborate that donor milk banks are globally beneficial but that success depends on stakeholder education, culturally-sensitive messaging and robust safety/quality systems [4].

This study suggests several avenues for further research. Qualitative studies (focus groups and in-depth interviews) with nurses, facility managers, religious leaders and mothers would unpack the specific cultural, religious and logistical concerns hinted at in the quantitative data, particularly the reasons for greater acceptance among older nurses and the facility-level differences observed [20]. Implementation research and pilot studies are needed to evaluate how targeted education and a clear safety/traceability protocol change nurses' knowledge, perceptions and willingness to support milk banks in practice; such pilot implementations should measure downstream outcomes (uptake by families, neonatal morbidity/mortality, breastfeeding duration) as well as cost-effectiveness.

Given the affordability worries raised by respondents, economic analyses to model different financing scenarios (government subsidy, insurance coverage, fee-for-service with means testing) would help policy makers choose sustainable options.

Finally, longitudinal studies following cohorts of nurses before and after structured training and before/after a pilot milk bank launch would provide stronger causal evidence about the effectiveness of educational and policy interventions.

The study has limitations that should be acknowledged when interpreting the results. The cross-sectional design limits causal inference and captures attitudes at a single time point; social desirability bias may have inflated expressed acceptability among a professional sample who recognize the clinical value of donor milk. Finally, while the narrow

confidence intervals suggest precision for many estimates, higher standard deviations on certain items (e.g., definition of milk banking) indicate heterogeneity that warrants qualitative follow-up.

In conclusion, nurses in Bono regional hospitals demonstrate conditional readiness to support breastmilk donation and banking: practical clinical knowledge and favourable acceptability exist alongside conceptual gaps and concerns about cost and residual risk. This profile points to a feasible pathway “from ward to policy”: start with targeted education and facility-level pilots (with robust safety protocols and transparent financing), use early success and local champions to build public trust, and couple implementation with operational research on cost, uptake and health outcomes. Doing so would align Ghana with global good practice and could help reduce neonatal morbidity and mortality where mothers cannot supply sufficient milk.

Conclusion

This study assessed nurses’ knowledge, perceptions, acceptability of breast milk donation and the association between sociodemographic characters and acceptability of breastmilk donation and banking in Bono regional hospitals, Ghana. This was to help provide evidence to inform policy development in Ghana. The findings reveal that, while nurses demonstrated reasonable knowledge of the practical health benefits of donor human milk such as its role in reducing morbidity and mortality among preterm and orphaned infants,’ significant gaps remain in conceptual understanding, awareness of information sources, and the broader socio-cultural implications of milk banking. Perceptions were neutral, particularly regarding the safety and clinical benefits of donor milk, though concerns about affordability and residual disease risk highlight areas requiring further education and policy clarification. Encouragingly,

acceptability levels were high, with many nurses expressing willingness to support, donate, or encourage donation to milk banks, indicating readiness to embrace the intervention when adequate safeguards are in place. Socio-demographic associations, particularly age, place of work, and religion, show the importance of tailoring educational and advocacy strategies to different nurse groups and community contexts.

In moving ‘from ward to policy,’ this study concludes that the establishment of donor breast milk banks in Ghana is both feasible and potentially impactful but will require deliberate investments in nurse education, public sensitization, culturally sensitive engagement with religious leaders, and transparent frameworks for safety and financing.

Ethical Approval

The study protocol was reviewed and approved by the Committee on Human Research, Publications and Ethics (CHRPE) of the Kwame Nkrumah University of Science and Technology (KNUST). Ethical approval was obtained prior to data collection to ensure that the study adhered to established ethical standards for research involving human participants. The approval process ensured that participants’ rights, confidentiality, and welfare were protected throughout the study. Informed consent was obtained from all participants before their inclusion, and participation was entirely voluntary, with the option to withdraw at any stage without any consequence.

Conflict of Interest

There is no conflict of interest to be declared.

Data Availability

The data used for generating the result of this study may be made available from the corresponding author upon request and with permission from the institutions.

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Authors' Contribution

Author	Contribution
Bennin Juabie Douri (Lead author)	• Conducted the primary research, including data collection, analysis, and interpretation. • Drafted the manuscript, integrating feedback from other authors. • Coordinated the revision process and finalized the article for submission. • Provided expertise in aspects like; conceptual framework of the study and review of theories related to the study. • Drafted ethical clearance protocol and all cover letters. • Assisted with drafting the study data collection tool. • Assisted with data collection.
Philip Teg-Nefaah Tabong	• Provided overall guidance and support throughout the research work. • Provided critical feedback and intellectual inputs throughout the research process, including reviewing and revising the manuscript. • Ensured the research adhered to ethical guidelines and institutional protocols.
Ankamah Ababio Christian	• Assisted with data collection and analysis (Descriptive and inferential statistics). • Helped drafted sections of the manuscript, particularly related to the study methodology and results. • Assisted with the draft of the study data collection tool.

References

- [1]. Adjei, B., Adu-Kofi, I. M., Alpan, C., Ababio, N., Dsaue, N. A., 2025, Acceptance and perception of human milk banking: A review. *International Journal of Multidisciplinary Research*, 7(2), 1-10.
- [2]. Iloh, K. K., Osuorah, C. D. I., Ndu, I. K., Asinobi, I. N., Obumneme-Anyim, I. N., Ezeudu, C. E., et al., 2018, Perception of donor breast milk and determinants of its acceptability among mothers in a developing community: A cross-sectional multi-

center study in south-east Nigeria. *International Breastfeeding Journal*, 13(1), 1-13.

- [3]. Mampane, T., Wolvaardt, J. E., 2024, The acceptability of a donor human milk bank and donated human milk among mothers in Limpopo Province, South Africa. *Maternal and Child Nutrition*, 20(3).

- [4]. Appiah, P. K., Amu, H., Osei, E., Konlan, K. D., Mumuni, I. H., Verner, O. N., et al., 2021, Breastfeeding and weaning practices among

- mothers in Ghana: A population-based cross-sectional study. *PLoS ONE*, 16(11), 1-19. Available at: <https://doi.org/10.1371/journal.pone.0259442>
- [5]. Namuddu, M. G., Kiguli, J., Nakibuuka, V., Nantale, R., Mukunya, D., 2023, Acceptability of donated breast milk among pregnant women in selected hospitals in central Uganda: A cross-sectional study. *International Breastfeeding Journal*, 18(1), 1-11.
- [6]. Zamahlubi, H. T., Naidoo, K. L., Khan, F., Masekela, R., 2024, Knowledge, attitudes and awareness regarding donor breast milk: A cross-sectional study of mothers in a high HIV-prevalent area. *South African Journal of Clinical Nutrition*, 37(1), 1-8. Available at: <https://doi.org/10.1080/16070658.2023.2189347>
- [7]. National Institute for Health and Care Excellence (NICE), 2021, Quick reference guide: Donor breast milk banks-The operation of donor breast milk bank services. *NICE Clinical Guideline*, February 1-15.
- [8]. Pinto, M., Moehlecke Iser, B., Molon Fernandes, T., Oliveira Schuelter, P., Ferreira D'Agostini, M., 2020, Contributing and limiting factors for human milk donation. *Journal of Health Sciences*, 22(2), 177-182.
- [9]. Chagwenwa, D. T., Mugariri, F., Sithole, B., Mataga, S. F., Danda, R., Matsungu, T. M., et al., 2020, Acceptability of donor breastmilk banking among health workers: A cross-sectional survey in Zimbabwean urban settings. *International Breastfeeding Journal*, 15(1), 1-11.
- [10]. Ramli, N., Ibrahim, N. R., Hans, V. R., 2021, Human milk banks-The benefits and issues in an Islamic setting. *East Journal of Medicine*, 15(4), 163-167.
- [11]. Tende, F. K., Nwameme, A. U., Tabong, P. T. N., 2023, Acceptability of breast milk donor banking: A qualitative study among health workers in Greater Accra Regional Hospital, Ghana. *PLOS Global Public Health*, 3(8), 1-17. Available at: <https://doi.org/10.1371/journal.pgph.0001870>
- [12]. Obeng, C., Jackson, F., Amissah-Essel, S., Siah-Asamoah, C., Perry, C. A., Gonzalez Casanova, L., et al., 2023, Women's perspectives on human milk banking in Ghana: Results from a cross-sectional study. *Frontiers in Public Health*, 11. Available at: <https://doi.org/10.3389/fpubh.2023.xxxxxx>
- [13]. Mpayo, L. L., Msuya, M. A., Moshiro, R., Cosmas, I. L., Kimaryo, Y., 2024, Awareness and acceptability of donor human milk banking among women in Dar es Salaam, Tanzania: A cross-sectional study. *Journal of African Neonatal*, 4, 77-83.
- [14]. UNICEF, 2010, Implementation guidance: Making EHS an integral part of process design. *UNICEF Publication*, 135-149.
- [15]. Dalinjong, P. A., Wang, A. Y., Homer, C. S. E., 2018, The implementation of the free maternal health policy in rural Northern Ghana: Synthesised results and lessons learnt. *BMC Research Notes*, 11, Article 276.
- [16]. Nanjundeswaraswamy, T. S., Divakar, S., 2021, Determination of sample size and sampling methods in applied research. *Proceedings in Engineering Sciences*, 3(1), 25-32.
- [17]. Abdul Hamid, S. B., Haris, S. N., Hui, J. C., 2022, Breastfeeding knowledge, attitude and practices and its association with food insecurity during COVID-19. *Environment and Public Health Journal*, 7(21), 153-164. Available at: <https://doi.org/10.21834/ebpj.v7i21.3686>
- [18]. Masi, A. C., Stewart, C. J., 2024, Role of breastfeeding in disease prevention. *Microbial Biotechnology*, 17(7), 1-10.
- [19]. World Health Organization (WHO), 2003, Global strategy for infant and young child feeding. *Fifty-Fourth World Health Assembly Document*, 1-8.
- [20]. Ogundare, E. O., Dedeke, I. O. F., Babatola, A. O., Adeniyi, A. T., Ajite, A. B., Lawal, O. A., et al., 2023, Human milk banking acceptability among pregnant and nursing mothers in Southwest Nigeria. *Journal of Public Health Research*, 12(3).

Knowledge and Utilization of Health Insurance following the Rollout of the State Contributory Health and Basic Healthcare Provision Fund in Kaduna State, Nigeria

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Abstract

The availability of information to the public plays a fundamental role in creating awareness, building trust and improving utilization of health insurance schemes. Knowledge of health insurance is often limited, and results in low utilization rates of services among vulnerable groups or those in informal sectors. This study examines the knowledge and utilization of health insurance schemes in Kaduna State, using z-test of difference of two proportions at 5% level of significance for 1944 respondents. Statistical analysis (chi-square tests and Z-test of proportions) using Stata 16.0 revealed that 86.1% of respondents have heard of the general term 'Health Insurance'. Knowledge declined significantly for specific schemes (KADCHMA: 67.0% and BHCPF: 59.2%). The State Contributory Health Scheme (KADCHMA) shows the highest mean utilization of services at 1,167.08 enrollees, National Health Insurance at 458.23 enrollees, private health insurance at 219.90 enrollees, BHCPF 179.61 at enrollees and Tertiary institutions Social Insurance scheme at 0.33. Despite the successes recorded, less than half of the population (49.6%) understands the operationality of the schemes, 29.3% only heard of the schemes with no understanding of their functionality, and 9.8% only heard of the schemes indicating low knowledge. The average percentage of the catchment population covered under all the schemes is extremely low, averaging 15.97% per facility. Addressing these issues requires multi-stakeholders' engagement to create awareness and mobilize citizens to understand and enrolled into the health insurance schemes.

Keywords: BHCPF, Health Insurance and Schemes, Knowledge, KADCHMA, Utilization.

Introduction

Understanding health insurance is crucial for the public, as it helps individuals grasp the reasoning behind its principles and operational procedures [1]. This knowledge will inform people about enrolment processes, available benefit packages, and the quality of services provided, among other important aspects [2]. Knowledge serves as the foundation of any society, offering essential information that leads

to improved and higher-quality healthcare services [3]. The advantages of being informed are substantial, as they equip individuals with the guidance they need for daily activities, innovation, and health management [4]. This information can help protect against infectious diseases, enhance environmental management, and mitigate their spread.

Public awareness and trust are significant in health insurance schemes. Public awareness of health insurance is often limited, and trust in

these systems can be fragile [5]. This trust is influenced by personal experiences, affordability, transparency, and effective communication. Several studies have indicated that there is significant awareness of health insurance schemes among Nigerians; however, this awareness does not lead to enrolment [6].

In Nigeria, especially in Kaduna State, low rates of insurance enrolment are primarily due to several factors, particularly those affecting vulnerable groups and the informal sector. Healthcare insurance is significantly underutilized, with most enrollees coming from the formal sector, which represents only about 10% of the country's population [7]. Meanwhile, most people in the informal sector primarily rely on out-of-pocket (OOP) expenditures for their healthcare costs [8].

Research Methodology

Research Design and Site

This study, a type of implementation research, employed a descriptive cross-sectional design to investigate adult residents of benefiting communities and healthcare providers in healthcare facilities within the selected communities, wards, and local government areas (LGAs) of Kaduna State, Nigeria.

Method of Data Collection

Data were collected from 18 wards (3 wards per Local Government Area) in Jema'a, Jaba, Chikun, Kaduna North, Makarfi, and Lere Local Government Areas of Kaduna State.

Primary data were collected using structured questionnaire designed to test the research hypothesis. The questionnaire was administered to the respondents to capture their views, opinions, and observations [9]. Additionally, secondary data were sourced from 18 Primary Healthcare Centres, 6 Secondary Health Facilities, and either private or faith-based health facilities within the six LGAs mentioned above. Both primary and secondary data were used to test the research hypothesis and to answer the research questions [10].

Population of the Study

The study included a target population of 1,944 respondents, which consisted of both male and female heads of households from different socioeconomic background as well as 30 healthcare facility managers responsible for the daily operations of their health facilities [11]. Ethical consent was obtained, and gender status was considered during the study.

Sampling Procedure and Sample Size

Sample Size

The sample sizes for the respective populations are as follows:

Adult residents of benefitting communities: A sample size of 324 was calculated for each LGA using the formula given in equation (1).

$$n = \frac{z_{\alpha/2}^2 P(1-P)}{d^2} = 324 \quad (1)$$

Where,

	Definition	Value
P	Proportion of the populations who reported benefitting from BHCPF & Health Insurance scheme ¹	0.26
Z_{α/2}	Z-score corresponding to level of statistical significance desired (0.05)	1.96
d	Desired level of precision	0.05
Adjusted for 10% non-response/ contingency factor 292		

Sampling Approach for the Quantitative Component: The study employed a multistage sampling approach to select respondents. The stage of the sampling is described as follows:

Stage 1, Simple random selection of LGAs: This involved a simple random selection of 6 LGAs from the 23 LGAs (approx. 26%) using the simple balloting method of 2 LGAs per each of the 3 senatorial zones in the State.

Stage 2, Simple random selection of wards: The sample framed for this stage is an alphabetically arranged list of all the wards in each of the selected LGA. Then 3 wards were selected through balloting from each of the 6 LGAs giving a total of 18 selected wards in all.

Stage 3, Simple random selection of communities: In each selected ward, 6 communities were selected using systematic random sampling approach.

Stage 4, Selection of Heads of households of benefiting communities: The households served as the secondary sampling unit. Eighteen households were selected per community through a systematic random sampling of housing structures and a simple random selection of household's heads.

Considering a non-response rate of 20%, the sample size was calculated as follows: $n = (1,944 \times 0.20) = 388.8$, approximately 389. Therefore, 1,555 households were considered in this study.

Selection of Health Facilities

Stage 1, Selection of Health Facilities

The one per ward priority PHC under the BHCPF were selected in each ward, one private or faith-based health facility offering KADCHMA/NHIA and one secondary health facility in the selected LGA offering referral services for BHCPF, KADCHMA/NHIA schemes were also selected.

Instruments for Data Collection

Data collection for this study involved both qualitative and quantitative methods [12]. Qualitative data were gathered using a focus group discussion guide, while quantitative data were obtained as secondary data from health facilities, specifically focusing on service utilization related to health insurance coverage [13]. In addition, secondary data were collected from sources such as the national health management information system and encounter registers for health insurance schemes.

Statistical Analyses

This section analyzes the public's understanding, showing that shallow awareness has not yet developed into the deep functional knowledge essential for widespread adoption.

Measurement of Variables

The study utilized a rigorous approach to measure key constructs related to Universal Health Coverage (UHC). The core variables were operationalized as follows:

Variable	Measurement Focus	Instrument(s)
Knowledge of Schemes	The populace's awareness of, and functional understanding of the schemes and their benefits.	Measured by assessing awareness of the scheme generally (Health Insurance Scheme) and specifically (KADCHMA, BHCPF), and the respondent's self-assessed understanding of how the schemes work and how to access them
UHC Attainment/Coverage	The extent of scheme expansion and its impact on financial risk protection.	Measured by perceived increase in access and affordability (Yes/No response and open-ended reasons), percentage of catchment population covered (provider

		survey), and reduction in Out-of-Pocket (OOP) expenditure (Yes/No response).

Validation of Instrument

The data collection tools underwent a thorough validation and pre-testing process to ensure accuracy, clarity, and cultural appropriateness prior to large-scale deployment.

1. **Expert Validation:** The data collection instruments, including the semi-structured questionnaires for adult residents and service providers, were reviewed and validated by five subject matter experts. This panel included public health officials, academic researchers with experience in healthcare financing, and executives from the health sector, ensuring the content aligned with established health system and policy constructs.
2. **Pre-testing:** The quantitative tools were pre-tested with 30 households in the Kaduna metropolis. This process was conducted to assess the ease of administration, test the logical flow of questions, confirm language appropriateness (in Hausa as well as English), and identify any questions that were difficult or ambiguous for respondents to understand or answer. The instruments were reviewed and updated based on all identified gaps.

Reliability of Instrument

Reliability ensures the consistency and stability of the measurement tools. Although a specific statistical reliability coefficient (such as Cronbach's Alpha) is not computed due to the non-uniform nature of the variables, measures were taken during the study design and data collection process to ensure the reliability of the data. This includes data tools digitized using electronic forms (Kobo Toolbox) pre-loaded onto Android tablets,

ensuring standardized question administration and minimizing data entry error, and a three-day training for data collectors focusing on familiarity with the questionnaires, gaining informed consent, and ensuring adherence to standardized recruitment and administration methods, thereby ensuring consistency across the seven data collection teams.

Method of Data Analysis

The data analysis was conducted using Stata 16.0. For descriptive statistics, we applied frequency counts, percentages, means, and graphical analyses to summarize the demographic profile, coverage, knowledge, and acceptability variables. Inferential statistics were utilized to test the formal null hypotheses, which included the Chi-Square test and the Z-test of proportions [14].

Chi-Square Test

The z-test for the proportion was employed as an inferential statistic to test the significance of the difference between categorical variables with two dichotomous categories (yes/no). In the case of multiple variables, when there are more than two categories, the Chi-Square test of independence was employed as a key inferential statistic to evaluate the association. Both techniques were useful for testing the Null Hypotheses. They provided the quantitative evidence base for either rejecting or failing to reject the null hypotheses formulated against the research objectives.

Rule Decision (Statistical Decision Rule)

All statistical inferences derived from the quantitative analysis were anchored to a pre-determined criterion, ensuring consistency and rigor in hypothesis testing:

- **Level of Significance (α):** The study established 5% types-I error limit ($\alpha=0.05$).

The decision rule applied to the null hypotheses was as follows:

1. If the calculated p-value is less than or equal to the significance level ($p \leq 0.05$):
 - The Null Hypothesis is **REJECTED**.
 - *Interpretation:* The observed difference or association is considered statistically significant and unlikely to have occurred by chance.

2. If the calculated p-value is greater than the significance level ($p > 0.05$):

- The Null Hypothesis is **NOT REJECTED** (Fail to Reject).
- *Interpretation:* The observed difference or association is considered statistically insignificant.

Results and Discussion

Table 1. Respondents' Knowledge of Health Insurance Schemes and Basic Healthcare Provision Fund

Level of knowledge	Poor Frequency (percent)		Good knowledge Frequency (percent)	
General knowledge of Health Insurance Scheme	254	(13.1)	1673	(86.1)
Knowledge of KADCHMA Scheme	618	(31.8)	1302	(67.0)
Knowledge of BHCPF Scheme	767	(39.5)	1150	(59.2)

Table 1 indicates that 86.1% of respondents were aware of the general "Health Insurance Scheme." However, awareness significantly dropped for the specific administering

agencies: KADCHMA (67.0% Yes) and BHCPF (59.2% Yes), demonstrating a high level of awareness at the top level.

Table 2. Respondent's Understanding of Health Insurance Schemes and Basic Healthcare Provision Fund

Understanding Operational Modalities	Frequency (N=1944)	Percentage
Good understanding of the schemes	964	(49.6)
Average understanding of the schemes	570	(29.3)
Fair Understanding of the schemes	191	(9.8)
Poor Understanding of the schemes	287	(14.8)

Table 2 highlights that less than half of the population (49.6%) understands how the schemes function and how to access them. The rest either have heard of the schemes but do not understand their benefits (29.3%) or only recognize their names (9.8%). This indicates a significant gap in functional knowledge and understanding.

Understanding utilization of Health Insurance Schemes

This section contains critical data confirming low coverage and highlighting the gap between policy, training, and operational reality.

Table 3. Enrolment into the Health Insurance Schemes

Enrolment into the schemes	Min	Max	Mean	Std. Dev.
National Health Insurance Scheme	0	3,991	458.23	1,042.956
State Contributory Health Scheme	0	13,793	1,167.08	2,529.853
Private Health Insurance	0	5,934	219.90	1,081.274

BHCPF	0	653	179.61	209.873
Tertiary Institutions Social Health Insurance	0	8	0.33	1.633

Table 3 displays the enrollment volume for various schemes. The State Contributory Health Scheme (KADCHMA) has the highest average enrollment per facility, with a means of 1,167.08, indicating its effectiveness in

providing coverage for the formal sector. In contrast, the Basic Health Care Provision Fund (BHCPF), which aims to assist the poor and vulnerable populations, has a much lower average enrollment of 179.61.

Table 4. Catchment Population

	Min	Max	Mean	Std. Dev.
Coverage Catchment Population	.00	98.00	15.9744	21.60375

Table 4 presents the overall coverage gap. Crucially, the average percentage of the catchment population actually covered under all health insurance schemes is extremely low, averaging only 15.97% per facility. This statistical confirmation reinforces the central argument that the risk pool is insufficient to reduce the state's catastrophic 84% Out-of-Pocket (OOP) expenditure rate. The vast majority of the population remains financially exposed despite the schemes' existence.

Discussion of Findings

The data confirmed the null hypothesis that the population, particularly those in the informal sector, has limited knowledge of the scheme [15]. While awareness of the general scheme is relatively high, with 86.1% having heard of it, functional understanding is low. Only 49.6% of the population understands how the schemes work and how to access them.

The operational modalities of the State Health Insurance and the BHCPF emphasize the importance of ongoing awareness creation among the general populace. This involves continuous engagement with both state and non-state actors.

State actors have played a crucial role in enrolling those who were previously uninsured, particularly through labour unions and organized labour groups. For the informal sector, community stakeholders and artisan

groups are essential in raising awareness, which has significantly improved public knowledge of the health insurance schemes, as reflected in the results mentioned earlier. Utilizing local dialects and providing information and communication materials have significantly enhanced awareness and understanding of these schemes.

The inability to translate awareness into functional knowledge is the main reason for the lack of acceptance, with 70.7% citing poor understanding as the issue [16]. This knowledge gap prevents the unorganized informal sector, which comprises over 80% of those surveyed, from enrolling.

Community knowledge is directly linked to understanding, as shown in Tables 1 and 2, where the majority of those knowledgeable about the schemes also demonstrate an understanding of how they function. Stakeholders, particularly government actors, play a vital role in creating awareness that leads to comprehension, acceptance, and the utilization of services offered under these schemes [17].

The enrollee's often express dissatisfaction because essential services, such as chronic disease management for hypertension and diabetes, as well as high-prevalence conditions like typhoid screening, are either excluded or poorly defined in the benefit package [18]. This

ambiguity further undermines their confidence in the scheme.

Despite some successes, the overall impact on the state's population remains minimal [19]. Facility data indicates that the average coverage rate across different areas is critically low, at just 15.97%. This confirms that the risk pool is insufficient to significantly reduce the state's out-of-pocket (OOP) expenditure, which remains alarmingly high at around 84% [20].

Enrolment in the state health insurance scheme is substantial, largely because the entire state workforce is enrolled in the formal sector. However, enrolment remains low since local government authorities have yet to onboard their staff into state schemes. The National Health Insurance demonstrates a significant enrolment rate, especially among those working for the Federal Government of Nigeria, as mandated by the revised NHIA Act. Private health insurance covers employees in private organizations, revealing a significant gap compared to the expected number of enrolees. This indicates that more efforts are necessary to ensure that private sector employers enrol their workers in health insurance schemes.

Unfortunately, the tertiary insurance scheme is underperforming, and regulatory bodies for tertiary institutions need to make it mandatory for all students across the state. The low enrolment numbers may also be due to the limited number of tertiary institutions in the selected local government areas. Additionally, parents should encourage their children to utilize the services offered at their institutions.

It is evident that a large portion of the population remains uncovered by health insurance schemes. To achieve Universal Health Coverage (UHC), significant efforts are required, and all stakeholders must collaborate to realize the UHC targets set for 2023 [21].

Conclusions

The establishment of the Kaduna State Contributory Health Management Authority (KADCHMA) and the effective decentralization of the Basic Healthcare Provision Fund (BHCPF) represent crucial policy reforms. These reforms lay the necessary legal and infrastructural groundwork for achieving Universal Health Coverage (UHC) by 2030 [22].

However, without immediate and decisive policy actions to ensure a timely and consistent flow of funding, which is essential for service stability, the scheme will remain caught in a cycle of instability. If this continues, Kaduna State may face a situation where it has a high-equity, low-coverage healthcare system, ultimately failing to achieve UHC for most of its population [23].

Recommendations

The following recommendations are crucial to stabilizing service quality, restoring beneficiary trust, and accelerating mass enrolment to meet the UHC goal:

1. Shift to Knowledge-Based Advocacy:

Advocacy campaigns by government stakeholders must move beyond simple awareness to deep education on the value proposition of risk pooling and cross-subsidy, rather than premium payment for unused services. Utilize successful enrolees (champions) to provide compelling testimonials on the financial relief achieved.

2. Strategic Staging of Mandatory Enrolment:

While mandatory enrolment is advocated for by state agencies, its implementation must be staged to avoid political backlash:

Phase 1: Mandate enrolment for easily regulated and fiscally resilient groups, such as students in tertiary institutions (TISHIP expansion) and the organized private sector.

Phase 2: Only after sustained stability and resolution of service quality failures (zero stock-outs for three consecutive quarters) should the state proceed with linking insurance status to general regulatory documents (e.g., driver's license renewal, business registration) to capture the mass unorganized informal sector.

Ethical Approval

Ethical approval for this study was obtained from the State Ministry of Health, as required before starting any health-related research in the state. This approval ensured strict adherence to ethical procedures and standards, as outlined by the State Health Research Ethical Committee guidelines. Informed consent was obtained from participants, with assurances of privacy and confidentiality. The rights of participants to withdraw from the study and their autonomy were prioritized throughout the research.

Data Availability

The utilization data are openly available in National Health Management Information System (NHMIS) tools available at the health facilities. Data accessible at: <https://dhis2nigeria.org.ng/dhis/dhis-web-commons/security/login.action>. Knowledge

data available on request via URL: <https://kc.kobotoolbox.org>

Author Contributions

Muazu, Habibu., conceived of the presented idea. Muazu, Habibu., planned and carried out the data collection, analysed the data and generated the manuscript. Ahmad, A. Umar., review the titles and supervise the manuscript development.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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References

- [1]. Lawan, U. M., Iliyasu, Z., Daso, A. M., 2012, Challenges to the scale-up of the Nigerian National Health Insurance Scheme: Public knowledge and opinions in urban Kano, Nigeria. *Ann Trop Med Public Health*. Available from: <http://www.atmph.org/text.asp?2012/5/1/34/92878>. Accessed on 12/10/2025.
- [2]. Abiba, L., Janine, H., and Jeroen, S., 2012, *Effects of Knowledge, Acceptance and use of Contraceptives on Household Wealth in 26 African Countries*. Available at: <http://www.ru.nl/nice/workingpapers>. Accessed 22/10/2025.

- [3]. Mimmie, C. N., Pranee, L., and Mary, C., 2013, Contraception Knowledge and Attitudes: Truths and Myths among African Australian Teenage Mothers in Greater Melbourne, Australia. *Available at: University of Roehampton Online Library*. Accessed 12/10/2025.
- [4]. Elegbede, O. E., Kabir, A., Durowade, T., Adedayo, S., Tope, M., Ipinnimo, A., Kamal, A., 2022, Knowledge of Community Based Health Insurance and Associated Factors among Artisans in a Selected Community of Ekiti State. *Nigerian Journal of Medicine* 31(5):p509-514, Sep–Oct 2022. | DOI: 10.4103/NJM.NJM_47_22.
- [5]. United Health Care, Understanding health Insurance. Available from:

- <https://www.uhc.com/individual-andfamily/understanding-health-insurance>. Last accessed on 3/10/2025.
- [6]. Muofhe, T., Makwakwa, N., Pagollang, D., 2023, Knowledge and perception of oral health professionals regarding the National Health Insurance. *SADJ* October 2023, Vol. 78 No.9 p432-436. Available at: https://www.researchgate.net/publication/376805382_Knowledge_and_perception_of_oral_health_professionals_regarding_the_National_Health_Insurance.
- [7]. Ogundeji, Y. K., Akomolafe, B., Ohiri, K., Butawa, N. N., 2019, Factors influencing willingness and ability to pay for social health insurance in Nigeria. *PLoS One*. 2019;14(8): e0220558. doi: 10.1371/journal.pone.0220558.
- [8]. Elegbede, O. E., Durowade, K. A., Sanni, T. A., Ipinimo, T. M., Alabi, A. K., 2022, Assessment of Willingness to pay for Community-Based Health Insurance among Artisans in a selected Community of Ekiti State, *Southwest Nigeria*. DOI: <https://doi.org/10.61386/imj.v15i2.253>.
- [9]. Danielle, L., Baron, O., Mensah, K., Cheryl, L., Lettenmaier, S., Krenn, C., Michelle, E., Bashin, M., Jato, C., Church, A., Young, Mi Kim., and Philippe, F. L., 1993, Qualitative Research for Family Planning Programs in Africa. 'Centre for Communication Programs, Johns Hopkins School of Public Health, Occasional Paper Series, No. 2, *Baltimore, Maryland*.
- [10]. Howell, B., and Kerry, E., 2012, An Introduction to the Philosophy of Methodology. *SAGE*. ISBN 978-1-4462-9062-0.
- [11]. Onwujekwe, O., Onoka, C., Uguru, N., Tasie, N., Uzochukwu, B., Kirigia, J., et al., Socioeconomic and geographic differences in acceptability of community-based health insurance. *Public health*. 2011;125(11):1;06-808. <https://doi.org/10.1016/j.puhe.2011.09.006>
- [12]. Harvey, R. B., 2011, Research Methods in Anthropology: *Qualitative and Quantitative Approaches*.
- [13]. Trueman, C. N., 2015, Structured Questionnaires. Available at: <http://www.historylearningsite.co.uk>. *The History Learning Site*. Accessed 18/10/2025.
- [14]. Chris, O. I., Diane, M., George, M. S., 2004, Cross-Sectional Study Design and Data Analysis. Available at: http://www.collegeboard.com/prod_downloads/yes/4297_MODULE_05.pdf. Accessed 26/10/2025.
- [15]. Abihiro, G. A., McIntyre, D., 2012, Achieving universal health care coverage: Current debates in Ghana on covering those outside the formal sector. *BMC Int Health Hum Rights* 2012; 12:25.
- [16]. Wagstaff, A., van Doorsaler, E., 2000, Equity in healthcare financing and delivery. In: Culyer, AJ, Newhouse JP, editors. *Handbook of Health Economics*. 1st ed., Vol. B. Ch. 34. *North Holland: Elsevier*; 2000. p. 1803-62.
- [17]. Bawa, S. K., Ruchita, M., 2011, Awareness and Willingness to Pay for Health Insurance: An Empirical Study with Reference to Punjab India. *International Journal of Humanities and Social Science*. 2011;1(7): 100-108.
- [18]. Carrin, G., 2003, Community based health insurance scheme in developing countries: Facts, problems and perspectives. Discussion paper No 1. Geneva: World Health Organisation, Department of Health System Financing, *Expenditure and Resource Allocation (FER)*; 2003.
- [19]. World Health Organization, 2010, The World Health Report - Health Systems Financing: The Path to Universal Coverage 2010, Geneva: The World Health Organization; 2010. Available from: <http://www.who.int/whr/2010/en/index.html>. (Accessed 15th October 2025).
- [20]. Aregbeshola, B. S., Khan, S. M., 2010, Out-of-Pocket Payments, Catastrophic Health Expenditure and Poverty Among Households in Nigeria, *Int J Health Policy Manag*. 2018;7(9):798-806. doi:10.15171/ijhpm.2018.19
- [21]. Andrew, G., Charles, C., Tolib, M., 2012, Management and Planning for Global Health in Merson, M. H., R. E. Black, & A. J. Mills, (eds) *Global Health: Diseases, Programs, Systems, and Policies*, Burlington, MA: Jones & Bartlett Learning.
- [22]. Uzochukwu, B., Ughasoro, M. D., Etiaba, E., Okwuosa, C., Envuladu, E., Onwujekwe, O. E.,

2015, Health care financing in Nigeria: implications for achieving universal health. *Nigerian Journal of Clinical Practice*. 18:437-444.

[23]. Garba, M. B., Ejembi, C. L., 2015, The role of National Health Insurance Scheme on structural

development of health facilities in Zaria, Kaduna State, Northwestern Nigeria. *Annals of Nigerian Medicine*. 9(1):9–14. doi: 10.4103/0331-3131.163327.

Vision Assessment of Drivers of Passenger Service Vehicles Operating across Bushenyi-Ishaka Municipality

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Abstract

The main purpose of the study is to establish the vision of the drivers of Passenger Service Vehicles operating across Bushenyi – Ishaka municipality in Uganda. A cross-sectional descriptive study with both quantitative and qualitative techniques was used. Semi structured questionnaires were administered to 392 participants and the data was analysed at three (3) different levels; Univariate, to find out the proportion of respondents with reduced vision for driving, Bivariate, to assess the effect of individual factors on accident involvement & Multivariate, to assess for the effect of the potential confounding variables. Participants underwent eye examinations comprising visual acuity, colour vision test using Ishihara Pseudo-Isochromatic plates, confrontational visual fields, external and internal Ocular eye health examinations. 87% of the drivers of Passenger Service Vehicles met the visual requirement for driving (visual acuity greater than 6/9 in both eyes) while 13% had inadequate vision for driving (visual acuity less than 6/9 in both eyes). The commonest cause of reduced vision was refractive error (71%) and the factors associated with it according to the respondents were the family history of blindness, old age and accidents (trauma). Poor visual acuity was significantly associated with road traffic accidents ($P=0.004$). This study implies that the number of operators of passenger service vehicles in Bushenyi District with visual acuity less than 6/9 for driving is high and the level of awareness and utilization of eye care services by the drivers of Passenger Service Vehicles in Bushenyi is low.

Keywords: *Drivers, Driving, Eyes, Vision, Passenger Service Vehicles (PSVs), Visual Acuity.*

Introduction

The Ophthalmological Society of East Africa (OSEA) recommended that all driving license application forms must be filled by a qualified eye health worker, but despite this recommendation, most of the motorists including drivers of Passenger Service Vehicles do not visit the eye clinics to have their sight tested before obtaining a driving license [15].

Vision/Eyes-sight is your ability to see, which could be clear or unclear as defined in the Long Dictionary of Contemporary English. Sight is therefore one of the human senses that

is absolutely essential for safe driving and to determine whether your sight is up to standard with driving, it is most paramount that one's visual acuity is ascertained [4].

According to WHO and the world report on road traffic injury prevention, [9]. A visual acuity of 6/9 in both eyes is taken as the yardstick for a normal or clear vision. Therefore, normal vision plays a major role in safe driving.

95% of sensory input to the brain required for driving comes from good vision [5]. However, the majority of drivers in Uganda are not assessed for this before they acquire driving licenses.

In Uganda as it is elsewhere, it is a mandatory requirement to have one's eye sight tested before obtaining a driving permit/license, however, the application form for a driving permit is surface level in that it does not require for a detailed eye examination by an eye specialist but a mere physical examination of applicant (to be completed by medical practitioner) [13, 14].

In Uganda, like other parts of the world, most health workers have poor knowledge on the guidelines in the area of fitness to drive and eye check up before obtaining a driving licence is not always taken seriously by the doctors [10].

The challenge of road traffic accidents involving drivers of Passenger Service Vehicles is worldwide. A study conducted in Ghana revealed that, 80% of the accidents which took place in Ghana involved commercial vehicles and the causes were linked to vision of the drivers. In another study conducted in Kampala-Uganda by Dr Grace Sali, it indicated that out of every 8 commercial vehicle drivers, 1 did not meet the required visual standard for driving [12].

Researchers and organizations seem to have become interested in the implications of vision on driving. Debates abound over the factors associated with road traffic accidents and its relationship to Vision, both theoretically and empirically.

According to Uganda Traffic Police report on accidents, vision has continually been cited as one of the salient features in causing accidents every year thus this henceforth sets the stage for this investigation [6].

Problem Statement

Road traffic accidents are a significant public health concern in Uganda, resulting in injuries, fatalities and economic losses. Visual impairment and poor eyesight are potential contributing factors to these accidents, as they can affect a driver's ability to react to hazards,

navigate roads, and respond to traffic signals. Despite the importance of good eyesight for safe driving, there is limited awareness and inadequate regulation regarding vision testing and correction for drivers in Uganda.

In Bushenyi, between January to June 2012, 87 passengers were seriously injured due to road traffic accidents and out of these, 17 were confirmed dead [1]. Visual issues surrounded the cause of these accidents.

This study aims to investigate the effect of eyesight on traffic accidents in Bushenyi district with the focus on establishing the proportion of drivers with reduced visual acuity, identify factors leading to reduced vision acuity and examine factors associated with road accidents.

Purpose of the Study:

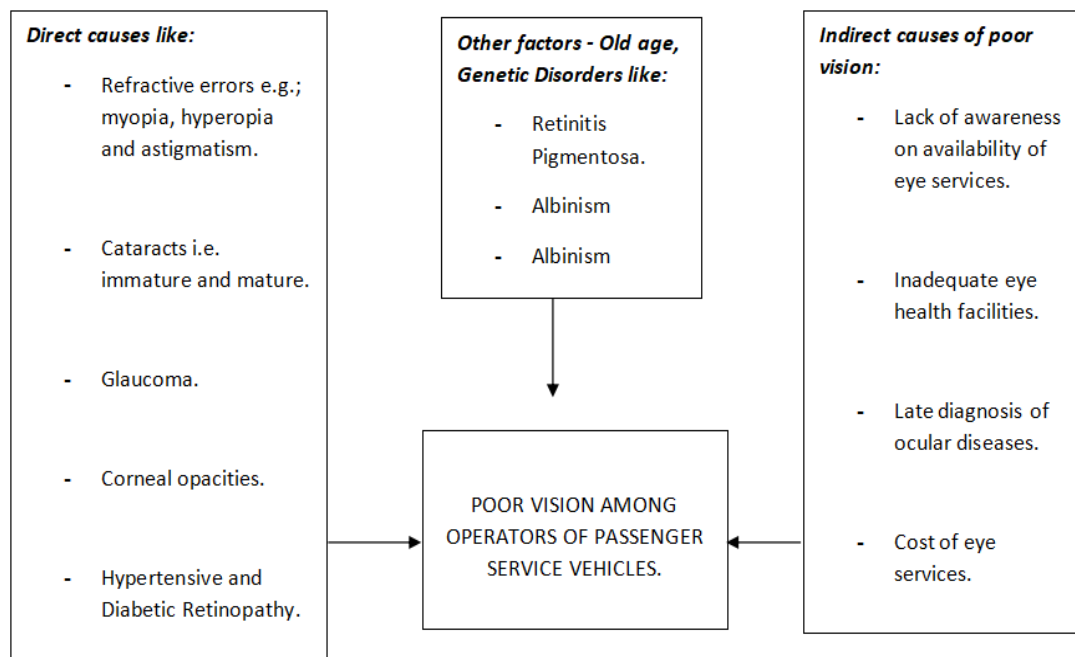
General Objective

To assess the vision of drivers of Passenger Service Vehicles operating across Bushenyi – Ishaka Municipality, Bushenyi District-Uganda.

Specific Objectives

1. To determine the proportion of drivers of Passenger Service Vehicles with reduced visual acuity for driving, across Bushenyi-Ishaka Municipality.
2. To examine the factors contributing to reduced vision among drivers of Passenger Service Vehicles with visual acuity less than 6/9, across Bushenyi-Ishaka Municipality.
3. To investigate the factors associated with road traffic accidents among drivers of Passenger Service Vehicles operating across Bushenyi-Ishaka Municipality.
4. To establish the level of awareness and utilization of eye services among operators of Passenger Service Vehicles operating across Bushenyi-Ishaka Municipality.

Conceptual Framework



(Source: *Eye Diseases in Hot climates*, John Sandford Smith, 1993).

Limitations and Strength of the Study

1. There was the respondent's fear to cooperate with the view that their licences may be revoked on account of their level of visual acuity. The respondents were assured of confidentiality and informed it was purely for study purposes.
2. The strength of this study was as a result of my own skills and the appropriate equipment which made the evaluation of the study possible.

Materials and Methods

Study Area

The study was conducted in Bushenyi District which is located in Southwestern Uganda. The road network in Bushenyi District comprises of mostly feeder roads which are poorly maintained and tend to become very impassable especially in the rainy season. The roads are narrow and are shared between pedestrians, motorcycle riders, motor drivers, cyclists and animals. This makes the roads very congested hence increasing the risk of accidents.

With an estimated population of 251,000 people, [1] an aggregated 75% of its population use motorcycle (Boda Bodas) and taxis as a means of transport. The motorcycles (Boda Bodas) are predominantly used than any other means though the taxis and bicycles and are spread all over the district [1].

The district has two main taxi parks referred to as Ishaka and Bushenyi parks respectively. The Ishaka Park is much bigger and busier.

The offices of Ishaka Bushenyi Taxi Owners & Drivers' association (IBUTODA) are located in Ishaka town. The IBUTODA offices were used for examining the drivers of the PSV's during the Traffic police road stop and check exercise.

Study Population

The target population of 392 drivers of Passenger Service Vehicles who plied the Ishaka -Bushenyi road during the road stop and check exercise, and drivers of PSV are registered under IBUTODA.

Sampling Method

The two-stage cluster sampling was used because it is useful in studying sparsely distributed populations. Two clusters used were:

1. The first cluster comprised of the 242 drivers of PSV's who are registered under the Ishaka- Bushenyi Taxi Owners & Drivers' Association (IBUTODA). The list of these operators was obtained from the management of IBUTODA.
2. The second cluster targeted 150 random PSV drivers who plied the Ishaka-Bushenyi road in June 2013 at the time of data collection. A total of 392 operators of passenger service vehicles were interviewed and examined.

Data Collection Tools

1. **Questionnaire:** This tool was used since the study was concerned with variables that could not be directly observed for example, views and feelings of the respondents. The sample size was also quite large (392) and given the time constraints, questionnaire was the ideal tool for collecting this data. Questionnaire is ideal because the information needed can easily be described in writing and it was used to collect quantitative data
2. **Data sheet:** This tool was used because it allowed the researcher to easily obtain qualitative data on Clinical findings during ophthalmic examination of the respondents.
3. **Focus group discussion guide:** This tool was also used to collect qualitative data.

It consisted of 242 PSV drivers registered with IBUTODA, some random PSV drivers at the Police Traffic checks and five key informants.

Data Analysis and Presentation

Both Qualitative and Quantitative data was collected because both methods supplemented each other. The qualitative methods provided in-depth explanations while quantitative methods provided the numerical data needed to meet required objectives.

1. **Qualitative data:** Qualitative data collected was coded, decoded and tabulated so as to generate patterns of resemblance and divergences. This helped to generate categories of data so as to deduce conclusions.
2. **Quantitative data:** Quantitative Data collected was entered using EPI INFO and exported to SPSS computer program for analysis.

The statistical significance in the quantitative data analysed was tested using Spearman's rho correlation coefficient at bivariate analysis to sort out the independent variables which were significant and in order to control the co funders; these variables were later combined together and tested at multivariate analysis level so as to come up with the significant ones. The data was analysed at three levels as seen below;

1. **Univariate analysis:** The data was summarized in to numerical data and categorical data. Numerical data was summarized using measures of central tendency (mean, mode and median) and measures of dispersion (standard deviation, variance, quartiles and range). Categorical data was summarized in percentages and proportions.
2. **Bivariate analysis:** This level of data analysis helped to identify the relationship between two variables i.e. the dependent variable and independent variable. There are usually many independent variables and one or two dependent variables, but we dealt with one by one. It helped to

generate the variables which are more significant in the study.

3. **Multivariate analysis:** This is the last level of data analysis which helped to identify the most significant variables in the study and it helped in adjusting for co-founding variables.

Recommended Data Collection Instruments / Equipment

The following instruments were used during data collection:

1. Snellens chart, for testing the distance vision of the respondents.
2. Direct ophthalmoscope, for assessing the retina of the respondent.
3. Ishihara colour plates, for testing the colour vision of the respondents.
4. Pin hole, this helped to rule out any refractive error of the respondent.
5. Trial set, this is a box of lenses used to correct refractive errors.
6. Mydriatic eye drop, this was used in some cases to dilate the pupil during retinal examination.
7. Blood pressure machine, this was used to measure the blood pressure of respondents especially suspected to be having hypertensive retinopathy.
8. A portable Slit lamp machine, this is a machine which magnifies the eye structures, hence making examination much simpler.
9. Torch, for examination of the anterior segment of the eye.
10. Tonopen, for measuring the intraocular pressure of the eye especially for motorists suspected to be having glaucoma.
11. Retinoscope, for diagnosing refractive errors.

The instruments which were used routinely on every participant are;

1. Visual acuity chart.
2. Torch.

3. Ophthalmoscope.

The rest of the instruments were used depending on the clinical findings.

Ethical Consideration

Institutional Consent

Ethical approval for the study was obtained from the research and ethics committee of Kampala International University (KIU). Permission was obtained from the management of IBUTODA to use their premises during the study. Permission was also obtained from the Uganda Police Traffic Department, Bushenyi branch to allow their staff to work with the research team.

Informed Consent

After explaining the details and the purpose of the study to the respondents, written consent for the participation was obtained. Confidentiality was observed during data collection, entry, storage, analysis and presentation of results. Respondents were assured of maximum protection during the study and they were at liberty to withdraw from the study whenever they wished.

IBUTODA staff were identified and briefed on the exercise and were requested to assist in the following ways;

1. Identifying the selected respondents with valid driving licences.
2. Directing the respondents to the examination premises.
3. Explaining and reassuring the selected respondents that their licenses will not be withdrawn even if they are diagnosed with eye problems.

Results

From May 2013 to August 2013, a total of 392 operators of passenger service vehicles were examined to determine their visual status. All the 392 operators of passenger service vehicles examined were male and they had valid driving licenses.

Table 1. Summary of Respondent Bio-data

		Count	Percentage
Age of the Respondents	20 – 30yrs	86	22%
	30 - 40yrs	192	49%
	40yrs - Above	114	29%
Total		392	100%
Religion of Respondent	Catholic	118	30%
	Protestant	198	51%
	Moslem	65	17%
	Others	11	3%
Total		392	100%
Highest level of Education Attained	None	35	9%
	Primary	183	47%
	Secondary	140	36%
	Tertiary	34	9%
Total		392	100%
Marital Status of Respondent	Married	340	87%
	Single	52	13%
Total		392	100%

Summary of Respondent Bio-data

The Table 1 above, Shows a summary of the respondent's bio- data (Age, Religion, highest level of education and marital status) with their percentages. The table shows that the biggest percentages of the respondents were those above 30 years of age (78%) and

the remaining percentage were those below 30 years of age (22%). Most of the respondents were Protestants. The highest level of education attained by most of the respondents is primary level (47%) and majority of the respondents were married (87%) while the remaining numbers were single (13%).

Table 2. Summary of Respondent Data

		Count	Percentage
Eye check-up before obtaining driving license	Yes	200	51%
	No	192	49%
Total		392	100%
Place where eye checkup was done	Eye Clinic	73	19%
	General Clinic	127	32%
	No Check Up	192	49%
Total		392	100%
Involvement in accident	Yes	75	19%
	No	317	81%
Total		392	100%
Number of accident times	1 - 5times	74	19%
	No Accident	317	81%
Total		391	100%

Cause of the accident involved	Reckless Driving	38	10%
	Over Speeding	27	7%
	Others	8	2%
	No Accident	318	81%
Total		391	100%
How long has the respondent been driving?	0 - 5 yrs	138	35%
	5 - 10yrs	98	25%
	10yrs - Above	156	40%
Total		392	100%
Does the respondent wear glasses?	Yes	42	11%
	No	350	89%
Total		392	100%
How long has the respondent worn glasses?	0 - 2yrs	34	9%
	2yrs - Above	9	2%
	Not Worn Glasses	349	89%
Total		392	100%
Are the glassess for distance or near vision?	Distance	37	9%
	Near	4	1%
	Not Worn Glasses	351	90%
Total		392	100%
Visual acuity of the respondent	Greater than 6/9	343	88%
	Less than 6/9	49	13%
Total		392	100%
Respondent's eye diagnosis	Normal Eyes	137	35%
	Allergic Reactions	170	43%
	Refractive Errors	36	9%
	Other	49	13%
Total		392	100%

Source: Primary Data

Summary of Respondent Data

Table. 2 above summarizes the data which was obtained from the respondents according to the questionnaire and it shows the different percentages. The table shows the different factors which were considered during the study for example, Eye check-up before obtaining driving license whereby, 200 (51%) of the respondents had eye check-up and 192 (49%) did not have eye check-up before

obtaining a driving license, Place where eye check-up was done, whereby some respondents went to the eye clinic while some went to the general clinic for eye check-up, involvement in accidents, use of glasses, Visual acuity of the respondents whereby 343 respondents had visual acuity greater than 6/9 and 49 respondents had visual acuity less than 6/9.

Objective 1. Proportion of Operators of Passenger service Vehicles with Reduced Visual Acuity for Driving, across Bushenyi- Ishaka Municipality

In order to achieve this objective, the following data was necessary.

Visual Acuity

Visual acuity was tested in both eyes (one eye at a time) using Snellen's chart at a distance of 6 meters. Those drivers with visual acuity less than 6/9 in both eyes were further examined to find out the cause.

Measurement of Visual Acuity (VA)

Visual acuity, which is the sharpness or clarity of vision, is commonly measured using a Snellen chart. This chart displays rows of letters or symbols in decreasing sizes. The patient reads the chart from a set distance, typically 20 feet or 6 meters, and the smallest line they can clearly identify determines their visual acuity.

Here's a more detailed explanation:

1. The Snellen Chart:

- The Snellen chart is a standardized eye chart with rows of letters or symbols that decrease in size as you move down the chart.
- Each row corresponds to the distance at which a person with normal vision can read that line.

- For example, a line labeled "20/20" means that a person with normal vision can read that line at 20 feet.

2. Testing Procedure:

- The patient sits or stands 20 feet (or 6 meters) away from the chart.
- The examiner covers one of the patient's eyes with a paddle or piece of paper or asks the patient to cover their own eye with one hand.
- The patient reads the letters aloud, starting from the top of the chart and progressing to smaller lines.
- The examiner notes the smallest line of letters the patient can read accurately.
- The same procedure is repeated for the other eye.

3. Recording Results:

- Visual acuity is recorded as a fraction, such as 20/20 or 6/6.
- The top number of the fraction represents the distance at which the patient was tested (20 feet or 6 meters).
- The bottom number represents the distance at which a person with normal vision can read the same line.
- For example, 20/40 vision means the patient sees at 20 feet what a person with normal vision sees at 40 feet.

Percentage of Respondents on Visual Acuity

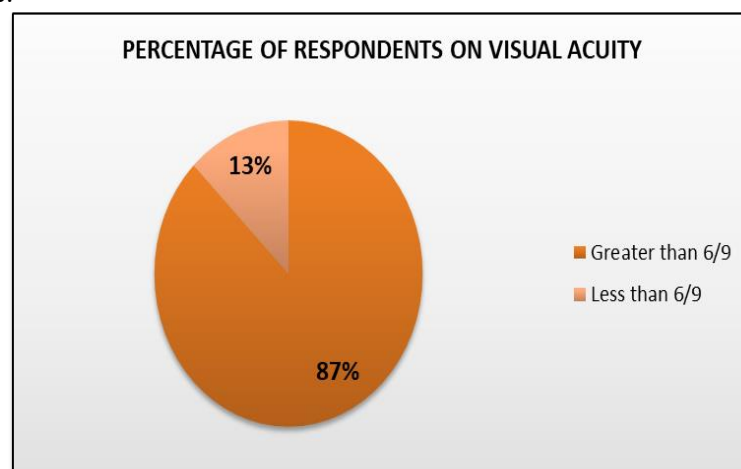


Figure 1. Showing Respondents Visual Acuity

Source: Primary Data

According to figure 1 above, 343 (87%) of the operators of passenger service vehicles had visual acuity greater than 6/9 in both eyes. while 49 (13%) of them had visual acuity less than 6/9 in both eyes. These findings probably could be due to the fact that most of the respondents visited a health worker for eye check-up before obtaining a driving license.

Table 3. A Cross Tabulation of Eye Diagnosis and Visual Acuity of the Respondent

		Visual Acuity of the Respondent				Total	
		Greater than 6/9		Less than 6/9		Count	%
		Count	%	Count	%		
Respondent's Eye Diagnosis	Normal Eyes	137	40%	0	0%	137	35%
	Allergic Reactions	170	50%	0	0%	170	43%
	Refractive Errors	1	0%	35	71%	36	9%
	Other	35	10%	14	29%	49	13%
Total		343	100%	49	100%	392	100%

Source: Primary Data

According to table 3 above, Of the 49 operators of passenger service vehicles with visual acuity less than 6/9, (poor vision), 35 (71%) had refractive errors, while 14 (29%) respondents had other ocular conditions like

cataracts, uveitis corneal scars and glaucoma. And all the respondents with normal eyes and allergic conjunctivitis had normal vision. Here, refractive error was found to be the leading cause of poor vision among the respondents.

Table 4. Factors Contributing to Reduced Vision

		Respondent's Eye Diagnosis			
		Refractive Errors		Other	
		Count	%	Count	%
Factors for Reduced Vision	Old Age	17	65%	9	35%
	Family History	6	86%	1	14%
	Accident	12	75%	4	25%

Source: Primary Data

Table 4 above shows the factors contributing to reduced vision among respondents with visual acuity less than 6/9 due to refractive errors and other conditions like; cataracts, uveitis, glaucoma and corneal scars. Here, reduced vision was mostly associated with family history of poor vision (86%), followed by trauma or home accidents (75%) and finally old age (65%).

Objective.2 Factors Contributing to Reduced vision Among Operators of Passenger Service Vehicles with Visual Acuity less than 6/9, across Bushenyi - Ishaka Municipality

To achieve our objective, the following data was necessary for achieving this objective.

Objective 3. Factors Associated with Road Traffic Accidents among Operators of Passenger Service Vehicles Operating across Bushenyi-Ishaka Municipality

In order to achieve this objective, the following data was obtained.

Table 5. Visual Acuity and Road Traffic Accident Involvement

		Involvement in Accident				Total	
		Yes		No		Count	%
		Count	%	Count	%		
Visual acuity of the Respondent	Greater than 6/9	60	17%	283	83%	343	100%
	Less than 6/9	15	31%	34	69%	49	100%
Total		75	19%	317	81%	392	100%

Source: Primary Data

Table 5 above, shows the relationship between visual acuity and the risk of getting involved in an accident. It was observed that operators of passenger service vehicles with visual acuity less than 6/9 in both eyes were more likely to get involved in accidents (31%)

as opposed to those with visual acuity greater than 6/9 in both eyes (17%). This is because, poor vision makes it difficult to judge the distance of objects while driving hence causing an accident. This was statistically significant with a p value of 0.004.

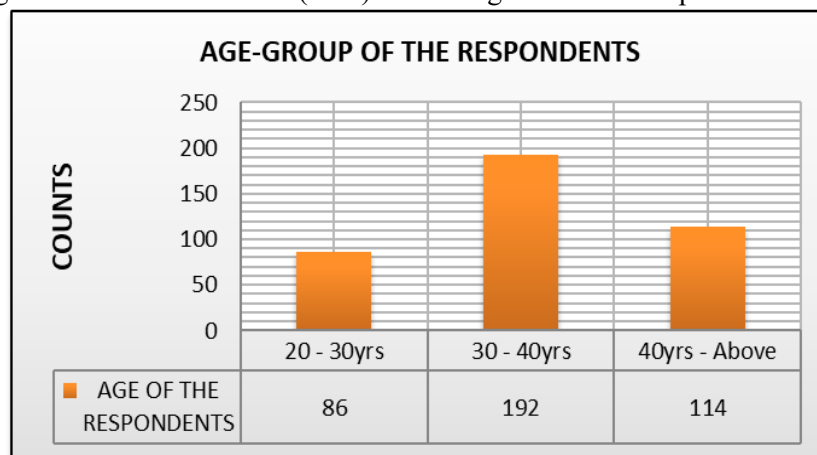


Figure 2. Age distribution of operators of Passenger Service Vehicles operating across Bushenyi –Ishaka Municipality (n = 392)

Source: Primary Data

As shown in figure 2 above, most of the drivers were in the age range of 30-40 year followed by drivers above 40 years of age. The

age group with the lowest number of drivers was in the range of 20-30 years.

Table 6. Age Group of the Respondents and History of Road Traffic Accident Involvement

		Involvement in Accident				Total	
		Yes		No		Count	%
		Count	%	Count	%		
Age of the Respondents	20 - 30yrs	20	23%	66	77%	86	100%
	30 - 40yrs	43	22%	149	78%	192	100%
	40yrs - Above	12	11%	102	89%	114	100%
Total		75	19%	317	81%	392	100%

Source: Primary Data

As shown table 6 above, the respondents in the age range of 20-30 yrs were more likely to get involved in accidents (23%), as compared to those respondents in the higher age range (11%). This could be because; the young drivers had less driving experience as

compared to the older drivers. This was found not to be statistically significant with a p value of 0.666.

Eye Check-up before Obtaining a Driving License and Road Traffic Accident Involvement

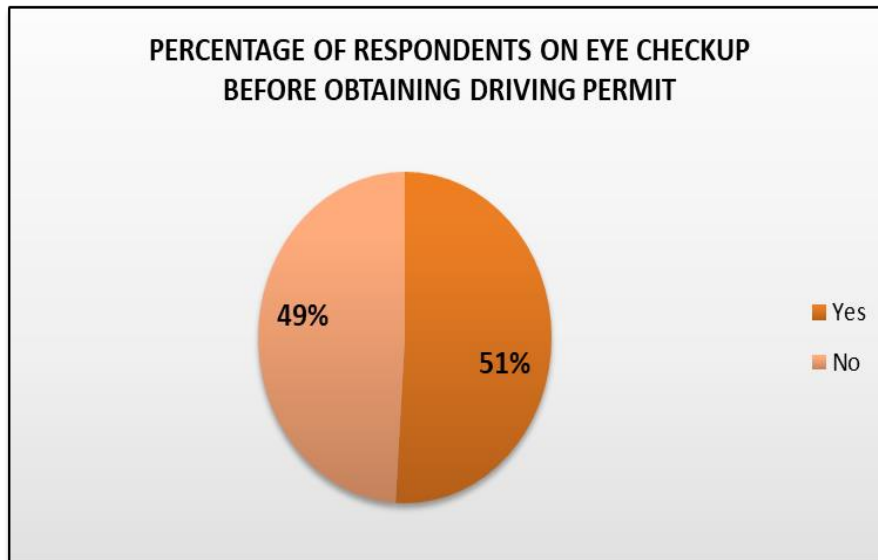


Figure 3. Percentage of Respondents whose Eyes were Checked before Obtaining Driving License

Source: Primary Data

According to figure 3 above, (49%) of the respondents did not have eye check-up before obtaining driving license. Probably because

they did not know where to go for eye check-up while obtaining a driving license.

The Place where Eye Check-up was Done

Table 7. Showing the Place where Eye Check-up was done

		Frequency	Percent
Valid	Eye Clinic	72	36.2
	General Clinic	127	63.8
	Total	199	100.0

Source: Primary Data

According to table 7 above, 72 (36.2%) of the respondents had their eyes checked at the eye clinic while 127 (63.8%) of the respondents had their eyes checked at the general clinic, the remaining respondents did not have their eyes checked at all before

obtaining driving license. The number of respondents who did not have eye check-up before obtaining driving license was high, this could be because, they did not know where to go for eye check-up.

Table 8. Eye check-up before Obtaining Driving License and Road Traffic Accident Involvement

		Involvement in Accident				Total	
		Yes		No		Count	%
		Count	%	Count	%		
Eye check-up before Obtaining Driving license	Yes	17	9%	183	92%	200	100%
	No	58	30%	134	70%	192	100%
Total		75	19%	317	81%	392	100%

Source: Primary Data

Table 8 above, shows the relationship between Eye check-up before obtaining a driving license and the likelihood of getting involved in Road traffic Accident. The risk of getting involved in road traffic accident is high when the drivers' eyes are not checked at all (30%) while the risk of getting involved in road traffic accident after eye check-up is

smaller (9%). Probably this is because, when drivers go for eye check-up while obtaining a driving license, poor vision can be detected early hence reducing the risk of getting involved in an accident. This was found not to be statistically significant with a p value of 1.000.

Table 9. Place where Eye Check-up was Done and Road Traffic Accident Involvement

		Involvement in Accident				Total	
		Yes		No		Count	%
		Count	%	Count	%		
Place where Eye Checkup was Done	Eye Clinic	7	10%	66	90%	73	100%
	General Clinic	10	8%	117	92%	127	100%
Total		17	9%	183	92%	200	100%

Source: Primary Data

Table 9 above shows the relationship between the place where eye check-up was done and the likelihood of getting involved in road traffic accident. Respondents whose eyes were checked at the eye clinic were more likely to get involved in road traffic accidents (10%) as compared to those whose eyes were

checked at the general clinic (8%). This means that, the place of eye check-up does not matter, but the most important thing is to have the eyes checked before one gets a diving license. This was found not to be statistically significant with a p value of 0.321.

Table 10. Duration of Driving and Road Traffic Accident Involvement

		Involvement in Accident				Total	
		Yes		No		Count	%
		Count	%	Count	%		
How long has the Respondent been Driving?	0 - 5 yrs	34	25%	104	75%	138	100%
	5 - 10yrs	27	28%	71	72%	98	100%
	10yrs - Above	14	9%	142	91%	156	100%
Total		75	19%	317	81%	392	100%

Source: Primary Data

Table 11. Multivariate Analysis

Variables in the Equation							
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1 ^a	VA	-2.117	.738	8.242	1	.004	.120
	AGE	.215	.498	.186	1	.666	1.240
	Eye check-Upbe4dl	17.495	4.019E4	.000	1	1.000	3.961E7
	Driving period	.580	.386	2.262	1	.133	1.786
	Eye check-up place	.556	.561	.984	1	.321	1.744
	Constant	-15.165	4.019E4	.000	1	1.000	.000
a. Variable(s) entered on step 1: VA, AGE, DRIVINGPERIOD, and EYECHECK-UPPLACE. EYECHECK-UPBE4DL- (Eye check up before obtaining driving licence).							

Source: Primary Data

From table 11 above, it shows that out of the five factors tested; only visual acuity was found to be significantly associated with road traffic accident involvement ($p=0.004$).

Objective 4. Level of Awareness and Utilization of Eye services by Operators of passenger Service Vehicles Operating across Bushenyi- Ishaka Municipality

To achieve this objective, the following data was obtained from the FGD and key informants.

The study investigated respondent's knowledge about the causes of poor vision, where to access eye care services and the challenges in accessing eye services.

Several issues emerged from both the FGD and in-depth interview. These causes of poor vision, where level of access to eye health services and the challenges faced in accessing eye health services.

Knowledge on the Causes of Poor Vision and the Categories of People who usually Suffer from Poor Vision

A number of responses emerged from the FGDS and KI interviews regarding the causes of poor vision and the categories of people who suffer from poor vision. Most respondents were of the view that poor vision is caused by old age. Some respondents said that, poor vision is caused by dust. While some discussants thought that poor vision is caused

by smoke from the kitchen, drinking waragi, (local gin) smoking tobacco and eating "mirunji"-which are scientifically not known causes of poor vision. However, it emerged from in depth interview that old people and children are the ones at risk of getting poor vision.

Knowledge on Availability of Eye Care Services

A majority of the respondents had full knowledge of the tertiary eye care service availability mainly at Ruharo eye centre in Mbarara (60km away) and few knew about other tertiary eye care centres like Mengo hospital and Mulago Hospital. Other respondents knew that people can access eye care services from drug shops and traditional healers. However, they suggested that eye services should be introduced in all the hospitals in Bushenyi district like Ishaka Adventist Hospital, Kampala International University Teaching Hospital (KIUTH) and Comboni Hospital so as to reduce the burden of going up to Ruharo in Mbarara.

Challenges Faced by People with Poor Vision Especially in Accessing Eye Care Services

Most respondents echoed lack of money for buying eye medicines, transport to the hospital and for buying glasses as the main challenge in accessing eye care services. Some

respondents cited availability of few eye care centres in the district as one of the challenges in accessing eye care services by people with poor vision. Inadequate social support was cited by some respondents as a challenge in accessing eye care services by people with poor vision especially among the elderly whose children no longer stay with them. Failure to get a helper to escort one to the eye care centre makes some patients fail to access the services.

Inadequate community sensitization by health workers and politicians about the location, availability and cost of eye care services was also cited as one of the challenges in accessing eye care services.

How to Overcome the above Challenges

A number of suggestions were raised in the FGD on how to overcome the challenges faced by people with poor vision.

Most of the respondents were of the view that, in order to overcome the above challenges, the government should build enough eye units in the district and the eye medicines and glasses should be provided to the communities for free of charge. Some respondents suggested that, people should be taught on the kind of diet to eat so as to prevent blindness and some respondents suggested that people should be sensitized on where to access the eye services.

Discussion

Discussion of findings According to the Objectives

Proportion of operators of passenger service vehicles with reduced visual acuity for driving, across Bushenyi –Ishaka Municipality

Forty-nine (13%) of the respondents had visual acuity less than 6/9 in both eyes. These drivers failed to meet the visual requirement for driving, which is a visual acuity of at least 6/9 in both eyes (WHO definition of visual acuity for driving). The findings are similar to

a Kenyan study by Mwangi, [7], a study by Davison in UK, a study by Mantyjarv in Finland and a study by Harms e tal in Germany whereby, a number of the drivers examined failed to meet the visual requirement for driving [8].

The finding of 13% of the drivers who did not meet the visual requirement for driving in this study is very high when compared to other countries, almost 4 times that in UK and only comparable to Kenya. This could be due to the fact that, unlike in UK, a majority of drivers in Uganda do not have their eyes checked before obtaining a driving license. According to this study, it was found that 192 (49%) of the respondents did not have their eyes checked at all before obtaining a driving license. And those who had eye check-up, a majority of them (32%) had their eyes checked at the general clinic by non- eye care workers.

This contradicts the Ophthalmological society of east Africa (OSEA) recommendation of 2005 that all driving license application forms must be filled by a qualified eye health worker [15]

Factors contributing to reduced vision among operators of passenger service vehicles with visual acuity less than 6/9, across Bushenyi- Ishaka Municipality

In this study, out of the 49 drivers who had visual acuity less than 6/9 in both eyes, 35 (71%) had simple refractive errors, 14 (29%) had other ocular conditions like cataracts, uveitis, glaucoma and corneal scars. The factors which were identified by the drivers to be associated with poor vision were; old age (49%), accidents (34%) and family history of poor vision (17%). Drivers with refractive errors without correction are likely to be involved in road traffic accidents because uncorrected refractive errors lead to difficulty in reading traffic road signs and interpreting the distances of objects including vehicles. A driver with poor visual acuity requires an obstacle to be near before its significance can

be appreciated leaving less time to react. The findings in this study are consistent with similar studies done in other countries. Mwangi in her study in Kenya, Guest and Jennings in Australia, Davson and Harms in Germany, G Ovenseri and M Adofu in Cape Town [17]. and RSA insurance company in UK also found refractive errors as the most common cause of visual impairment among PSV drivers.

However, the above findings differ from those in a study by Grace Sali in Kampala Uganda who found that 18.4% of the PSV drivers had cataracts, whereby 8 drivers had incipient cataracts, and 1 driver had traumatic cataract in the right eye following trauma one year prior to examination and the visual acuity in that eye was 6/36 [12]. This could be because, during the time of her study, there were many patients with cataracts as Vision 2020 program of elimination of avoidable blindness had not rolled throughout the whole country.

In this study, four drivers were found with glaucoma, only one had colour deficiency (red-green). This driver also had allergic conjunctivitis. This is almost similar to the Kenyan study by Mwangi, where only 1.7% of PSV drivers in Nairobi had colour deficiency [7].

Factors associated with road traffic accidents among operators of passenger service vehicle operating across Bushenyi-Ishaka Municipality

Visual acuity and road traffic accident involvement

This study revealed that, the operators of passenger service vehicles with visual acuity less than 6/9 were more likely to get involved in accidents (31%) while those drivers with visual acuity greater than 6/9 were less likely to get involved in accidents (17%). This means that poor vision predisposes to road traffic accidents [2, 3]. The findings in this study are consistent with those of other studies by

Ovenseri et al in Ghana and Kulmala et al on association between poor vision and road traffic accidents [20] whereby, During the 10-year follow-up of the participants, 239 (58%) participants suffered at least one injurious accident. The risk for injurious accidents in a multivariate model adjusted for age, gender, eye-related diseases, diabetes and cardiovascular diseases among participants with lowered vision was 1.45 (95%) compared with that for people with normal visual acuity. Participants with visual impairment had an increased risk for injurious accidents whereby, commercial vehicle drivers with visual acuity less than 6/9 were more involved in accidents compared to those with visual acuity greater than 6/9.

Visual acuity and road traffic accident involvement were found to be statistically significant. ($p=0.004$). A driver with poor vision is at risk of causing accident because poor vision makes the drivers fail to judge the distance of an object from them hence affecting the reaction time.

Drivers with poor vision cannot interpret colours for example of the traffic lights; hence this puts them at risk of getting involved in accidents. However, a study which was conducted in Ghana by Ocansey Stephen in 2010 [11], found that there are a number of other physical conditions a part from poor vision which can affect safe driving and physical abilities which are necessary for avoiding accidents. Physical conditions which can lead to accidents include poor hearing, illness, and fatigue. Good vision is important for safe driving and avoiding accidents. You need to have good visual acuity, peripheral vision, depth perception, and glare resistance and recovery. Good vision allows you to identify potential hazards and react more quickly. You also need to keep your view unobstructed by not hanging things from your mirrors or otherwise blocking your windows, and keeping your windows and mirrors clean.

A number of accidents are caused by not checking blind spots.

Age group of Respondent and History of Road Traffic Accident Involvement

This study found that, operators of passenger service vehicles in the age range of 20 -30 years were more likely to get involved in accidents (23%) compared to those in the higher range (11%). This means that the young drivers with less driving experience were more likely to get involved in accidents due to their less experience in driving compared to older drivers with much experience in driving. Although age was found to be insignificantly associated with road traffic accident involvement ($p=0.666$), the findings are similar to the study which was conducted by Vingrys et al, on 17,500 Californian drivers, whereby, there was a weak association between road traffic accident involvement and advancing age or much experience in driving this was because, the older drivers were more careful while driving as compared to the younger drivers [16]. the relationship between age group of respondents and accident involvement was found to be statistically significant in this study. However, a study by Cynthia Owsley et al, in UK, found that older drivers were more likely to get involved in road traffic accidents compared to the young drivers and this was because the older drivers were more nervous while driving compared to younger drivers [18].

Relationship between Duration of driving and Road Traffic Accident Involvement

This study also found that the duration of driving was important in road traffic accident involvement, whereby, those drivers who had driven for less than 10 years were more likely to get involved in road traffic accidents (28%) as compared to those drivers who had driven for more than 10 years (9%). Although duration of driving was found to be insignificantly associated with road traffic

accidents ($p=0.133$), these findings are consistent with a study by Eunice Kennedy on Effect of Experience on Driving Performance in New Teenage Drivers whereby, Motor vehicle crash rates were highest among teen drivers, especially during the first six months and 1000 miles of independent licensed driving. Crash rates decline with driving experience; however, no research has demonstrated learning effects on performance due to independent driving experience and the extent and variability in driving performance among young drivers.

You should have your vision checked and wear prescription lenses as necessary to compensate for a visual deficiency.

Eye Check-up before Obtaining Driving License and Road Traffic Accident Involvement

This study revealed that the risk of getting involved in road traffic accident when the eyes are not checked before obtaining a driving license was high (30%), while the risk of getting involved in road traffic accident after eye check-up before obtaining a driving license was smaller (9%) therefore, this suggested that there was need for all operators of passenger service vehicles to undergo eye check-up before obtaining a driving license so as to reduce the risk of getting involved in accidents. Eye check-up before obtaining a driving license is important because it helps in early diagnosis of conditions like; Refractive error, Amblyopia, Strabismus, Eye teaming problems, Focusing problems, glaucoma and diabetic retinopathy among others, once these conditions are diagnosed and managed early, then the risk of accidents will be reduced.

Although the relationship between eye check-up before obtaining driving license and road traffic accident involvement was found to be statistically insignificant ($p=1.000$), these findings are similar to those in a study by Eby GW in America [19]. The eye test that you

take when you get your driver's license renewed is an example of a vision screening.

Depending on who is performing the test and where the test is given, vision screenings may include tests for blur, muscle coordination and/or common eye diseases. Keep in mind that a vision screening can indicate that you need to get your eyes checked, but it does not serve as a substitute for a comprehensive eye exam.

Eye Check-up Place and Road Traffic Accident Involvement

This study also revealed that the respondents whose eyes were checked at the eye clinic were more at risk of getting involved in road traffic accidents as compared to those whose eyes were checked at the general clinic. Therefore, the place where respondents go for eye check-up does not matter but what is more important is to have eye check-up before obtaining a driving license. Although the relationship between place of eye check-up and road traffic accident involvement was found to be statistically insignificant ($p=0.321$), these findings are similar to those in a study by Kulmala et al in Australia whereby majority of commercial drivers went to the general practitioners to have their eyes checked when getting driving licenses [20].

Level of Awareness and Utilization of eye services by operators of Passenger Service Vehicles operating across Bushenyi-Ishaka Municipality

The study investigated participant's knowledge about the causes of poor vision, where to access eye care services and the challenges in accessing eye services.

Several issues emerged from both the FGD and in-depth interview. These included causes of poor vision, where to access eye health services and the challenges faced in accessing eye health services.

Knowledge on the Causes of Poor Vision and the Categories of People who usually suffer from Poor vision

A number of responses emerged from the FGDS and KI interviews regarding the causes of poor vision and the categories of people who suffer from poor vision. Most respondents were of the view that poor vision is caused by old age. Some respondents said that, poor vision is caused by dust. While some discussants thought that poor vision is caused by smoke from the kitchen, drinking waragi, smoking tobacco and eating "mirunji"-which are scientifically not known causes of poor vision. However, it emerged from in depth interview that old people and children are the ones at risk of getting poor vision, this is because they are the group with low immunity and they are always neglected. The discussants also cited poor feeding as one of the causes to poor vision.

Awareness on Availability of Eye Care Services

A majority of the respondents had full knowledge of the tertiary eye care service availability mainly at Ruharo eye centre in Mbarara (60km away) and few knew about other tertiary eye care centres like Mengo hospital and Mulago Hospital. Other respondents knew that people can access eye care services from drug shops and traditional healers. However, they suggested that eye services should be introduced in all the hospitals in Bushenyi district like Ishaka Adventist Hospital, KIUTH and Comboni Hospital so as to reduce the burden of going up to Ruharo in Mbarara. Some discussants suggested that there is need for community sensitization about the availability of these services in the district. However, a study by Eby GW in America found that, the most reported barrier to treatment was ignorance. The majority of respondents 67 (32.5%) indicated that they were not aware of their visual problem while 24 (11.7%) could not

make out time to go for an eye examination. Another 23 (11.2%) reported cost as the reason for not having an eye examination.

Challenges faced by Respondents with Poor Vision especially in accessing Eye Care Services

Most respondents pointed out lack of money for buying eye medicines, transport to the hospital and for buying glasses as the main challenge in accessing eye care services. Some respondents cited availability of few eye care centres in the district as one of the challenges in accessing eye care services by people with poor vision. Inadequate social support was cited by some respondents as a challenge in accessing eye care services by people with poor vision especially among the elderly whose children no longer stay with them. Failure to get a helper to escort one to the eye care centre makes some patients fail to access the services.

Inadequate community sensitization by health workers and politicians about the location, availability and cost of eye care services was also cited as one of the challenges in accessing eye care services.

How to Overcome the above Challenges

A number of suggestions were raised in the FGD on how to overcome the challenges faced by people with poor vision. Most of the respondents were of the view that, in order to overcome the above challenges, the government should build enough eye units in the district and the eye medicines and glasses should be provided to the communities for free of charge. Some respondents suggested that, people should be taught on the kind of diet to eat so as to prevent blindness. Some respondents suggested that there is need to sensitize people about eye services through their local leaders, and religious institutions. This could be an area for further research.

Conclusions

Forty-nine (13%) of the respondents had visual acuity less than 6/9, this means that, they did not meet the WHO visual requirement for driving.

The commonest cause of reduced vision among the operators of passenger service vehicles with visual acuity less than 6/9 was simple correctable refractive error (71%) and the factors which contributed to reduced vision were; old age (49%), accidents (34%) and family history of poor vision (17%).

Poor vision is associated with increased risk of road traffic accidents. ($p=0.004$).

There is generally a low awareness about eye check-up before obtaining a driving license and the barriers to obtaining these services are; inadequate numbers of eye specialists to carry out eye check-ups, lack of sensitization to the drivers and other stake holders about the importance of eye screening before obtaining a driving license and the cost of the eye services.

Conflict of Interest

I Okaali Simon Daniel hereby declare that, there is no conflict of interest in this work and I certify that, the submission is original work and it is not under review at any other publication.

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References

- [1]. Bushenyi District Records Department, 2012, *Annual Report (unpublished)*.
- [2]. Owsley, C., 1999, *Vision impairment and Driving*.
<https://www.sciencedirect.com/science/article/pii/S0039625799000351>
- [3]. International Centre for Eye health journal, 1998, *Vision and Driving*, vol.6, Pgs, 10-11.
- [4]. John Sanford Smith, 1993, *Eye diseases in Hot Climates*.
- [5]. Kanski, J. J., 1999, Clinical Ophthalmology 4th Edition., *The Glaucoma Perimetry*, Pgs, 6-12., Macmillan publishers Ltd.
- [6]. Kaweesa, S., 2003, Road traffic accidents and Procedure for Registration of Vehicles Imported into Uganda(unpublished).
- [7]. Mwangi, C. W., 2000, Vision assessment of drivers in Nairobi.,dissertation, *University of Nairobi*.
- [8]. Mantyjarvi, et al, 1999, January - March., Visual functions of drivers involved in road traffic accidents. *Journal of Safety Research*, vol.31 no.1-2. Pgs, 121-124.
https://www.researchgate.net/publication/257939664_Trafiksakerhet_skadehandelse_och_prevention_f_or_synskadade_och_blinda_i_norra_delen_av_Sverige_-_ett_vinterlandskap
- [9]. Margie Peden., 2004, World Report on Road Traffic Injury prevention., Pgs, 11-103.
<https://apps.who.int/iris/bitstream/handle/10665/42871/9241562609.pdf>
- [10]. Shanahan., E. M., 2007, A Chapter in Medical Aspects of fitness to Drive.
<https://pubmed.ncbi.nlm.nih.gov/17535380/>
- [11]. Owsley, J., 2010, Social economic differences in road traffic injuries in Mexico, a multi-method Approach, vol.57 Pg,11.
- [12]. Sali, G., 2003, *Vision assessment of public service vehicle drivers operating in and from Kampala.*, Dissertation, Makerere University, Kampala.
- [13]. The Uganda Traffic and Road Safety Act,1998, Application form for Driving Licenses., Section 11.
<https://ulii.org/akn/ug/act/1998/15/eng@2020-05-22>
- [14]. *Uganda National Traffic Police Department Report*, 2003/2006, unpublished.
- [15]. *Ophthalmological society of East Africa (OSEA) meeting recommendation.*, 2005, unpublished.
- [16]. Vingrys et al, 2000. Are colour vision standards justified in the transport industry? *Ophthalmic Physiology*, vol. 6 Pgs,23-38).
<https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1475-1313.1988.tb01056.x>

[17]. Ovenseri Ogomo., Adofu M., 2011. *Poor vision, Refractive errors and barriers to treatment among commercial vehicle drivers in cape coast municipality.*

<https://www.ajol.info/index.php/ahs/article/view/65003>

[18]. Cynthia Owsley, et al., 1998, *Visual processing impairment and risk of motor vehicle crash among older drivers.* Vol. 279.

<https://jamanetwork.com/journals/jama/article-abstract/187414>

[19]. Eby, G. W., 2012, *Importance of eye checkup among American adults.*

[20]. Kulmala., Erapparssinen, O., Sakari., Rantanel, 2010, *Lowered vision as a risk factor for injurious accidents in older people.* <https://link.springer.com/article/10.1007/BF03324744>.

Healthcare Providers' Perceptions of Universal Health Coverage in Lubero and Butembo, DR-Congo

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Abstract

The target of this investigation is to contribute to the implementation of universal health coverage in the Democratic Republic of Congo. As a descriptive, cross-sectional, comparative, and correlational study, it was conducted from March to August 2025. Data collection consisted of a survey questionnaire administered to 920 healthcare providers in both the Lubero Territory and Butembo City. Regarding increased frequency and use of services, expectations on UHC are positive ($M=3.75[3.68; 3.81] \pm 0.05$), increasing rate of income recovery ($M=3.39[3.31; 3.46] \pm 1.15$) and protecting of household finances ($M=3.38[3.32; 3.45] \pm 1.07$). Healthcare providers fear delays in patient bill payments ($M=2.42 [2.35; 2.50] \pm 1.13$) and disruption of input stocks ($M=2.55 [2.47; 2.63] \pm 1.23$). Expectations of healthcare providers vary by residence ($t = 7.06; p = 0.000$), whereas fears do not ($t = 0.00; p = 0.999$). Expectations of healthcare providers vary depending on each one's main job ($F = 3.536; p = 0.001$). The same is observed for fears ($F=3.390; p=0.001$). Perceptions vary by marital status ($F=2.832; p=0.037$) but not by gender ($F=-0.074; p=0.918$). Expectations of healthcare providers of UHC are influenced by the level of education ($r=0.094; p=0.004$) and depend on household income ($r=-0.079; p=0.016$).

Keywords: *Expectation, Fear, Healthcare providers, Perception, Universal Health Coverage (UHC).*

Introduction

Universal health coverage, also known as universal healthcare, is defined by the World Health Organisation (WHO) as a situation in which everyone receives quality health services that meet their needs without experiencing financial hardship [16]. UHC is a situation that facilitates access for all to the health services they need without facing unnecessary financial hardship [25]. Every person, wherever they are, has access to the complete range of quality health services they need, when they need them, without facing financial lack. It encompasses the full range of essential health services throughout life, including health promotion,

prevention, treatment, rehabilitation and palliative care [8, 10, 13]. UHC is characterised by three dimensions: population coverage, service coverage and financial protection [13, 24].

The objectives of universal health coverage can be summarized in four points: ensuring access to quality healthcare and services for the population by promoting the achievement of desired health outcomes [9, 13, 15, 23, 19] protecting the population from the financial risk associated with the use of health services and from impoverishment due to illness [9, 13, 15, 18] improve and promote equity, i.e. the absence of discrimination against certain individuals or groups of individuals [15, 16,

23], and contribute to development and facilitate economic growth [16].

Most countries in sub-Saharan Africa face a high burden of disease and insufficient financial resources to fund the provision of quality health services [12]. The WHO [18] reports that basic healthcare is not accessible to one billion people worldwide and nearly two billion people worldwide face health expenses that lead to their impoverishment. The Global Fund [26] indicates that one of three families must borrow money or sell assets to access essential care in developing countries in Africa and Asia. According to Care et al. [3], six million women and children could be saved if they had access to essential, affordable medicines, medical supplies and simple medical devices. The proportion of the population facing direct catastrophic health expenditures continues to rise, from 9,6% in 2000 to 13,5% in 2019, representing more than one billion people [17].

Several countries have demonstrated that UHC can be achieved even with limited resources. This is the case in countries such as Cambodia, Chile, China, Colombia, Ghana, Indonesia, Mexico, the Philippines, Rwanda, Thailand and Vietnam [16]. Hence, inaccessibility to quality healthcare and lack of disease prevention mean that millions of people die every year around the world [26].

UNAIDS [19] reports that in 2017, less than half of the world's population was covered by essential health services and estimates that only 60% will have universal health coverage by 2030. According to Save the Children (2015), UHC guarantees the population access to essential, quality health services without financial hardship. It promotes the realization of the universal right to health.

In the Democratic Republic of the Congo (DRC), an estimated 60% of the population lacks access to the health system (National Strategic Plan, 2020). "The Democratic Republic of Congo has been committed to the process of universal health coverage since the

adoption of the National Health System Development Plan (PNDS) in 2015" [2].

A main research question has guided this study: Does the present level of perception of healthcare providers in both Lubero Territory and Butembo City, regarding universal health coverage, reflect growth towards its implementation in the Democratic Republic of Congo? From this main question arise the following specific questions:

1. What is the level of perception of universal health coverage among healthcare providers in Lubero and Butembo, as far as expectations and concerns are concerned?
2. Does perception of UHC significantly vary between the two entities (rural area of Lubero and urban area of Butembo)?
3. Do socio-demographic characteristics such as age, education level, gender, household size, marital status, main job, and household income significantly influence healthcare providers' perceptions of universal health coverage?

The study is based on the assumptions that:

The study evolves on the assumptions that:

1. Perceptions of UHC would vary significantly between the two entities (rural area of Lubero Territory and urban area of Butembo) and between healthcare applicants and providers.
2. Socio-demographic characteristics of respondents such as age, education level, gender, household size, marital status, primary job, and household income, would significantly impact healthcare providers' perceptions of universal health coverage.

This study targets to contribute to the implementation of universal health coverage in the Democratic Republic of Congo and to assess the implementation of UHC through perceptions of healthcare providers in both Lubero territory and Butembo city.

Specific objectives:

3. To determine the level of perception of healthcare providers in both Lubero and Butembo concerning universal health coverage in terms of both expectations and concerns.
4. To assess the difference in perceptions of UHC between the rural areas of Lubero and the urban areas of Butembo.
5. To verify the statistical relationship between socio-demographic characteristics and perceptions of UHC by healthcare providers.

Materials and Methods

This is a descriptive, cross-sectional, comparative, and correlational study using quantitative approach. It was conducted from March to August 2025 in two areas: a rural setting, the Territory of Lubero, and an urban setting, the City of Butembo. Both areas are located in the North Kivu Province of the Democratic Republic of Congo (DRC), in Central Africa.

The study population consisted of healthcare providers located in nine Health Zones (HZs) which are: the Urban HZs of Katwa and Butembo in the city of Butembo, the Rural HZs of Masereka, Kayna, Alimbongo, Lubero, Musinene, Biena and Manguredjipa in the Territory of Lubero. The main professions of the healthcare providers considered were physicians, Health Management Administrators, accountants of health institutions, cashiers, nurses, midwives, pharmacists, physiotherapists, medical imagists, laboratory technicians, anesthesiologists, dentists and other administrative, technical staff whose number is 5,302, including 3,814 in Lubero Territory and 1,488 in Butembo. Inclusion criteria have been being a member of the healthcare staff in one of the health institutions in either Lubero Territory or Butembo City and being available to fill in our questionnaire.

The study has been conducted with a sample of 920 healthcare providers, including 460 in rural areas and 460 in urban areas. It has used non-random, casual sampling. Data have been collected using a survey questionnaire. The data collection tool has been validated by seven experts. Prior to data collection, a pilot study to assess the instrument's reliability was conducted with 58 participants. The results of the pilot study have been tested using Cronbach's alpha. The study retained the variable when Cronbach's alpha was greater than or equal to 0.70 and less than 0.9.

The data collection tool was developed and validated by the ethics committee prior to a preliminary study. To test the validity of our data collection tools, we have used content validity analysis. The test/retest method has been used to test the reliability of the collection tools. The questionnaire has been administered twice to the same sample and the results obtained have been compared and interpreted by Cronbach's alpha coefficient.

Data analysis was conducted using SPSS version 20. OpenEpi software has been used to determine confidence intervals for proportions at the 5% significance level using Fleiss's Exact Quadratic method. The study has used frequencies and percentages to analyze socio-demographic characteristics. Means and standard deviations have been used to interpret the level of perception.

We have used the Student's t-test to test for a difference between the means of two groups. The one-way ANOVA test for independent samples has allowed us to test differences in the means of more than two groups. The Scheffe and Tukey post hoc tests were used to determine the mean differences in understanding and/or perception. The Bravais Pearson r correlation test has helped us test the relationship between other variables.

Results

Respondent Characteristics

The results in Table 1 show that out of 920 respondents, 460 (50.0%) have been from Lubero (rural area), compared to 460 (50.0%) from Butembo (urban area). 408 (44.3%) have been under 30 years of age, and 117 (12.7%) have been aged 51 and over. The average age of healthcare providers has been 34.7 years. 496 (53.9%) have been male, and 424 (46.1%) have been female.

The results in Table 1 show that out of a total of 920 respondents, married people dominate with 488 or 53.0% and widowers are in the minority with a number of 22 or 2.4%. Regarding the level of education, the results indicate that those with the first-cycle level

(Nurse Level A1/G3) are in the majority, at 324 (35.2%). Those having the primary school certificate, that is to say those who do not have a school qualification, have been the minority (71 or 7.7%). As for the main profession, nurses have dominated with 328 or 35.7% and healthcare institution administrators have the minority (47 or 5.1%). Regarding household size, 320, or 34.8%, belong to households of 5 to 6 people. Those who have belonged to households of 1 to 2 people have been 202, or 22.3%. Finally, according to the estimation of daily income, the results have shown that those with an income less than \$2.14 per person per day are 92 or 10.0% and those who have estimated that the income is greater than or equal to \$2.14 per person per day are 828 or 90.0%. The average household income is \$137.8. Details are in the following table.

Table 1. Distribution of Healthcare Providers by Residence (n=920)

Residence	Numbers (%)
Lubero Territory	460(50.0)
City of Butembo	460(50.0)
Total	920(100.0)
Age groups	Numbers (%)
Under 30	408(44.3)
30-40	246(26.7)
41-50	149(16.2)
51 and over	117(12.7)
Total	920(100.0)
Gender	Numbers (%)
Feminine	424(46.1)
Masculine	496(53.9)
Total	920(100.0)
Marital status	Numbers (%)
Single	376(40.9)
Married	488(53.0)
Divorced/Separated	34(3.7)
Widowed	22(2.4)
Total	920(100.0)
Level of education	Numbers (%)
Primary School Certificate	71(7.7)
Level A3	110(12.0)
Level A2 and State Diploma	250(27.2)

Level A1 and undergraduate	324(35.2)
Level A0 and graduate	165(17.2)
Total	920(100.0)
Main profession	Numbers (%)
Pharmacist and Pharmacy Attendant	27(2.9)
Nurse	328(35.7)
Midwife	101(11.0)
Other Paramedical Staff	176(19.1)
Physician	60(6.5)
Healthcare institution administrator	47(5.1)
Accountant/Cashier	78(8.5)
Other workers	103(11.2)
Total	920(100.0)
Household size	Numbers (%)
1-2 people	189(20.5)
3-4 people	205(22.3)
5-6 people	320(34.8)
7 or more people	206(22.4)
Total	920(100.0)
Monthly household income	Numbers (%)
Income less than \$2.14/person per day	828(90.0)
Income greater than or equal to \$2.14/person per day	92(10.0)
Total	920(100.0)

Perception of Universal Health Coverage

The level of healthcare seekers' perception of UHC was measured using their expectations and fears.

Health Care Providers' Expectations Regarding UHC

Considering the seven components of perception of health care based on expectations regarding UHC, health care providers in Lubero Territory have demonstrated greater expectations regarding increased use and attendance of services ($A = 3.76 \pm 0.98$). However, those from Butembo City have demonstrated greater expectations regarding the protection of household finances ($A = 3.27$

± 1.09). Healthcare providers in Lubero Territory have lower expectations regarding the provision of reception services, waiting time, compliance with the order of arrival, explanation of treatment and respect of the patient privacy during consultations, which are effective ($A=3.32 \pm 1.07$). While those in Butembo City have had a negative perception of the increase in healthcare staff remuneration ($A=2.86 \pm 1.09$). Overall, the perception of healthcare providers according to expectations in Lubero Territory ($A=3.49\pm0.75$), as in Butembo city ($A=3.15\pm0.71$), has been considered positive. The combined perception of two entities ($A=3.32 [3.27; 3.37] \pm 1.11$) has also been considered positive as shown in Table 2.

Table 2. Healthcare Providers' Perception of UHC Expectations (n=920)

Expectations of healthcare seekers	Lubero			Butembo			Total		
	A	SD	VI	A	SD	VI	A [CI]	SD	VI
Conviction to increase attendance and utilization of services	3,76	0,98	PP	3,73	1,11	PP	3,75[3,68; 3,81]	1,05	PP
Conviction to motivate healthcare providers	3,48	1,05	PP	3,05	1,07	PP	3,27[3,20; 3,34]	1,08	PP
Conviction to increase revenue collection rates	3,60	1,09	PP	3,18	1,18	PP	3,39[3,31; 3,46]	1,15	PP
Conviction to increase healthcare staff compensation	3,41	1,17	PP	2,86	1,09	NP	3,14[3,06; 3,21]	1,16	PP
Conviction to protect household finances	3,50	1,04	PP	3,27	1,08	PP	3,38[3,32; 3,45]	1,07	PP
Conviction to cover care for the entire population	3,38	1,09	PP	3,06	1,07	PP	3,22[3,15; 3,29]	1,09	PP
Conviction to improve the quality of services	3,32	1,07	PP	2,91	1,22	NP	3,12[3,04; 3,20]	1,16	PP
Overall average	3,49	0,75	PP	3,15	0,71	PP	3,32[3,27; 3,37]	1,11	PP

Note: PP = Positive perception if the average is > 3, I = Indifference if the average is equal to 3, NP = Negative perception if the average is < 3, VI = Verbal interpretation, P = Perception, A = Average, SD = Standard deviation; CI = Confidence interval.

Healthcare Providers' Fears about UHC

Based on nine selected components, healthcare providers surveyed in Lubero Territory ($M=2.90 \pm 1.23$) and those in the city of Butembo ($M=2.77 \pm 1.21$) have demonstrated a fear about protecting the population against financial risks (catastrophic expenditure). The same fear has also been reflected in the combination of the two entities ($M=2.83 [2.76; 2.91] \pm 1.22$). In summary, the perception of healthcare providers regarding fears has been the same in Lubero Territory ($M=2.61 \pm 0.83$) as in Butembo town (2.61 ± 0.76), and for both entities ($M=2.61 [2.57; 2.66] \pm 0.80$), which suggests a negative perception, as detailed in Table 3.

Healthcare Providers' Fears about UHC

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Table 3. Healthcare Providers' Perception of Concerns about UHC (n=920)

Fears of healthcare seekers	Lubero			Butembo			Total		
	A	SD	VI	A	SD	IV	A [CI]	SD	IV
Believing that the government will not honor its commitments to finance UHC	2,57	1,25	NP	2,56	1,11	PP	2,57 [2,49; 2,64]	1,18	NP
Accusing late payment of patient bills	2,44	1,17	NP	2,40	1,09	NP	2,42 [2,35; 2,50]	1,13	NP
Overwork of healthcare personnel	2,60	1,25	NP	2,51	1,20	NP	2,55 [2,47; 2,63]	1,23	NP
Stock shortages of supplies in healthcare structures	2,45	1,25	NP	2,56	1,05	NP	2,51 [2,44; 2,58]	1,16	NP
Risk of overprescribing medications (prescribing will not be rational)	2,80	1,25	NP	2,72	1,12	NP	2,76 [2,69; 2,83]	1,19	NP
Some funds allocated to healthcare structures will be misappropriated by governments	2,52	1,13	NP	2,64	1,20	NP	2,58 [2,50; 2,65]	1,17	NP
Believing that with UHC, access to care will be equal based on individuals' socioeconomic status	2,61	1,13	NP	2,78	1,20	NP	2,80 [2,62; 2,78]	1,17	NP
Failing to protect the population against financial risks (catastrophic spending)	2,90	1,23	NP	2,77	1,21	NP	2,83 [2,76; 2,91]	1,22	NP
The DRC will not achieve UHC by 2030	2,65	1,21	NP	2,56	1,16	NP	2,60 [2,53; 2,68]	1,18	NP
Overall average	2,61	0,83	NP	2,61	0,76	NP	2,61 [2,57; 2,66]	0,80	NP

Note: PP = Positive perception if the average is > 3, I = Indifference if the average is equal to 3, NP = Negative perception if the average is < 3, VI = Verbal interpretation, P = Perception, A = Average, SD = Standard deviation; CI = Confidence interval.

Summary of Perceptions of Healthcare Providers

By combining the two components of perception on the UHC, healthcare providers in the Lubero territory have come out on top ($A=3.05 \pm 0.59$) with a perception has been

positive against those in the city of Butembo ($A=2.88 \pm 0.48$) with a perception has been negative. The synopsis of respondents from two entities ($A=2.97 [2.93; 3.00] \pm 0.54$) shows that healthcare providers had a negative perception on the UHC as indicated in Table 4.

Table 4. Summary of Healthcare Providers' Perceptions (n=920)

Perception	Lubero			Butembo			Total		
	A	SD	IV	A	SD	IV	A [IC]	SD	IV
Healthcare Provider Expectations	3,49	0,75	PP	3,15	0,71	PP	3,32 [3,27; 3,37]	0,75	PP

Healthcare Provider Fears	2,61	0,83	NP	2,61	0,76	NP	2,61 [2,56; 2,67]	0,80	NP
Overall average	3,05	0,59	PP	2,88	0,48	PN	2,97 [2,93; 3,00]	0,54	NP

Note: PP = Positive perception if the average is > 3 , I = Indifference if the average is equal to 3, NP = Negative perception if the average is < 3 , IV = Verbal interpretation, P = Perception, A = Average, SD = Standard deviation; CI = Confidence interval.

Difference in Perceptions of Healthcare Providers in the Two Entities

For expectations, comparing the mean scores between healthcare providers in Lubero ($M = 3.49 \pm 0.85$) and those in the city of Butembo ($M = 3.15 \pm 0.71$) yielded a t-value of 7.06 ($p = 0.000$). Regarding fears, comparing healthcare

providers in Lubero ($M = 2.61 \pm 0.83$) with those in Butembo ($M = 2.61 \pm 0.76$) yielded a t-value of 0.00 ($p = 0.999$). This result indicates a highly significant difference in expectations between providers across the two entities, whereas the difference in fears is non-significant, as shown in Table 5.

Table 5. Difference in Perceptions of Healthcare Providers in the Two Entities

Entity	n	Average	SD	ddl	t	p	IV
Healthcare providers' expectations regarding UHC							
Lubero Territory	460	3.49	0.75	918	7.06	0.000	S
Butembo City	460	3.15	0.71				
Healthcare providers' concerns regarding UHC							
Lubero Territory	460	2.61	0.83	918	0.00	0.999	NS
Butembo City	460	2.61	0.76				

Note: n=sample size; df=degrees of freedom; t=Student's t-test difference value; p=significance threshold; SD=Standard Deviation; IV=verbal interpretation; NS=Not Significant if $p \geq 0.05$; S=Significant if $p < 0.05$.

Perceptions of UHC and Socio-demographic Characteristics

Differences in Healthcare Providers' Perceptions by Main Occupation

The overall mean of healthcare providers' expectations regarding UHC was 3.3227 ± 0.74962 , and the mean of concerns has been

2.6130 ± 0.79703 . The results have shown that the mean of healthcare providers' expectations differed by main occupation ($F = 3.536$; $p = 0.001$). The same has been true for the mean of concerns, which has also differed by main occupation ($F = 3.390$; $p = 0.001$). Details are provided in Table 6.

Table 6. Differences in Healthcare Providers' Perceptions by Primary Profession

Perception	Occupation	Average	Standard deviation	df	F	p	IV
Perception of expectations	Pharmacist and Pharmacy Assistant	3.1005	0.65563				
	Nurse	3.3236	0.78540				
	Midwife	3.1796	0.56194				
	Other Healthcare Professionals	3.4464	0.78315				
	Physician	3.3048	0.42530	7	3.536	0.001	S

	Healthcare institution administrator	3.5289	0.89755				
	Accountant/Cashier	3.4560	0.65891				
	Other Administrative, Technical, and Labor Staff	3.1221	0.82731				
	Total	3.3227	0.74962				
Perception of fears	Pharmacist and Pharmacy Assistant	2.5062	0.55925				
	Nurse	2.5830	0.75297				
	Midwife	2.9329	0.85924				
	Other Healthcare Professionals	2.5574	0.85544	7	3.390	0.001	S
	Physician	2.4870	0.64468				
	Healthcare institution administrator	2.6903	0.98973				
	Accountant/Cashier	2.4630	0.74362				
	Other Administrative, Technical, and Labor Staff	2.6699	0.77598				
	Total	2.6130	0.79703				

Note: *n*=sample size; *df*=degrees of freedom; *t*=Student's *t*-test difference value; *p*=significance threshold; *IV*=verbal interpretation; NS=Not Significant if $p \geq 0.05$; S=Significant if $p < 0.05$.

The application of the Tukey test has presented a difference in the means of perception of expectations of healthcare providers which proved to be statistically significant between the average of other Administrative, Technical, and Labor Staff and professions such as the profession of Administrator Manager of Health Institutions ($p=0.040$) and Other health professionals ($p=0.011$).

The application of the Scheffé test has presented a difference in the means of fears of healthcare providers which have been found statistically significant between the average of

midwives and professions such as nursing ($p=0.035$), Other health professionals ($p=0.044$) and accountants/cashiers ($p=0.030$).

Differences in Care Providers' Perceptions by Gender

The overall mean of care providers' perceptions of UHC was 2.9664 ± 0.55054 for female care seekers and 2.9691 ± 0.53331 for male care seekers. The results showed that the means of care providers' perceptions did not differ by gender ($F = -0.074$; $p = 0.918$). Details are provided in Table 7.

Table 7. Differences in Healthcare Providers' Perceptions by Gender

Gender	Average	Standard deviation	df	<i>t</i>	<i>p</i>	<i>IV</i>
Female	2.9664	0.55054	918	-0,074	0,918	NS
Male	2.9691	0.53331				

Note: *N*=sample size; *df*=degrees of freedom; *t*=Student's *t*-test difference value; *p*=significance threshold; *IV*=verbal interpretation; NS=Not significant if $p \geq 0.05$; S=Significant if $p < 0.05$.

Differences in Care Providers' Perceptions by Marital Status

The mean score for healthcare providers' overall perception of UHC has been 2.97 ± 0.54

in both entities. The results has indicated that care providers' average perceptions have differed in respect to marital status ($F = 2.832$; $p = 0.037$), as shown in Table 8.

Table 8. Differences in Healthcare Providers' Perceptions by Marital Status

Marital status	Moyenne	Ecart-type	ddl	F	p	IV
Single	3.01	0.55				
Married	2.95	0.55				
Divorced/Separated	2.77	0.36	3	2.832	0.037	S
Widowed	2.86	0.40				
Total	2.97	0.54				

Note: *df*= degrees of freedom, *F*= Snedecor file or value of the difference in variances, *p*= significance, *IV*= verbal interpretation, *NS*= Not significant if $p \geq 0.05$, *S*= Significant if $p < 0.05$.

The application of the Tuckey test has presented a difference in perception means that has proved statistically significant between the marital status of single people and divorced ones ($p=0.046$).

Socio-demographic Characteristics and Expectations Regarding UHC

A statistically significant relationship has been observed between healthcare providers'

expectations and their characteristics, such as education level ($r=0.094$; $p=0.004$) and household income ($r=-0.079$; $p=0.016$), indicating that expectations increase with higher education level and household income. The relationship between expectations and other characteristics, such as respondent age and household size, has insignificant, as shown in Table 9.

Table 9. Socio-demographic Characteristics and Expectations of Healthcare Providers

Independent variables	Healthcare providers' expectations regarding UHC		
	<i>r</i>	<i>p</i>	<i>IV</i>
Respondent's age	-0,004	0,903	NS
Education Level	0,094	0,004	S
Household Size	0,021	0,520	NS
Monthly Household Income	0,079	0,016	S

Note: *r*=Pearson coefficient, *p*=significance threshold, *IV*=verbal interpretation, *NS*=non-significant if $p \geq 0.05$, *S*=significant if $p < 0.05$.

Socio-demographic Characteristics and Concerns about UHC

The results have revealed a statistically significant positive relationship between healthcare providers' concerns about UHC and household income ($r=0.105$; $p=0.001$),

meaning that healthcare providers' concerns become increasingly positive as household income increases. The relationship between concerns and characteristics such as respondent age, education level, and household size of healthcare providers has not been statistically significant, as shown in Table 10.

Table 10. Socio-demographic Characteristics and Concerns of Healthcare Providers

	Healthcare providers' fears about UHC		
Independent variables	<i>r</i>	<i>p</i>	<i>IV</i>
Respondent's Age	0,064	0,052	NS
Education Level	0,003	0,939	NS
Household Size	0,035	0,287	NS
Household Income	0,105	0,001	S

Note: *r*=Pearson coefficient, *p*=significance threshold, *IV*=verbal interpretation, NS=non-significant if $p \geq 0.05$,
S=significant if $p < 0.05$.

Discussion

This section presents a discussion of the results in respect to the three research questions. These questions address the level of healthcare providers' perception of UHC, the difference in perception, and the influence of socio-demographic characteristics on perception.

Perception of Universal Health Coverage

This subsection includes the perceptions of both healthcare seekers and providers. The discussion has been based on the results from the two combined entities and the overall results in Lubero Territory compared to those in Butembo City.

Healthcare Providers and their Perceptions of UHC

The variables that have considered to measure healthcare providers' perceptions of UHC are: expectations and fears about UHC.

Healthcare Providers' Expectations of UHC

The results in Table 2 have shown overall that the expectations of healthcare providers on the UHC are judged to be positively perceived on the increase in attendance and use of services ($M=3.75[3.68; 3.81] \pm 1.05$), on the increase in the revenue collection rate due to the UHC ($M=3.39[3.31; 3.46] \pm 1.15$), on the protection of household finances by the UHC ($M=3.38[3.32; 3.45] \pm 1.07$), the motivation of healthcare providers thanks to the UHC ($M=3.27[3.20; 3.34] \pm 1.08$), the coverage of

healthcare for the entire population ($M=3.22[3.15; 3.29] \pm 1.09$), the increase in the remuneration of the nursing staff ($M=3.14[3.06; 3.21] \pm 1.16$) and improvement in the quality of services ($M=3.12[3.04; 3.20] \pm 1.16$). Although the perception of healthcare providers according to expectations is considered positive, it should be noted that in rural Butembo, this perception is considered negative regarding the increase in the remuneration of healthcare staff ($M=32.86 \pm 1.09$) and the improvement in the quality of services ($M=2.91 \pm 1.22$). The overall perception of healthcare providers according to expectations in the territory of Lubero (3.49 ± 0.75) as in the city of Butembo ($M=3.15 \pm 0.71$) is considered positive. The combined perception of two entities ($M=3.32 [3.27; 3.37] \pm 1.11$) is also considered positive.

A study conducted in Togo on 2,400 households showed that 7% (at the 40% threshold) of households had incurred catastrophic expenses despite the application of health insurance to public employees for five years. At-risk Togolese households allocate 60% of their total monthly expenses to healthcare [20].

Faye [5] showed in his doctoral thesis on Universal Health Coverage in Senegal that, despite the low enrollment rate, municipal mutual insurance companies had a positive impact on the use of healthcare services and the likelihood of paying for healthcare. The study conducted by Alkodaymi et al. [1] also showed that 79.1% of respondents believe that

mandatory cooperative health insurance is a good method for achieving universal health coverage in Saudi Arabia.

These findings are consistent with a research conducted in 2020 in OECD countries. This study concluded that the overall level of satisfaction with the availability of quality health services was 71% in 37 countries. However, in some countries, such as Poland (26%), Greece (38%), and Chile (39%), were less satisfied [14].

Healthcare Providers' Fears about UHC

The results in Table 3 have indicated that healthcare providers in general have a negative perception of the protection of the population against financial risks (catastrophic expenditure) by the UHC ($M=2.83 [2.76; 2.91] \pm 1.22$), they do not believe that with the UHC, access to care will be equal depending on the socio-economic situation of people ($M=2.80 [2.62; 2.78] \pm 1.17$), they believe that there is a risk of overprescribing medicines, i.e., non-rational prescribing ($M=2.76 [2.69; 2.83] \pm 1.19$), they are convinced that the DRC will not achieve UHC by 2030 ($M=2.60 [2.53; 2.68] \pm 1.18$), some funds allocated to health structures will be diverted by the government ($M=2.58 [2.50; 2.65] \pm 1.17$), they are of the opinion that the government will not respect its commitments to finance the UHC ($M=2.57 [2.49; 2.64] \pm 1.18$), health personnel will be overloaded because of the SCU ($M=2.55 [2.47; 2.63] \pm 1.23$), with the UHC, there is a risk of stock shortages of inputs in health structures ($M=2.51 [2.44; 2.58] \pm 1.16$) and in order, the UHC will experience delays in paying patients' bills ($M=2.42 [2.35; 2.50] \pm 1.13$). In short, the perception of health providers according to fears is the same in the territory of Lubero ($M=2.61 \pm 0.83$) as in the city of Butembo (2.61 ± 0.76) and for both entities ($M=2.61 [2.57; 2.66] \pm 0.80$), which suggests a negative perception.

Combining both expectations and fears about UHC, the results in Table 4 indicate that

healthcare providers in Lubero Territory have a positive perception ($M=3.05 \pm 0.59$), compared to those in the city of Butembo ($M=2.88 \pm 0.48$), who have a negative perception. The summation of respondents from both entities ($M=2.97 [2.93; 3.00] \pm 0.54$) have shown that healthcare providers have a negative perception of UHC.

These results confirm what healthcare providers working in the free healthcare system of the Sésame plan in Senegal had stated. They said that the workload had increased and that they had less time for patient consultations. This demonstrates a decline in the quality of care [22]. The study conducted by Mbeva and colleagues [11] on the issues and challenges of universal health coverage in the Democratic Republic of Congo showed that more than 85% of health district managers in North Kivu Province positively perceived the support and guidance from the intermediate level (the Provincial Health Division) in terms of the availability of supervisors and the frequency of support visits. This reflects good governance.

The results of the study by Alkodaymi et al. [1] are consistent with this study, showing that out of 464 respondents, only 42.7% expected Saudi Arabia's healthcare system to protect its entire population (nationals and residents) from the financial burden of medical expenses.

The study conducted on the perceived challenges to achieving universal health coverage in Beijing, Ningbo, Harbin, and Chongqing, China, showed that 44.7% of respondents expressed concern about the management of the health insurance system. According to them, this could compromise the achievement of UHC [21].

The study conducted in Uganda on the awareness and perception of health workers on UHC shows that health care providers had raised the obstacles to UHC such as limited quality health infrastructure, staff overload, insufficient public funding for health, poor management of funds, stockouts of medicines and the use of substandard medicines [6]. As for

Senegal, health care providers complained about delays in government reimbursement, which led to the withdrawal of certain services. But also the workload had increased because of free care due to the Sesame plan [22].

Difference in Perceptions of Healthcare Providers in the Two Entities

The results in Table 5 show that regarding expectations, comparing the mean scores between healthcare providers in Lubero ($M = 3.49 \pm 0.85$) and those in Butembo City of ($M = 3.15 \pm 0.71$) yields a t-value of 7.06 ($p = 0.000$). Regarding fears, comparing healthcare providers in Lubero ($M = 2.61 \pm 0.83$) with those in Butembo ($M = 2.61 \pm 0.76$) yields a t-value of 0.00 ($p = 0.999$). This result suggests a highly significant difference in the expectations of healthcare providers between these two entities, whereas the difference in fears is non-significant.

These results provide 25% confirmation of the first research hypothesis. Indeed, healthcare providers in rural areas have more positive expectations of UHC because it can improve working conditions, while in urban areas, healthcare providers are better equipped with resources. They perceive the implementation of UHC as a constraint.

Socio-demographic Characteristics and UHC

Differences in Healthcare Provider Perceptions by Main Occupation

The results in Table 6 show that healthcare providers' expectations differ by main occupation ($F=3.536$; $p=0.001$). The same is true for their fears, which also differ by main function ($F=3.390$; $p=0.001$). Applying the Tukey test reveals a statistically significant difference in the average perceptions of healthcare providers' expectations between other administrative, technical, and labor staff and professions such as Healthcare institution administrators ($p=0.040$) and other healthcare professionals ($p=0.011$). As for fears, the

application of the Scheffé test shows a difference in the fears of healthcare providers which is statistically significant between midwives and professions such as nurses ($p=0.035$), other healthcare professionals ($p=0.044$) and accountants/cashiers ($p=0.030$).

These results partially confirm the second research hypothesis. The results of Ismail's study [7] on the economic evaluation of the health insurance reform in Tunisia show that there is no disparity in access to consumption across sectors. However, the results of Julie Etcheberry's doctoral thesis [4] on students' knowledge and representations in Île-de-France regarding complementary universal health coverage showed that satisfaction levels varied depending on the studies followed.

Regarding perception based on expectations, the expectations of other administrative, technical, and labor staff such as sentinels, receptionists and hygienists regarding the UHC differ significantly from those of Healthcare institution administrator and other health personnel, due to their often precarious professional situation and are sometimes faced with difficulties in accessing care, but also they are less informed than healthcare institution administrators and other health personnel. Regarding perception based on fears, the midwifery profession shows less fear regarding the UHC than other categories such as nurses, accountants and other health personnel due to their recognition as an autonomous profession in the DRC. This encourages them for the management of future programs. The relationship that midwives uphold with parturients makes them more sensitive to the issues of the UHC and are therefore more confident in its usefulness and functioning. In comparison, nurses are more confronted with more unstable working conditions or work overload. Thus, they may fear a possible deterioration in the quality of care.

Difference in Perceptions of Healthcare Providers by Gender

The results in Table 7 show that the perception of healthcare providers does not differ with gender ($F = -0.074$; $p = 0.918$). These results partially undermine the second research hypothesis. The fact that the perception of UHC by healthcare providers does not differ with gender can be explained by the fact that men and women in the healthcare sector share the same work environment. These results do not support those found in a study conducted in Togo which showed that households controlled by men were less exposed to catastrophic expenditures. On the other hand, households ruled by women were more exposed to catastrophic expenditures [20].

Differences in Healthcare Providers' Perceptions by Marital Status

The results in Table 8 indicate that healthcare providers' perceptions differ by marital status ($F=2.832$; $p=0.037$). Applying the Tuckey test reveals a statistically significant difference in perception means between the marital status of single and divorced individuals ($p=0.046$).

These results partially confirm the second research hypothesis. This difference in perception of the UHC between single people, who have a positive perception, and divorced people, who have a negative perception, can be explained by the fact that their past lives are different. Since single people are often younger and childless, they may have a positive view of the role of the state. As for divorced people, their negative past experiences may negatively influence their perception.

Socio-demographic Characteristics and Expectations of Healthcare Providers on UHC

The results in Table 9 indicate a statistically significant relationship between the expectations of healthcare providers and their characteristics such as education level

($r=0.094$; $p=0.004$) and household income ($r=-0.079$; $p=0.016$), i.e., the expectations of healthcare providers increase with increasing education level and household income. The relationship between expectations and other characteristics such as respondent age and household size is not significant. These results partially confirm the second research hypothesis.

The results of Ismail's [7] study on the economic evaluation of health insurance reform in Tunisia show that conditional consumption is not strongly influenced by household standard of living. But age also had an impact on healthcare utilization. When you are wealthy, you favor the private sector more in order to benefit from a better quality of care. In his doctoral thesis on Universal Health Coverage in Senegal: Impact Assessment and Analysis of Health Financing Policies, Faye [5] shows that household size and the age of members negatively correlate with expectations regarding UHC.

Expectations of UHC increase with healthcare providers' education level, as higher education provides a better understanding of the challenges facing the healthcare system. They are better able to identify limitations of UHC and analyze its potential dysfunctions. Expectations of UHC generally increase when healthcare providers' income decreases, and vice versa, because low-income professionals are more dependent on the public healthcare system. They have fewer means to finance care and hope that UHC will guarantee them equitable and quality access to healthcare.

Socio-demographic Characteristics and Healthcare Providers' Fears about UHC

The results in Table 10 show that there is a statistically significant positive relationship between healthcare providers' fears about UHC and household income ($r=0.105$; $p=0.001$), i.e., healthcare providers' fears become increasingly positive as household income increases. The relationship between fears and

characteristics such as respondent's age, education level, and household size of healthcare providers is not statistically significant.

These results partially confirm the second research hypothesis. Fears about UHC may increase with the income of the healthcare provider, as the best-paid staff often fear changes that could affect their working conditions. They may also anticipate an overload of the system, a decline in the quality of care, thus stimulating feelings of anxiety about the generalization of UHC.

Conclusion

The implementation of universal health coverage in the Democratic Republic of Congo is a necessity for the population. Healthcare providers have a major role to play. This study, conducted in Lubero Territory and Butembo City, has showed that healthcare providers have a positive perception of UHC expectations. Regarding concerns, healthcare providers have a negative perception regarding the government's compliance with its commitments to fund UHC, delays in paying patients' bills, overworked healthcare staff, and embezzlement. Therefore, decision-makers should consider these concerns and consider how to address them in implementing this program.

References

- [1]. Alkodaymi, S. M., Abou Shaar, B., Ashraf Fawzy, N., Alhabbbash, R., Senjab, A., & Rawan AlSaoudm, R., 2020, Knowledge, perception, and attitudes of Universal Health Coverage policies among Alfaisal University students in Saudi Arabia. *Journal of education and health promotion*. <https://pmc.ncbi.nlm.nih.gov/articles/PMC7871921/>
- [2]. Bukele Kekemb, T., & Mbuyi, Y., 2022, Determinants of the Universal Health Coverage Process in the Democratic Republic of Congo: An Econometric Approach Using the PLS Algorithm

Conflict of Interest

The declaration of the author is that there's no conflict with interest.

Data Availability

Data will be available when needed.

Approval and Consent to Participate

This study was approved by the Research Ethical Committee of the Adventist University of Lukanga in its N° SGR001/CER/04/CR2025. The agreement was obtained from the participants to the study.

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Author Contributions

Both Paluku Kahuko and Katembo Kambere, authors, dealt with all phases of the study, from the formulation of the research protocol to the gathering of data and the analysis of results.

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[3]. Care, et al., 2017, Health for All: Why Universal Health Coverage Is Important ?. https://www.cordaid.org/en/wp-content/uploads/sites/11/2017/12/Cordaid_Health_HealthForAll-Why-is-Universal-Health-Coverage-important-FR-LR.pdf

[4]. Etcheberry, J., 2015, Knowledge and Perceptions of DCEM4 Students from Île-de-France on Complementary Universal Health Coverage and Its Beneficiaries. [Doctoral Theses, Paris Diderot University – Paris 7]. <http://www.bichat->

- larib.com/publications.documents/4995_ETCHEB
ERRY_these.pdf
- [5]. Faye, M. F., 2021, Universal Health Coverage in Senegal: Impact Evaluation and Analysis of Health Financing Policies. *[Doctoral Thesis, Cheikh Anta Diop University of Dakar]*. <https://theses.hal.science/tel-03690782/>
- [6]. Ifeagwu, S. C., Nakaboga Kikonyogo, R., Nakkazi, S., Beinomugisha, J., Ojiambo Wandera, S., Kiwanuka, S. N., King, R., Tine Van Bortel, T. V., Brayne, C., Parkes-Ratanshi, R., 2024, Sickness has no time: Awareness and perceptions of health care workers on universal health coverage in Uganda. *Plos one* 19(7). <https://doi.org/10.1371/journal.pone.0306922>
- [7]. Ismail, S., 2016, Economic Evaluation of Health Insurance Reform in Tunisia. *[Doctoral Theses. PARIS-DAUPHINE UNIVERSITY]*. <https://theses.hal.science/tel-01300569/>
- [8]. Kabinda, J., Mitashi, P., & Chengem, F., 2017, Universal Health Coverage (UHC): *How to Finance the Inclusion of the Informal Sector in the Democratic Republic of Congo (DRC)?* https://aenweb.blob.core.windows.net/aenweb/files/files/Policy_brief_1.pdf
- [9]. Maeda, A., Araujo, E., Cashin, C., Harris, J., Ikegami, N., Michael, R., & Reich, 2015, Universal Health Coverage for Inclusive Sustainable Development. <http://dx.doi.org/10.1596/978-1-4648-0592-9>
- [10]. Mataria, A., 2018, Basic Health Coverage: *Review of International Experiences*.
- [11]. Mbeva, K. J-B., Ndeba, M. P., Nguemeleu, T. E., Mahamba, N., Nyavanda, K. L., & Syayipuma, K. J-R., 2023, Challenges and Issues of Universal Health Coverage in the Democratic Republic of Congo: An Interpretative Critical Literature Review. *International Journal of Innovation and Scientific Research*, (66)1, pp. 42-56. <http://www.ijisr.issr-journals.org/>
- [12]. Mugo, M., 2022, Health Insurance and Health Status in Kenya: *Toward Universal Health Coverage*. <http://publication.aercafricalibrary.org/bitstream/handle/123456789/3390/HC-002.pdf?sequence=1&isAllowed=y>
- [13]. Nations Unies, 2022, Report of the International Universal Health Coverage Day, 12 December. [https://www.un.org/fr/observances/universal-health-coverage-day#:~:text=Les%20trois%20dimensions%20de%20la,entra%C3%A9nent%20pas%20de%20difficult%C3%A9s%20financi%C3%A8res\).](https://www.un.org/fr/observances/universal-health-coverage-day#:~:text=Les%20trois%20dimensions%20de%20la,entra%C3%A9nent%20pas%20de%20difficult%C3%A9s%20financi%C3%A8res).)
- [14]. OECD, 2021, Population with Health Coverage, in Health at a Glance 2021: OECD Indicators, *Éditions OCDE, Paris*. <https://doi.org/10.1787/d9136695-fr>
- [15]. WHO., 2013, World Health Report 2013: *Research for Universal Health Coverage*. https://apps.who.int/iris/bitstream/handle/10665/85764/9789240691193_fre.pdf
- [16]. WHO., 2015, Making Fair Choices for Universal Health Coverage. https://iris.who.int/bitstream/handle/10665/185069/9789242507157_fre.pdf
- [17]. WHO., 2022a, Universal Health Coverage. [https://www.who.int/fr/news-room/fact-sheets/detail/universal-health-coverage-\(uhc\)](https://www.who.int/fr/news-room/fact-sheets/detail/universal-health-coverage-(uhc))
- [18]. WHO., 2022b, Progress Report of the Democratic Republic of Congo (DRC). https://www.social-protection.org/gimi/gess/Media.action;jsessionid=S_r_t4Y570uMPw6YHT30Pt3KEcO9i5wLBm2JW_kSOH-WZPE1oWwng!-1975053523?id=19073#:~:text=Pour%20progresse r%20vers%20la%20couverture,financement%20de %20la%20CSU%2C%20la
- [19]. ONUSIDA., 2019, Universal Health Coverage. <https://www.unaids.org/fr/topic/UHC#:~:text=Le%20but%20de%20la%20Couverture,%C3%A0%20p ayer%20pour%20ces%20services>.
- [20]. Sanoussi, Y., et., Ametoglo, M., 2019, Extent and Determinants of Catastrophic Health Expenditures: *The Case of Togolese Households*. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3440106
- [21]. Shan, L., Wu, O., Liu, C., Li, Y., Cui, C., Zi Liang, Z., Hao, Y., Liang, L., Ning, N., Ding, D., Qingxia Pan, Q., & Han, L., 2017, Perceived challenges to achieving universal health coverage: *A*

cross-sectional survey of social health insurance managers/administrators in China.
<https://bmjopen.bmj.com/content/7/5/e014425>

[22]. Taverne, B., Laborde-Balen, G., Rassoul Top, B., Sow, K., & Coumé, M., 2023, Perceptions and Use of Universal Health Coverage (Plan Sésame) by Elderly People in Dakar (Senegal), and Its Impact on Health Expenditures Related to Diabetes and Hypertension. *Médecine Tropicale Et Santé Internationale*. 10.48327/mtsi.v3i3.2023.320

[23]. Inter-Parliamentary Union, & WHO., 2022, *The Path to Universal Health Coverage*. <https://apps.who.int/iris/bitstream/handle/10665/365283/9789240061408-fre.pdf?sequence=1>

[24]. USAID., 2017, Financing Universal Health Coverage and Family Planning. *Consulté sur file:///C:/Users/Lanares/Downloads/HFG-Region-de-lAfrique-de-lOuest-Rapport-Financement_Francais-Final_juillet-2017%20(1).pdf*

[25]. OMS & Groupe de la Banque mondiale. 2014, Universal Health Coverage: *Tracking Progress at the National and Global Levels*. https://iris.who.int/bitstream/handle/10665/112823/WHO_HIS_HIA_14.1_fre.pdf

[26]. The Global Fund, 2016, *Audit Report on Global Fund Grants to the Republic of Uganda*. https://www.theglobalfund.org/media/2820/oig_gf-oig-16-005_report_fr.pdf

Assessing the Mental Health Challenges and Experiences of Returnee Migrants in Nigeria

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Abstract

Returnee migrants in Nigeria often experience severe psychological distress due to traumatic migration experiences and reintegration challenges. This study assesses the mental health challenges and experiences of returnee migrant in Nigeria. This study adopted a quantitative cross-sectional design to examine mental health challenges and psychosocial experiences among returnee migrants across Nigeria's six geopolitical zones. A sample size of 1,316 was determined using Cochran's formula, with participants selected through multi-stage sampling and snowballing techniques. Data was collected via pretested interviewer-administered questionnaires and analyzed using SPSS 28. The mean age of the respondents was 29±6.212 years. The results revealed that the main reasons for migration were the pursuit of better living conditions (43.2%), followed by torture (38.6%), while torture (24.1%) and labour exploitation (22.3%) were the leading reasons for return. Findings revealed a high prevalence of mental health status, with over 80% reporting trouble sleeping, anxiety, and loss of interest in activities. Regression analysis on factors associated with mental health status among returnee migrants confirmed that sex and religion remained significant predictors of mental health status. Female returnees were about five times more likely to report poor mental health than males (AOR = 5.499, $p < 0.001$). Also, Religion showed a protective effect, with Christianity associated with lower odds of poor mental health (AOR= 0.119: $P < 0.001$) compared to Islam. The findings underscore the urgent need for trauma-informed, community-based, and government-supported mental health interventions for returnee migrants in Nigeria.

Keywords: Mental Health, Psychological Distress, Returnee Migrant, Reintegration.

Introduction

Migration is the movement of individuals, families, and communities from their usual residence, either across an international border or within a state [1]. According to the World Migration Report 2022, there are an estimated 281 million international migrants globally, representing 3.6% of the world population [2].

According to the World Health Organization (WHO), "Mental health is a state of mental well-being that enables people to cope with the stresses of life, realize their abilities, learn well and work well, and contribute to their community"[3]. The World Health Organisation estimates that 450 million people globally are suffering from mental health disorders, and 25% of the population will suffer from mental illness at some point in their lives

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[4, 5]. Initially, immigrants often report better health and well-being upon arrival compared to citizens of their host countries. However, over time, they may face various health challenges, rendering them vulnerable to physical and mental health threats a phenomenon referred to as the "health effect" [6, 7]. Unfortunately, immigrants' specific health needs are often poorly understood, exacerbated by inadequate communication between healthcare providers and immigrants, as well as unprepared health systems [8]. These challenges are compounded by varying perceptions of health and mental health across different cultures, as cultural influences shape how health issues are identified, understood, and addressed [9].

The mental health of returnee migrants in Nigeria is a multifaceted issue influenced by pre-migration experiences, challenges encountered during migration, and the complexities of reintegration upon return. Understanding these factors is essential for developing effective support systems to facilitate their successful reintegration into Nigerian society. Many Nigerian migrants embark on perilous journeys in search of better opportunities, often facing significant adversities.

Upon returning to Nigeria, migrants often encounter additional challenges that exacerbate mental health issues. Social stigma, unemployment, and difficulties in accessing healthcare services are prevalent obstacles. Reports indicate that many voluntary returnees suffer from long-term mental and physical health problems and face societal stigma upon their return [10]. Recognising these challenges, various organisations have initiated programs to support the psychosocial well-being of returnees. The International Organization for Migration (IOM) has been instrumental in this regard, implementing training sessions aimed at protecting and enhancing migrants' psychosocial well-being. These sessions focus on mental health care tailored to the Nigerian context, addressing issues such as depression,

suicide, psychoses, and substance abuse [11]. Community engagement has also proven beneficial in addressing mental health challenges among returnees. Involving returnees in the design of mental health services and establishing accountability mechanisms ensure that interventions are culturally sensitive and effective. Engaging religious and traditional leaders, as well as local influencers, facilitates better community acceptance and support for returnees [12].

Despite these efforts, gaps remain in the provision of mental health services for returnee migrants in Nigeria. The need for a well-coordinated humanitarian response is evident, with calls for rapid assessments to identify vulnerabilities and existing support mechanisms. Strengthening the national mental health care system and enhancing healthcare workers' skills to provide community-based psychosocial support are crucial steps toward addressing these challenges [12]. This study assesses the mental health challenges and experiences of returnee migrant in Nigeria.

Material and Methods

Research Design

This study adopted a quantitative cross-sectional design to examine mental health challenges and psychosocial experiences among returnee migrants in Nigeria. The cross-sectional approach enabled systematic assessment of mental health status and associated factors at a single point in time, providing a comprehensive analysis of the psychological well-being of returnees across the country.

Study Settings and Population

The research was conducted in Nigeria, West Africa's most populous country, noted for its cultural richness. Nigeria is divided into six geopolitical zones (Northwest, Northcentral, Northeast, Southwest, South-south, and Southeast), each with its own set of characteristics and challenges [13]. The study

focused on all six geopolitical zones of Nigeria, with participants recruited from various Ministries, Departments, and Agencies (MDAs) and Civil Society Organisations (CSOs) involved in managing returnee migrants across the country. The research population consisted of returnee migrants in Nigeria.

Inclusion Criteria

1. Participants comprised individuals who have returned to Nigeria after a period of migration, whether voluntarily or forcibly, and have psychosocial or mental health needs.
2. Participants who can provide mature perspectives on their experiences and well-being.
3. Returnee migrants who willingly agreed to participate in the study and provide informed consent, ensuring their voluntary involvement.

Exclusion Criteria

1. Participants who have not experienced migration and return to Nigeria.
2. Participants who cannot provide informed consent due to cognitive impairments, mental health issues, or any other factors that prevent them from fully understanding the nature of the study and voluntarily participating were excluded.

Sample Size Determination

Since the Finite population size is known, Yamane's Formula below was utilized to calculate the sample for this study [14].

$$\frac{N}{1 + N(e)^2}$$

Where:

n = sample size

N = total population (30,574) [15]

e = margin of error (commonly 5% or 0.05)

deff = 3

$$\frac{30,574}{1 + 30,574 (0.05)^2}$$

$$\frac{30,574}{1 + 30,574 \times 0.025}$$

$$\frac{30,574}{77,435}$$

$$= 395$$

The design effect (deff) accounts for the impacts of complete sampling methods (e.g cluster sampling) on variance.

If deff = 3, the adjusted sample size is

$$= n \times \text{deff}$$

Where:

n = 395 (original sample size from Yamane's formula)

$$\text{deff} = 3$$

$$= 395 \times 3$$

$$= 1,185$$

$$\text{Non-response (10\%)} = n/0.9$$

$$n = 1316.$$

Sampling Technique

A multistage sampling approach was used to ensure a representative sample of returnee migrants across Nigeria. Returnees were first grouped by the six geopolitical zones. Probability Proportional to Size (PPS) was then applied to determine sample sizes for each zone and state based on the number of returnees. Finally, individual participants were selected using convenience and snowball sampling through returnee networks and associations.

Data Collection Procedures

Data was collected using a pretested interviewer-administered questionnaire designed to capture comprehensive information on the mental health challenge, and experiences of returnee migrants in Nigeria. Before the main data collection, the questionnaire was tested twice over a two-week period on a small group of returnee migrants similar to the study population, allowing for adjustments to enhance clarity and reliability. During the pretesting phase, some mental health questions were rephrased to be more empathetic and less direct, helping participants feel more

comfortable. Additionally, complex response options were simplified to make it easier for respondents to provide accurate answers. The quantitative data for this study was collected between May 2025 and July 2025.

To evaluate the effect of the psychosocial intervention on mental health, the General Health Questionnaire-28 (GHQ-28) was chosen as the primary outcome based on results from a comparable trial and its evaluation as an appropriate tool for capturing emotional stress. The GHQ-28 requests participants to indicate how their mental health has been over the past few weeks, using behavioural items with a 4-point scale indicating the following frequencies of experience: “not at all”, “no more than usual”, “rather more than usual” and “much more than usual”. The scoring system applied in this study was the same as the original scoring system used in the Likert scale 0, 1, 2, 3. The minimum score for is 0, and the maximum is 84. Higher GHQ-28 scores indicate greater distress. Goldberg suggests that participants with total scores of 23 or below should be classified as non-psychiatric, while participants with scores ≥ 24 may be classified as psychiatric, but this score is not an absolute cut-off.

Validity and Reliability Test

Validity measures how well an instrument reflects the concept it is designed to assess. In this study, content validity was established by consulting field experts who reviewed the questionnaire and ensured it comprehensively addressed the mental health needs of returnee migrants. Criterion validity was also assessed by comparing the study’s instrument with established measures used in similar research, ensuring its ability to predict relevant mental health outcomes.

Reliability refers to the consistency of the instrument over time. Internal consistency was evaluated using Cronbach’s Alpha, with a score of 0.80, indicating a high degree of reliability. Test-retest reliability was also conducted by

administering the questionnaire to a subset of participants on two separate occasions. The high correlation between the two sets of responses ($r = 0.85$) confirmed the instrument’s stability, demonstrating that it reliably measured the same constructs over time.

Data Analysis

Data was initially collected in Excel and cleaned before analysis. Approximately 20% of the study questionnaires were rejected due to incomplete responses and inconsistencies in the provided answers. The cleaned data were then analysed using statistical software, specifically IBM-SPSS version 28.0. Quantitative analysis comprehensively examined the collected data using descriptive statistics (frequencies and percentages), while multivariate logistic regression was used to identify factors associated with mental health status among returnee migrants. Data were considered significant at $p < 0.05$. All completed questionnaires were checked for accuracy and completeness before entry. Double data entry and validation were conducted to minimize typographical errors and ensure consistency. Outliers and inconsistencies were reviewed and corrected through reference to original records. The cleaned dataset was then securely stored and analyzed using SPSS version 28, ensuring reliability and reproducibility of results.

Result

Socio-Demographic Characteristics of Returnee Migrants

Table 1 shows that most returnee migrants were young adults aged 18–30 years (65.7%), with a mean age of 29 ± 6.2 years, indicating a predominantly youthful population. Females (56.5%) slightly outnumbered males (43.5%). The majority were single (58.3%), while over one-third were married (38.4%). Most respondents were Christians (79.0%), and Edo ethnicity constituted the largest group (50.9%). Most returnees had migrated from North Africa

(88.8%), with very few returning from Europe or North America.

Table 1. Socio-Demographic Characteristics of Returnee Migrants

Variables	Frequency (n=1316)	Percentage (%)
Age Category		
0-17 Years	5	0.4
18-30 Years	864	65.7
31-50 Years	441	33.5
51 Years	6	0.5
Mean age:	29±6.212	
Sex		
Male	572	43.5
Female	744	56.5
Marital Status		
Single	776	58.3
Married	506	38.4
Separated	5	0.4
Divorce	24	1.8
Widowed	14	11
Religion		
Christianity	1040	79.0
Islam	276	21.0
Ethnicity		
Hausa	208	15.8
Igbo	104	7.9
Yoruba	127	9.7
Edo	670	50.9
Others	207	15.7
Region Returned from?		
Europe	2	0.2
North America	2	0.2
North Africa	1168	88.8
West Africa	128	9.7

Figure 1 illustrates the reasons for migration among respondents. The leading reason cited was the pursuit of a better life or improved living conditions, reported by 43.2% of participants. This was closely followed by experiences of torture, which accounted for

38.6% of the reported reasons for migration. Economic hardship was cited by 12.1%, while 8.6% migrated due to unemployment. A very small proportion (1.1%) reported being victims of kidnapping as their primary reason for migration.

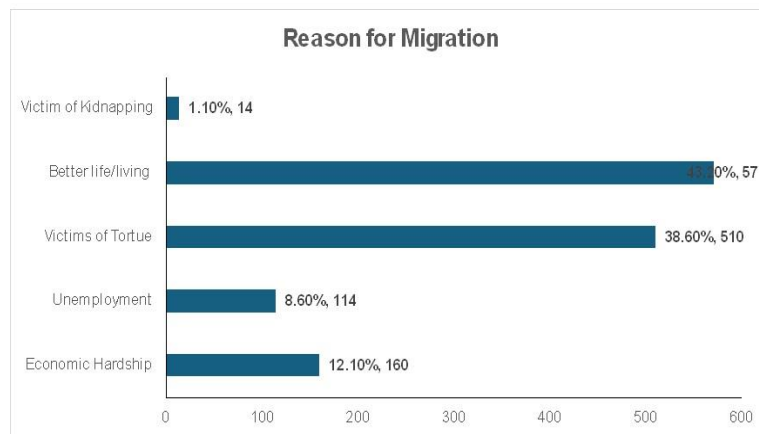


Figure 1. Reasons for Migration by returnee

Figure 2 presents the distribution of reasons why respondents eventually returned. The most frequently reported reason was unemployment (24.1%), indicating that the inability to secure stable work significantly influenced the decision to return. Labour exploitation was the second most common reason (22.3%), highlighting poor working conditions as a major driver of return. Victimization from torture was also a prominent factor, reported by 20.6% of respondents, while medical reasons accounted for 20.3%. Mental health and

psychosocial support (MHPSS) needs were reported by 16.9%, suggesting a considerable burden of psychological distress among the returnees. Sexual exploitation (16.1%) and unstable living conditions (13.5%) were other notable reasons. Voluntary return was chosen by 12.9%, while pregnancy accounted for 8.4% of returns. Less frequent reasons included being a single parent (4.4%), unemployment (4.0%), gender-based violence (3.8%), and kidnapping (3.4%).



Figure 2. Reasons for Eventual Return by Returnee

Assessment of Mental Health Status of Respondents

Table 2 shows a high burden of mental health challenges among the 1,316 respondents in the month preceding the survey. More than four-

fifths of respondents reported increased sleep problems, with 84.8% experiencing trouble sleeping “rather more than usual” or “much more than usual.” Similarly, anxiety and worry were highly prevalent, as 83.5% reported

feeling anxious more than usual, indicating widespread psychological distress. Depressive symptoms were also prominent. About 82.5% of respondents reported feeling down, depressed, or hopeless more than usual, with a notably high proportion (39.3%) reporting this “much more than usual.” Difficulties with concentration were common, affecting 42.4% of respondents at elevated levels, potentially reflecting impaired daily functioning. Exposure to trauma-related symptoms was particularly severe. A striking 86.1% of respondents reported experiencing flashbacks or disturbing memories related to migration or displacement more than usual, with nearly seven in ten

(69.2%) reporting this “much more than usual,” suggesting a substantial burden of post-traumatic stress symptoms.

Feelings of strain, low self-confidence, and being overwhelmed were also widespread. Over 74% felt constantly under strain, 56.5% reported losing confidence in themselves more than usual, and 55.1% felt overwhelmed by their problems. Although feelings of hopelessness about the future were less extreme compared to other symptoms, more than one-third (38.4%) still reported elevated hopelessness. Despite the high prevalence of mental health symptoms, help-seeking behavior was relatively low.

Table 2. Assessment of Mental Health Status of Respondents

Variables	Frequency (n=1316)	Percentage (%)
In the past month, have you had trouble sleeping?		
Not at all	169	12.8
No more than usual	31	2.4
Rather more than usual	749	56.9
Much more than usual	367	27.9
In the past month, have you felt anxious or worried?		
Not at all	159	12.1
No more than usual	57	4.3
Rather more than usual	860	65.3
Much more than usual	240	18.2
In the past month, have you felt down, depressed, or hopeless?		
Not at all	159	12.1
No more than usual	68	5.2
Rather more than usual	569	43.2
Much more than usual	520	39.3
In the past month, have you had difficulty concentrating?		
Not at all	160	12.1
No more than usual	598	45.4
Rather more than usual	328	24.9
Much more than usual	230	17.5
In the past month, have you lost interest in activities you usually enjoy?		
Not at all	74	5.6
No more than usual	516	39.2
Rather more than usual	395	30.0
Much more than usual	331	25.0
In the past month, have you experienced flashbacks or disturbing memories related to migration or displacement?		
Not at all	16	1.2

No more than usual	167	12.7
Rather more than usual	222	16.9
Much more than usual	911	69.2
Have you experienced any other mental health symptoms not listed above?		
Not at all	169	12.8
No more than usual	739	56.2
Rather more than usual	74	5.6
Much more than usual	334	25.4
Have you sought any form of mental health support since returning?		
Not at all	190	14.4
No more than usual	772	58.7
Rather more than usual	341	25.9
Much more than usual	13	1.0
Do you sometimes feel hopeless about the future?		
Not at all	163	12.4
No more than usual	647	49.2
Rather more than usual	240	18.2
Much more than usual	266	20.2
Have you ever felt overwhelmed with your problems?		
Not at all	157	11.9
No more than usual	434	33.0
Rather more than usual	569	43.2
Much more than usual	156	11.9
Do you feel constantly under strain?		
Not at all	105	8.0
No more than usual	234	17.8
Rather more than usual	826	62.8
Much more than usual	151	11.5
Have you ever lost confidence in yourself?		
Not at all	114	8.7
No more than usual	459	34.9
Rather more than usual	596	45.3
Much more than usual	147	11.2
Total	1316	100.0

Factors Associated with Mental Health Status of Returnee Migrants

Table 3 presents the bivariate and multivariate logistic regression analysis of factors associated with mental health status among returnee migrants. Sociodemographic

characteristics, such as sex, were significantly associated with mental health status. Female respondents were five times more likely to report poor mental health compared to males (AOR = 5.499, 95% CI: 2.186-13.831, $p < 0.001$).

Table 3. Multivariate Logistic Regression Analysis of Factors Associated with Mental Health Status among Returnee Migrants

Variable	COR	95% CI	P value	AOR	95% CI	P value
Sex						
Male	Ref			Ref		-
Female	29.576	14.940-58.550	<0.001*	5.499	2.186-13.831	<0.001*
Marital status						
Single	Ref		-	Ref		-
Married	0.338	0.240-0.477	<0.001*	0.766	0.416-1.410	0.392
Separated	0.331	0.036-3.013	0.327	0.198	0.016 – 2.481	0.210
Divorced	1.906	0.253-14.362	0.531	0.588	0.014-25.057	0.781
widowed			-			
Religion						
Christianity	111.024	58.579-210.422	<0.001*	0.119	0.044-0.319	<0.001*
Islam	Ref		-	Ref		-
Ethnicity						
Hausa	Ref		-	Ref		-
Igbo	87.744	26.801-287.264	<0.001*	8.384	1.733-40.562	0.008*
Yoruba	45.571	18.770-96.552	<0.001*	7.646	2.488-23.495	<0.001*
Edo	1661.350	228.422-12083.244	<0.001*	204.632	24.205-1729.954	<0.001*
Others	511.567	70.108-3732.810	<0.001*	156.935	18.680-1318.446	<0.001*
Education						
None	Ref		-	Ref		-
Primary	0.838	0.540-1.299	0.429	1.657	0.761-3.477	0.209
Secondary	5.151	3.391-7.825	<0.001*	1.187	0.531-2.651	0.677
Tertiary	4.556	2.008-10.337	<0.001*	0.269	0.064-1.123	0.072
Dropped out	-		-			-

* $p < 0.05$ statistically significant, COR (Crude odd ratio), AOR (Adjusted odd ratio).

Discussion

This study's findings show that the leading reason for migration was the pursuit of a better life (43.2%), followed by experiences of torture (38.6%), economic hardship (12.1%), and unemployment. These findings align with existing literature, which has shown that migration from sub-Saharan Africa is strongly motivated by aspirations for improved socioeconomic conditions and safety, as well as by coercive circumstances, including violence and persecution [16, 17]. The high percentage of torture-related migration underscores the severe risks and vulnerabilities faced by Nigerian migrants, echoing findings from

studies multiple where many Nigerian migrants experience inhumane treatment [18, 19].

On the other hand, the reasons for return were largely associated with structural and psychosocial difficulties. Torture (24.1%) and labour exploitation (22.3%) were the most frequent reasons, followed closely by being a Single Parent (20.6%) and medical issues (20.3%). This pattern supports studies in West Africa which show that forced returnees often come back due to failed migration projects, poor labour conditions, and health challenges (Carling & Collins, 2018). The prominence of mental health and psychosocial support needs among reasons for return suggests that

psychological distress plays a significant role in shaping return decisions. This is consistent with research in Gambia, where returnees reported high levels of trauma, psychosocial strain, and stigmatization, often leading to voluntary or assisted return [20]. Many Nigerian migrants face severe trauma during migration, including violence, dangerous crossings, and harsh detention conditions in Libya, which contribute to high rates of PTSD [21]. On return, many struggle with stigma, unemployment, limited healthcare access, and long-term health problems, further worsening their mental health [10]. However, to address these issues, the International Organization for Migration (IOM) has developed psychosocial support programs, including training sessions on mental health conditions such as depression, suicide, psychoses, and substance abuse, tailored to the Nigerian context [11].

The mental health assessment revealed troubling levels of psychological distress. A large proportion of respondents reported symptoms such as difficulty sleeping, anxiety, depression, and loss of interest in daily activities. Flashbacks or disturbing migration-related memories were the most severe symptom, with others reporting them “much more than usual.” These findings point toward PTSD symptoms, which have been well-documented among returnee migrants exposed to torture, trafficking, and violence [18]. However, only a small percentage of returnees reported actively seeking mental health support, suggesting a major treatment gap. Barriers may include stigma, limited awareness, poor access to services, and cultural interpretations of mental health. Similar treatment gaps have been reported in studies from Nigeria and Ghana, where less than 20% of people with mental disorders receive adequate care [5, 22].

Multivariate logistic regression analysis of factors associated with mental health status among returnee migrants confirmed that sex, religion, and ethnicity remained significant

predictors of mental health status after adjusting for confounders. Female respondents had significantly higher odds of poor mental health compared to males (AOR:5.499: $p<0.001$), even after adjustment, reinforcing gender as a critical determinant. Religion showed a protective effect, with Christianity associated with lower odds of poor mental health (AOR 0.119: $P<0.001$) compared to Islam after adjustment, which may reflect differences in social support networks, coping mechanisms, or community integration. Ethnicity emerged as a strong predictor, with several ethnic groups such as Igbo, Edo, Yoruba and others showing markedly higher adjusted odds of poor mental health compared to the Hausa, indicating potential structural, cultural, or contextual disparities influencing mental health outcomes among returnees.

Conclusion

Returnee migrants in Nigeria experience significant mental health challenges rooted in traumatic migration experiences, economic hardship, and reintegration difficulties. The high prevalence of mental health symptoms and the significant associations with sex, ethnicity, and religion underscore the urgent need for targeted mental health and psychosocial support, alongside inclusive reintegration and livelihood interventions for returnee populations. The study also highlights the need for a coordinated national response that integrates mental health care into reintegration programs, strengthens community-based support systems, and promotes awareness to reduce stigma. Sustainable, gender-sensitive, and trauma-informed interventions are essential to enhance the psychological wellbeing and social reintegration of returnee migrants in Nigeria.

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Conflict of Interest

There is no conflict of interest among the authors.

Ethical Approval

Ethical approval was sought and obtained from the Nigeria Institute of Medical Research (NIMR). The reference number for the ethical approval is (IRB/24/017). Informed consent was obtained from all study participants, ensuring their voluntary and informed participation in the research. To protect participants' privacy, measures were taken to ensure the anonymity and confidentiality of their responses and personal information. Ethical approval was also sought from NIMR to ensure that the study adheres to ethical standards and safeguards the well-being and rights of all participants.

Data Availability Statement

The datasets generated and analyzed during the current study are not publicly available due to ethical restrictions related to the protection of participants' privacy and confidentiality, as the data contains sensitive information on the mental health and psychosocial experiences of returnee migrants. De-identified data may, however, be made available from the corresponding author upon reasonable request and subject to approval by the Nigeria Institute of Medical Research (NIMR) ethics committee, in line with the approved ethical protocol.

References

- [1]. International Organization for Migration, 2019, Migration in Nigeria: A Country Profile 2019. *International Organization for Migration*, https://publications.iom.int/system/files/pdf/iom_re_integration_handbook.pdf
- [2]. International Organization for Migration, 2022, World Migration Report 2022: Migration and Migrants – A Global Overview. *International Organization for Migration*, <https://worldmigrationreport.iom.int>.

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- **Florence Ngozi Uchendu:** Supervision, Writing – Review & Editing, Project Administration, Funding Acquisition.
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- **Kazeem Uthman:** Conceptualization, Writing – Review & Editing, Supervision.
- All authors read and approved of the final manuscript.

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- [3]. World Health Organization, 2022, Mental Health: Strengthening Our Response. *World Health Organization*, <https://www.who.int/news-room/fact-sheets/detail/mental-health-strengthening-our-response>.
- [4]. World Health Organization, 2017, Depression and Other Common Mental Disorders: Global Health Estimates. *World Health Organization, Geneva, Switzerland*, <https://apps.who.int/iris/handle/10665/254610>.
- [5]. Wada, Y. H., Rajwani, L., Anyam, E., Karikari, E., Njikizana, M., Srour, L., et al., 2021, Mental

- health in Nigeria: A neglected issue in public health. *Public Health in Practice*, 2, <https://doi.org/10.1016/j.puhip.2021.100166>.
- [6]. Moullan, Y., Jusot, F., 2014, Why is the “healthy immigrant effect” different between European countries? *European Journal of Public Health*, 24(Suppl. 1), 80–86, <https://doi.org/10.1093/eurpub/cku112>.
- [7]. Blair, A. H., Schneeberg, A., 2014, Changes in the “healthy migrant effect” in Canada: Are recent immigrants healthier than they were a decade ago? *Journal of Immigrant and Minority Health*, 16(1), 136–142, <https://doi.org/10.1007/s10903-013-9813-9>.
- [8]. Wapmuk, S., 2019, International migration, Nigerian returnee migrants, and challenges of reintegration. *Journal of African Studies and Development*, 9, 158–180.
- [9]. Biswas, J., Gangadhar, B. N., Keshavan, M., 2016, Cross-cultural variations in psychiatrists’ perception of mental illness: A tool for teaching culture in psychiatry. *Asian Journal of Psychiatry*, 23, 1–7, <https://doi.org/10.1016/j.ajp.2016.05.011>.
- [10]. Sanderson, S., 2019, Returnees struggle to adjust to life in Nigeria. *InfoMigrants*, <https://www.infomigrants.net>.
- [11]. International Organization for Migration, 2020, Returnees and health workers join hands to improve psychosocial well-being in Nigeria. *International Organization for Migration*, <https://www.iom.int>.
- [12]. Kunnuji, M., Onitolo, E., Grant, C., 2024, Addressing the humanitarian needs of forced rural-to-city migrants in north-west Nigeria with a focus on mental health vulnerability. *Social Science in Action*, <https://www.socialscienceinaction.org>.
- [13]. Akinlua, J. T., Meakin, R., Umar, A. M., Freemantle, N., 2015, Current prevalence pattern of hypertension in Nigeria: A systematic review. *PLOS ONE*, 10(10), <https://doi.org/10.1371/journal.pone.0140021>.
- [14]. Yamane, Y., 1967, Mathematical formulae for sample size determination. *Open Journal of Statistics*, 12, 291–302.
- [15]. International Organization for Migration, 2023, IOM Nigeria Annual Report 2023. *International Organization for Migration*.
- [16]. Atem, D. M., 2020, Unthinkable journeys: Sub-Saharan Africa involuntary youth migration. *Journal of Economic Development Studies*, 8(3), <https://doi.org/10.15640/jeds.v8n3a5>.
- [17]. Sumata, C., 2021, A framework for understanding migration from Sub-Saharan Africa: Transnational and global perspectives. *In Handbook of Culture and Migration*, 162–167, <https://doi.org/10.4337/9781789903461.00022>.
- [18]. Cattaneo, C., Magli, F., Franceschetti, L., 2022, Commentary on: “Tortures alleged by migrants in Italy: compatibility and other medicolegal challenges”. *International Journal of Legal Medicine*, 136(2), 391–392, <https://doi.org/10.1007/s00414-021-02744-3>.
- [19]. Esposito, M., Salerno, M., Chisari, M. G., Sessa, F., Rapisarda, V., Pomara, C., 2024, Analysis of the health conditions of migrants and asylum seekers in reception centers: From scene investigation to the evaluation of signs of torture. *Forensic Science International*, 365, <https://doi.org/10.1016/j.forsciint.2024.112288>.
- [20]. Leichtle, N., 2025, Not a semester hero. *Migration and Society*, 8, 1–16, <https://doi.org/10.3167/arms.2025.0122of5>.
- [21]. Tessitore, F., Parola, A., Margherita, G., 2023, Mental health risk and protective factors of Nigerian male asylum seekers hosted in Southern Italy: A culturally sensitive quantitative investigation. *Journal of Racial and Ethnic Health Disparities*, 10(2), 730–742, <https://doi.org/10.1007/s40615-022-01260-3>.
- [22]. Adusei, A. B., Ayiku, R. N. B., Amarteyfio, K. A. N. A., Bondzie, E. P. K., Adjei-Banuah, N. Y., Abdul-Samed, A. B., et al., 2025, Disparities in the access and provision of mental health services as part of primary health care: A case study of Ga-South District in the Greater Accra Region. *Frontiers in Public Health*, 13, <https://doi.org/10.3389/fpubh.2025.1537955>.

Determinants for Pre-exposure Prophylaxis Discontinuation among Perceived Low Risk Populations in Homa Bay and Kisii Counties, Kenya

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Abstract

Pre-exposure prophylaxis (PrEP) effectively prevents HIV, but early discontinuation—especially among those perceiving low risk—reduces its impact. This study explored socio-demographic and contextual factors influencing PrEP discontinuation and assessed healthcare worker engagement in Homa Bay and Kisii counties, Kenya. Using a correlational design, 293 individuals who stopped PrEP within three months were selected via stratified random sampling from LVCT Vukisha95-supported facilities. Data, collected through structured questionnaires and linked to program records, were analyzed using descriptive statistics, chi-square tests, and multivariable logistic regression to identify factors associated with discontinuation. Most participants were female (71.7%), aged 20–34 years, and from Homa Bay (68.3%). County of residence predicted discontinuation, with Kisii residents less likely to stop PrEP than Homa Bay residents (aOR = 0.09; 95% CI: 0.04–0.19; $p < 0.001$). Formal employment was associated with increased odds of discontinuation (aOR = 2.80; 95% CI: 1.24–6.45; $p = 0.014$). Individuals aged 25–29 (aOR = 0.26; $p = 0.041$) and 45–49 (aOR = 0.16; $p = 0.038$) were less likely to discontinue PrEP than adolescents 15–19 years. Education had a marginal effect, while sex, marital status, income, and HIV risk category were not significant. About 40% cited reasons differing from records, and only 15% consulted healthcare workers before stopping PrEP. PrEP discontinuation driven by perceived low HIV risk is influenced more by contextual and socioeconomic factors than actual risk, highlighting the need for personalized risk assessment, better documentation, and proactive healthcare worker engagement in high-burden areas.

Keywords: Discontinuation, Engagement, PrEP, Risk Perception.

Introduction

HIV remains a major global health challenge, with an estimated 39 million people living with the virus in 2022 and about 1.3 million new infections recorded that year. Africa continues to bear the greatest burden, accounting for roughly two-thirds of global cases, more than 660,000 new infections, and 60% of AIDS-related deaths [1]. Although new HIV infections have declined by 38% since 2010, sustaining strong prevention efforts remains essential, particularly in regions with

persistently high transmission rates. Pre-Exposure Prophylaxis (PrEP) is a highly effective biomedical intervention that can reduce HIV acquisition by up to 99% when used consistently and correctly [2-4].

Despite its proven effectiveness, maintaining PrEP use over time remains a global challenge. Studies show that up to 40% of individuals initiating PrEP discontinue within six months, and nearly 35% stop within one year [5, 6]. Low perceived HIV risk is among the most frequently cited reasons for stopping, accounting for nearly half of discontinuation

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decisions [3]. Although many clients eventually resume PrEP—nearly 50% within a year—periods of interruption expose users and their partners to renewed risk of infection [7, 8].

African countries show strong PrEP uptake but lower consistency in long-term use. While return visits for early refills reach up to 88% in some settings, biomarker evidence indicates that daily adherence remains suboptimal, with more than one-third of clients showing no evidence of active use at six months [9, 10]. Reported reasons for discontinuation include low perceived HIV risk, side effects, relationship stability, and peer or partner influence. These patterns are reflected in Kenya, where PrEP uptake among women, especially those in serodiscordant relationships, has been substantial. However, only 12% of users remain on PrEP by the sixth month [11]. Among adolescent girls and young women in Homa Bay and Kisumu, clinic attendance was high, yet drug level testing revealed inconsistent use, often linked to low perceived risk [12].

Much of the existing research focuses on PrEP uptake and adherence, whereas the drivers of discontinuation—particularly decisions rooted in perceived low HIV risk—remain understudied. This gap is especially critical in high-prevalence counties such as Homa Bay and Kisii, where ongoing HIV transmission necessitates consistent prevention. Understanding why individuals discontinue PrEP despite residing in high-risk environments is essential for strengthening retention strategies and designing targeted, context-appropriate interventions.

This study therefore examines the factors contributing to PrEP discontinuation among individuals who perceive themselves to be at low risk of HIV infection in Homa Bay and Kisii Counties, Kenya. Specifically, it seeks to: (1) identify socio-demographic characteristics associated with stopping PrEP among people who believe their HIV risk is minimal and (2) assess the nature of support provided by

healthcare workers and the health system to those who discontinue.

By addressing these gaps, the study aims to generate evidence that can strengthen PrEP retention, enhance risk-communication strategies, and support the development of responsive HIV prevention approaches in two of Kenya's highest-burden regions.

Materials and Methods

Description of the Site

The study was conducted in Homa Bay and Kisii Counties, focusing on individuals who had initiated PrEP but later discontinued it at LVCT Vukisha95-supported facilities. Data were obtained through interviews conducted in 12 purposively selected high-volume health facilities across both counties.

Homa Bay and Kisii are located in western Kenya. Homa Bay, along Lake Victoria, has approximately 1.31 million residents in 262,036 households and is served by 304 health facilities and 284 community health units staffed by about 2,950 community health volunteers. The county has the second-highest HIV burden nationally, with 109,786 people living with HIV, a 10.6% prevalence, 984 annual new infections, a 7.9% mother-to-child transmission rate, and 1,404 HIV-related deaths.

Kisii County has about 1.27 million people in 312,665 households and operates 156 health facilities supported by 190 community health units and 2,100 volunteers. It ranks tenth nationwide in HIV burden, reporting 48,202 people living with HIV, a 3.8% prevalence, 443 new infections annually, an 11.1% mother-to-child transmission rate, and 663 HIV-related deaths.

Despite strong health systems in both countries, their substantial HIV burden—especially in Homa Bay—highlights the need for focused and sustained prevention efforts.

Research Design

A correlational research design was employed. This design was used because PrEP use, risk perception, and behavioral or structural factors cannot be ethically manipulated. It allowed observation in natural settings, efficient data collection across subgroups, and identification of meaningful relationships and predictive patterns to inform future research, interventions, and policy.

Sampling and Sample Size

A stratified random sampling method was employed to ensure representation across different population groups strata that include high-risk populations, fisher fork, individuals in discordant relationships, adolescents and young persons, plus Pregnant and breastfeeding women. From each stratum, participants were randomly selected to participate in the survey.

Study Population

The study targeted 1,224 individuals from Homa Bay and Kisii Counties who stopped using PrEP after assessing themselves as being at low risk of HIV infection. Participants were identified using a PrEP line list generated from the Kenya EMR database by the LVCT Vukisha95 health informatics team. This line list captured whether clients were still on PrEP or had discontinued, as well as their reported reasons for discontinuation. All individuals had initiated PrEP within LVCT Vukisha95-supported health facilities.

The target population of 1,224 represented the annual average number of PrEP discontinuations recorded by the project in the two counties over the last three years. Homa Bay and Kisii were selected due to their strong involvement in the Vukisha95 program, which focuses on enhancing HIV prevention and care. From this population, the sample size was determined using the formula recommended by Kothari and Garg (2016).

$$n = \frac{Z^2 \cdot p \cdot q \cdot N}{e^2 \cdot (N - 1) + Z^2 \cdot p \cdot q}$$

This gives a sample size of 292.87, which is rounded to 293. A stratified random sampling approach was used to ensure proportional representation across various population groups, including high-risk populations, fisherfolk, individuals in discordant relationships, adolescents and young people, as well as pregnant and breastfeeding women, as outlined in Table 1 below. Participants from each stratum were randomly selected to take part in the survey.

Inclusion and Exclusion Criteria

Eligible participants for this study were individuals who were initiated on PrEP at LVCT Vukisha95-supported health facilities in Homa Bay and Kisii Counties, who were followed up by healthcare workers in these facilities, and discontinued PrEP not more than three months prior to the interview due to a perceived low risk of HIV infection.

Table 1. Distribution of Participants across Various Strata

Population Typology (Strata)	Population Count	Percentage of Population	Calculation (Sample of 293)	Sample Count
Discordant relationship	159	13%	0.13 x 293	38
Dreams Girl	79	6%	0.6 x 293	19
Female Sex Worker	192	16%	0.16 x 293	46
Fisher fork	104	8%	0.8 x 293	25
General Population	468	38%	0.38 x 293	112
MSM	63	5%	0.5 x 293	15

Research Instruments

A structured questionnaire combining open- and closed-ended questions was used to collect quantitative data. It was pilot-tested with 20 respondents to assess its clarity, effectiveness, and reliability, and adjustments were made based on feedback. Validity was ensured through expert review and field testing, which confirmed that the questions accurately captured the intended variables. Ambiguous, complex, or leading questions were avoided, and response scales carefully structured. Standardized administration procedures ensured consistency in questioning and recording, providing reliable and accurate data for the study.

Data Analysis

Quantitative data analysis was done to address the study objectives. Socio-demographic characteristics of participants, including age, gender, education, and occupation, were summarized using descriptive statistics such as frequencies, percentages, means, and standard deviations. Inferential analyses, including chi-square tests and logistic regression, were conducted to identify socio-demographic factors significantly associated with PrEP discontinuation. To evaluate the role of healthcare professional support, descriptive methods were used to categorise the services provided, including counselling, risk reassessment, follow-up, and referrals to alternative prevention strategies, while inferential analyses assessed whether specific types or levels of support were associated with discontinuation. All quantitative analyses were performed using SPSS Version 20, and results were presented in tables, graphs, and charts to enhance clarity and interpretation, providing insights to guide targeted interventions to improve PrEP retention and HIV prevention outcomes. In all analyses, $p < 0.05$ were considered statistically significant.

Results

Socio-Demographic Factors Influencing PrEP Discontinuation Among Low-Risk Perceiving Individuals Homa Bay and Kisii

As demonstrated in tables 2, a total of 293 participants were enrolled in the study. The majority resided in Homa Bay County (200; 68.3%), while 93 (31.7%) were from Kisii County. Participants were predominantly young adults, with the largest proportion aged 25–29 years (62; 21.2%), followed by those aged 30–34 years (59; 20.1%) and 20–24 years (58; 19.8%). Adolescents aged 15–19 years accounted for 39 respondents (13.3%). Smaller proportions were aged 40–44 years (34; 11.6%), 45–49 years (20; 6.8%), 50 years and above (13; 4.4%), and 35–39 years (8; 2.7%).

Females constituted the majority of participants (210; 71.7%), while males accounted for 83 (28.3%). Regarding marital status, 133 (45.4%) were married, 113 (38.6%) were single, 35 (11.9%) were divorced or separated, and 12 (4.1%) were widowed. Most respondents had attained secondary education (129; 44.0%), followed by primary education (102; 34.8%). Tertiary education was reported by 51 (17.4%), while 11 (3.8%) had no formal education.

Nearly half of the participants were in formal employment (144; 49.1%), whereas 76 (25.9%) were unemployed, 59 (20.1%) were engaged in informal employment, and 14 (4.8%) were self-employed. The majority reported a monthly income of less than KES 10,000 (202; 68.9%), with 66 (22.5%) earning KES 10,001–20,000. Few participants earned KES 20,001–30,000 (16; 5.5%) or more than KES 30,000 (9; 3.1%).

Based on documented HIV risk assessment, most participants were classified as having low (133; 45.4%) or very low risk (98; 33.4%). Moderate risk was documented among 35 (11.9%), while 13 (4.4%) and 14 (4.8%) were categorized as high and very high risk, respectively. Overall, 231 (78.8%) fell into the

low/very low-risk group, 35 (11.9%) into the moderate-risk group, and 27 (9.2%) into the high/very high-risk group.

Table 2. Demographic Characteristics

Variable	N = 293
County of residence	
Homa Bay	200 (68.3%)
Kisii	93 (31.7%)
Age	
15-19 years	39 (13.3%)
20-24 years	58 (19.8%)
25-29 years	62 (21.2%)
30-34 years	59 (20.1%)
40-44 years	34 (11.6%)
45-49 years	20 (6.8%)
35-39 years	8 (2.7%)
50+ Years	13 (4.4%)
Sex	
Female	210 (71.7%)
Male	83 (28.3%)
Marital status	
Married	133 (45.4%)
Single	113 (38.6%)
Divorced/Separated	35 (11.9%)
Widowed	12 (4.1%)
Education level	
No Formal education	11 (3.8%)
Primary education	102 (34.8%)
Secondary education	129 (44.0%)
Tertiary education	51 (17.4%)
Variable	N = 293
Occupation	
Unemployed	76 (25.9%)
Self-employed	14 (4.8%)
Informal employment	59 (20.1%)
Formal employment	144 (49.1%)
Income level	
Less than KES 10,000	202 (68.9%)
KES 10,001 to KES 20,000	66 (22.5%)
KES 20,001 to KES 30,000	16 (5.5%)
More than KES 30,000	9 (3.1%)
Documented Risk	
Very low	98 (33.4%)
Low	133 (45.4%)

Moderate	35 (11.9%)
High	13 (4.4%)
Very high	14 (4.8%)
Risk Group	
High/Very High	27 (9.2%)
Low/Very Low	231 (78.8%)
Moderate	35 (11.9%)

As shown in Table 3, findings varied across the two counties. Notable differences were observed in age distribution. Participants from Homa Bay tended to be older, with the largest proportions aged 30–34 years (49; 24.5%) and 25–29 years (41; 20.5%). In contrast, Kisii had a comparatively younger cohort, with most participants aged 20–24 years (30; 32.3%) and 15–19 years (22; 23.7%).

Females predominated in both counties, comprising 69.0% (138) of participants in Homa Bay and 77.4% (72) in Kisii; however, the difference in sex distribution between counties was not statistically significant ($p = 0.14$). Marital status, on the other hand, differed significantly by county ($p = 0.002$). A greater proportion of respondents in Homa Bay were married (104; 52.0%), whereas over half of those in Kisii were single (49; 52.7%).

Significant differences were also noted in educational attainment ($p < 0.001$). Participants from Homa Bay were more likely to have primary-level education (89; 44.5%), whereas those from Kisii were more likely to have

secondary-level education (47; 50.5%) or tertiary education (25; 26.9%). Additionally, Kisii had a higher proportion of individuals with no formal education compared to Homa Bay (8; 8.6% vs. 3; 1.5%).

Occupational status varied significantly between the counties ($p < 0.001$). Formal employment was more common in Homa Bay (116; 58.0%), whereas unemployment was substantially higher in Kisii (40; 43.0%). Income distribution also differed significantly ($p = 0.006$), with a larger share of Kisii participants earning less than KES 10,000 per month (76; 81.7%) than in Homa Bay (126; 63.0%).

Documented HIV risk profiles showed marked county-level variation ($p < 0.001$). Participants in Kisii were more frequently classified as having very low risk (50; 53.8%), while those in Homa Bay were predominantly categorized as low risk (118; 59.0%). Higher proportions of individuals classified as high or very high risk were observed in Kisii relative to Homa Bay.

Table 3. Demographic Characteristics

Variable	Homa Bay N = 200 ¹	Kisii N = 93 ¹	p-value ²
Age			
15-19 years	17 (8.5%)	22 (23.7%)	
20-24 years	28 (14.0%)	30 (32.3%)	
25-29 years	41 (20.5%)	21 (22.6%)	
30-34 years	49 (24.5%)	10 (10.8%)	
40-44 years	31 (15.5%)	3 (3.2%)	
45-49 years	17 (8.5%)	3 (3.2%)	
35-39 years	6 (3.0%)	2 (2.2%)	
50+ Years	11 (5.5%)	2 (2.2%)	
Sex			0.14

Female	138 (69.0%)	72 (77.4%)	
Male	62 (31.0%)	21 (22.6%)	
Marital status			0.002
Married	104 (52.0%)	29 (31.2%)	
Single	64 (32.0%)	49 (52.7%)	
Divorced/Separated	22 (11.0%)	13 (14.0%)	
Widowed	10 (5.0%)	2 (2.2%)	
Education Level			<0.001
No Formal education	3 (1.5%)	8 (8.6%)	
Primary education	89 (44.5%)	13 (14.0%)	
Secondary education	82 (41.0%)	47 (50.5%)	
Tertiary education	26 (13.0%)	25 (26.9%)	
Occupation Status			<0.001
Unemployed	36 (18.0%)	40 (43.0%)	
Self-employed	7 (3.5%)	7 (7.5%)	
Informal employment	41 (20.5%)	18 (19.4%)	
Formal employment	116 (58.0%)	28 (30.1%)	
Income level			0.006
Less than KES 10,000	126 (63.0%)	76 (81.7%)	
KES 10,001 to KES 20,000	54 (27.0%)	12 (12.9%)	
KES 20,001 to KES 30,000	14 (7.0%)	2 (2.2%)	
More than KES 30,000	6 (3.0%)	3 (3.2%)	
Documented risk			<0.001
Very low	48 (24.0%)	50 (53.8%)	
Low	118 (59.0%)	15 (16.1%)	
Moderate	26 (13.0%)	9 (9.7%)	
High	4 (2.0%)	9 (9.7%)	
Very high	4 (2.0%)	10 (10.8%)	
¹ n (%)			
² NA; Pearson's Chi-squared test; Fisher's exact test			

Although all participants were initially documented as having discontinued PrEP due to perceived low HIV risk, further review showed inconsistencies between recorded and self-reported reasons. Approximately 39% (111 participants), as indicated in Table 4, provided alternative explanations, underscoring gaps in routine documentation. Among these participants, 40.5% were from Homa Bay, while 59.5% were from Kisii. County of residence was strongly associated with discontinuation due to low-risk perception ($p < 0.001$). The majority of participants who discontinued PrEP because they perceived

themselves to be at low risk were from Homa Bay County (155; 85.2%), whereas most participants who discontinued for alternative reasons were from Kisii County (66; 59.5%).

Age distribution did not differ significantly between the two groups (Table 4). However, among those who discontinued due to low-risk perception, higher proportions were observed among participants aged 30–34 years (41; 22.5%) and 25–29 years (34; 18.7%), while discontinuation for alternative reasons was more common among those aged 20–24 years and 25–29 years (each 28; 25.2%).

Sex was not significantly associated with the reason for PrEP discontinuation ($p = 0.2$). Females constituted the majority in both groups, accounting for 126 (69.2%) of those who discontinued due to low-risk perception and 84 (75.7%) of those who discontinued for other reasons. Similarly, marital status showed no significant association with discontinuation due to low-risk perception ($p = 0.7$).

Educational attainment was significantly associated with the reason for PrEP discontinuation ($p = 0.008$). Participants who discontinued due to low-risk perception were more likely to have primary (70; 38.5%) or secondary education (82; 45.1%), whereas those who discontinued for alternative reasons had higher proportions of no formal education (9; 8.1%) and tertiary education (23; 20.7%).

Occupation status differed significantly between the two groups ($p < 0.001$). Formal employment was more prevalent among

participants who discontinued PrEP due to low risk perception (106; 58.2%), whereas unemployment was more common among those who discontinued for other reasons (39; 35.1%). Informal employment was also more frequent among participants who discontinued for reasons other than low-risk perception (Table 4).

Income level was not significantly associated with the reason for PrEP discontinuation ($p = 0.14$), although a larger proportion of participants in both groups earned less than KES 10,000 per month. Similarly, documented HIV risk group did not differ significantly between participants who discontinued PrEP due to low-risk perception and those who discontinued for alternative reasons ($p = 0.11$). In both groups, the majority were classified as having low or very low HIV risk.

Table 4. Factors Associated with Stopping PrEP due to Low-Risk Perception

Variable	Alternative discontinuation reason N=111 ¹	Discontinued due to low-risk N=182 ¹	p-value ²
County of Residence			<0.001
Homa Bay	45 (40.5%)	155 (85.2%)	
Kisii	66 (59.5%)	27 (14.8%)	
Age			
15-19 years	15 (13.5%)	24 (13.2%)	
20-24 years	28 (25.2%)	30 (16.5%)	
25-29 years	28 (25.2%)	34 (18.7%)	
30-34 years	18 (16.2%)	41 (22.5%)	
40-44 years	9 (8.1%)	25 (13.7%)	
45-49 years	8 (7.2%)	12 (6.6%)	
35-39 years	1 (0.9%)	7 (3.8%)	
50+ Years	4 (3.6%)	9 (4.9%)	
Sex			0.2
Female	84 (75.7%)	126 (69.2%)	
Male	27 (24.3%)	56 (30.8%)	
Marital Status			0.7
Married	49 (44.1%)	84 (46.2%)	
Single	44 (39.6%)	69 (37.9%)	
Divorced/Separated	15 (13.5%)	20 (11.0%)	
Widowed	3 (2.7%)	9 (4.9%)	

Education			0.008
No Formal education	9 (8.1%)	2 (1.1%)	
Primary education	32 (28.8%)	70 (38.5%)	
Secondary education	47 (42.3%)	82 (45.1%)	
Tertiary education	23 (20.7%)	28 (15.4%)	
Occupation status			<0.001
Unemployed	39 (35.1%)	37 (20.3%)	
Self-employed	7 (6.3%)	7 (3.8%)	
Informal employment	27 (24.3%)	32 (17.6%)	
Formal employment	38 (34.2%)	106 (58.2%)	
Income Level			0.14
Less than KES 10,000	84 (75.7%)	118 (64.8%)	
KES 10,001 to KES 20,000	20 (18.0%)	46 (25.3%)	
KES 20,001 to KES 30,000	3 (2.7%)	13 (7.1%)	
More than KES 30,000	4 (3.6%)	5 (2.7%)	
Risk group			0.11
High/Very High	14 (12.6%)	13 (7.1%)	
Low/Very Low	88 (79.3%)	143 (78.6%)	
Moderate	9 (8.1%)	26 (14.3%)	
¹ n (%)			
² Pearson's Chi-squared test; NA; Fisher's exact test			

Table 5 summarizes the crude odds ratios assessing factors associated with discontinuation of PrEP attributed to perceived low HIV risk. County of residence emerged as a strong determinant of this outcome. Participants residing in Kisii County were significantly less likely to discontinue PrEP due to low-risk perception compared with those from Homa Bay County (OR = 0.12; 95% CI: 0.07–0.21; $p < 0.0001$), indicating substantial geographic variation in discontinuation behavior.

Across age categories, no statistically significant associations were observed with PrEP discontinuation due to perceived low risk. Although individuals aged 35–39 years demonstrated higher odds of discontinuation, the estimate was imprecise, as reflected by a wide confidence interval (OR = 4.37; 95% CI: 0.49–39.18; $p = 0.187$), likely attributable to small numbers in this age group. Similar non-significant findings were noted across the remaining age categories.

Sex was not significantly associated with stopping PrEP due to low-risk perception. Male participants showed slightly higher odds compared to females; however, this difference did not reach statistical significance (OR = 1.38; 95% CI: 0.81–2.36; $p = 0.236$). Likewise, marital status did not demonstrate a meaningful association with the outcome, with comparable odds observed among married, single, divorced/separated, and widowed participants.

Educational level was strongly associated with discontinuation due to low-risk perception. Relative to participants with no formal education, those with primary, secondary, and tertiary education had significantly higher odds of stopping PrEP for this reason, with the magnitude of association decreasing as education level increased. These findings suggest a potential link between educational attainment and self-assessed HIV risk.

Occupation status also showed a significant association. Participants engaged in formal

employment were nearly three times more likely to discontinue PrEP due to perceived low risk compared to unemployed participants (OR = 2.94; 95% CI: 1.64–5.27; $p < 0.0001$), while self-employment and informal employment were not significantly associated.

Although income level was not significantly associated with discontinuation due to low-risk perception, higher income categories

demonstrated a trend toward increased odds. Documented HIV risk level was largely not associated with the outcome; however, participants classified as having moderate risk were significantly more likely to discontinue PrEP due to perceived low risk compared to the reference group (OR = 3.11; 95% CI: 1.07–9.07; $p = 0.038$).

Table 5. Crude Odds Ratios for Factors Associated with Stopping due to Low-Risk Perception

Predictor	Level	OR	CI lower	CI upper	P value
County	County Kisii	0.12	0.07	0.21	<0.0001
Age	Age 20-24 years	0.67	0.29	1.53	0.341
	Age 25-29 years	0.76	0.34	1.72	0.508
	Age 30-34 years	1.42	0.61	3.33	0.416
	Age 40-44 years	1.74	0.64	4.71	0.279
	Age 45-49 years	0.94	0.31	2.82	0.909
	Age 35-39 years	4.37	0.49	39.18	0.187
	Age 50+ Years	1.41	0.37	5.39	0.619
Sex	Male	1.38	0.81	2.36	0.236
Marital Status	Marital Single	0.91	0.55	1.53	0.736
	Marital Divorced/Separated	0.78	0.37	1.66	0.515
	Marital Widowed	1.75	0.45	6.77	0.418
Education Level	Education Primary education	9.84	2.01	48.19	0.005
	Education Secondary education	7.85	1.63	37.87	0.010
	Education Tertiary education	5.48	1.08	27.92	0.041
Occupation	Occupation Self-employed	1.05	0.34	3.30	0.928
	Occupation Informal employment	1.25	0.63	2.47	0.522
	Occupation Formal employment	2.94	1.64	5.27	<0.0001
Income Levels	Income KES 10,001 to KES 20,000	1.64	0.90	2.97	0.104
	Income KES 20,001 to KES 30,000	3.08	0.85	11.16	0.086
	Income More than KES 30,000	0.89	0.23	3.41	0.865
Risk Levels	Risk group Low/Very Low	1.75	0.79	3.90	0.170
	Risk group Moderate	3.11	1.07	9.07	0.038

Table 6 presents the results of the multivariable logistic regression analysis examining factors independently associated with discontinuation of PrEP due to perceived low HIV risk. After adjusting for potential confounders, county of residence remained a strong and statistically significant predictor of PrEP discontinuation due to low-risk perception. Participants from Kisii County had substantially lower odds of stopping PrEP for this reason compared to those from Homa Bay County (aOR = 0.09; 95% CI: 0.04–0.19; $p < 0.001$).

Age remained independently associated with PrEP discontinuation, attributable to perceived low risk in selected age groups. Compared to adolescents aged 15–19 years, participants aged 25–29 years had significantly lower odds of discontinuing PrEP due to low-risk perception (aOR = 0.26; 95% CI: 0.07–0.92; $p = 0.041$). Similarly, participants aged 45–49 years were less likely to discontinue PrEP for this reason (aOR = 0.16; 95% CI: 0.03–0.89; $p = 0.038$). No significant associations were observed in other age categories, and estimates for participants aged 35–39 years were imprecise, likely due to small sample sizes.

Sex was not independently associated with discontinuation due to low-risk perception. Male participants had higher adjusted odds compared to females; however, this association was not statistically significant (aOR = 1.42;

95% CI: 0.70–2.97; $p = 0.340$). Marital status also showed no independent association with the outcome.

Educational attainment was associated with elevated adjusted odds of discontinuation due to low-risk perception across all education levels relative to no formal education; however, these associations did not reach statistical significance after adjustment, although borderline effects were observed for secondary and tertiary education.

Occupation status remained an independent predictor of PrEP discontinuation due to a low perception of risk. Participants in formal employment had nearly three times higher odds of stopping PrEP due to perceived low risk compared to unemployed participants (aOR = 2.80; 95% CI: 1.24–6.45; $p = 0.014$). In contrast, self-employment and informal employment were not significantly associated with the outcome.

Income level and documented HIV risk group were not independently associated with discontinuation due to low-risk perception after adjustment. Overall, the findings indicate that geographic location, specific age groups, and formal employment status independently influence PrEP discontinuation due to perceived low HIV risk, highlighting the need for differentiated risk communication and adherence support strategies.

Table 6. Adjusted Odds Ratios for Factors Associated with Stopping due to Low-Risk Perception

Variable	aOR	95% CI	95% CI	p-value
County				
Homa Bay	—	—	—	
Kisii	0.09	0.04, 0.19	0.04, 0.19	<0.001
Age				
15-19 years	—	—	—	
20-24 years	0.39	0.12, 1.16	0.12, 1.16	0.096
25-29 years	0.26	0.07, 0.92	0.07, 0.92	0.041
30-34 years	0.38	0.09, 1.47	0.09, 1.47	0.168
40-44 years	0.40	0.08, 1.94	0.08, 1.94	0.253
45-49 years	0.16	0.03, 0.89	0.03, 0.89	0.038
35-39 years	2.07	0.16, 60.8	0.16, 60.8	0.611

50+ Years	0.34	0.05, 2.44	0.05, 2.44	0.273
Sex				
Female	—	—	—	
Male	1.42	0.70, 2.97	0.70, 2.97	0.340
Marital				
Married	—	—	—	
Single	1.64	0.76, 3.64	0.76, 3.64	0.214
Divorced/Separated	0.94	0.35, 2.59	0.35, 2.59	0.905
Widowed	2.11	0.39, 15.9	0.39, 15.9	0.413
Education				
No Formal education	—	—	—	
Primary education	6.13	0.84, 66.0	0.84, 66.0	0.095
Secondary education	7.57	1.08, 80.9	1.08, 80.9	0.059
Tertiary education	7.48	0.96, 87.1	0.96, 87.1	0.073
Occupation				
Unemployed	—	—	—	
Self-employed	1.39	0.18, 10.6	0.18, 10.6	0.749
Informal employment	1.37	0.52, 3.65	0.52, 3.65	0.522
Formal employment	2.80	1.24, 6.45	1.24, 6.45	0.014
Income				
Less than KES 10,000	—	—	—	
KES 10,001 to KES 20,000	0.93	0.43, 2.04	0.43, 2.04	0.850
KES 20,001 to KES 30,000	1.93	0.40, 12.5	0.40, 12.5	0.445
More than KES 30,000	0.77	0.08, 8.91	0.08, 8.91	0.825
Risk group				
High/Very High	—	—	—	
Low/Very Low	0.59	0.20, 1.71	0.20, 1.71	0.332
Moderate	1.30	0.36, 4.94	0.36, 4.94	0.692
Abbreviations: CI = Confidence Interval, OR = Odds Ratio				

Table 7 presents county-stratified multivariable logistic regression models examining factors associated with discontinuation of PrEP due to perceived low HIV risk in Homa Bay and Kisii counties. The

county-specific analyses reveal distinct patterns, with several associations approaching significance in Homa Bay, while estimates in Kisii were largely unstable due to small sample sizes and sparse data.

Table 7. County-Specific Logistic Models

County	Variable	aOR	P value	n
Homa Bay	Age 20-24 years	0.29	0.308	200
Homa Bay	Age 25-29 years	0.21	0.206	200
Homa Bay	Age 30-34 years	0.24	0.258	200
Homa Bay	Age 40-44 years	0.37	0.450	200
Homa Bay	Age 45-49 years	0.13	0.143	200
Homa Bay	Age 35-39 years	0.70	0.850	200
Homa Bay	Age 50+ Years	0.31	0.440	200

Homa Bay	Sex Male	1.58	0.344	200
Homa Bay	Marital Single	2.32	0.118	200
Homa Bay	Marital Divorced/Separated	4.32	0.063	200
Homa Bay	Marital Widowed	3.60	0.277	200
Homa Bay	Education Primary education	1.61	0.779	200
Homa Bay	Education Secondary education	2.02	0.679	200
Homa Bay	Education Tertiary education	4.37	0.418	200
Homa Bay	Occupation Self-employed	0.95	0.966	200
Homa Bay	Occupation Informal employment	1.27	0.709	200
Homa Bay	Occupation Formal employment	2.84	0.056	200
Homa Bay	Income KES 10,001 to KES 20,000	0.86	0.763	200
Homa Bay	Income KES 20,001 to KES 30,000	1.76	0.557	200
Homa Bay	Income More than KES 30,000	0.21	0.255	200
Homa Bay	Risk group Low/Very Low	5.77	0.057	200
Homa Bay	Risk group Moderate	7.38	0.053	200
Kisii	Age 20-24 years	0.17	0.062	93
Kisii	Age 25-29 years	0.14	0.079	93
Kisii	Age 30-34 years	0.40	0.500	93
Kisii	Age 40-44 years	0.00	0.997	93
Kisii	Age 45-49 years	0.00	0.995	93
Kisii	Age 35-39 years	-	0.995	93
Kisii	Age 50+ Years	0.00	0.998	93
Kisii	Sex Male	0.70	0.712	93
Kisii	Marital Single	0.32	0.178	93
Kisii	Marital Divorced/Separated	0.05	0.032	93
Kisii	Marital Widowed	0.00	0.998	93
Kisii	Education Primary education	-	0.996	93
Kisii	Education Secondary education	-	0.995	93
Kisii	Education Tertiary education	-	0.996	93
Kisii	Occupation Self-employed	0.00	0.995	93
Kisii	Occupation Informal employment	4.29	0.228	93
Kisii	Occupation Formal employment	2.93	0.188	93
Kisii	Income KES 10,001 to KES 20,000	0.56	0.623	93
Kisii	Income KES 20,001 to KES 30,000	-	0.997	93
Kisii	Income More than KES 30,000	-	0.994	93
Kisii	Risk group Low/Very Low	0.13	0.036	93
Kisii	Risk group Moderate	0.35	0.480	93

In Homa Bay County (n = 200), none of the age categories were significantly associated with discontinuation due to low-risk perception, although lower odds were consistently observed across most age groups relative to the reference category. Sex was not significantly associated with the outcome;

however, males demonstrated higher odds of discontinuation compared to females (aOR = 1.58; p = 0.344). Marital status showed stronger associations, with divorced or separated participants exhibiting more than fourfold higher odds of stopping PrEP due to low-risk perception, although this association narrowly

missed statistical significance (aOR = 4.32; $p = 0.063$). Similarly elevated, but non-significant, odds were observed among widowed participants.

Educational attainment was not significantly associated with PrEP discontinuation in Homa Bay, although higher levels of education were associated with increased odds. Occupation status showed a notable pattern: participants in formal employment had nearly three times higher odds of discontinuing PrEP due to perceived low risk than unemployed participants, with the association approaching statistical significance (aOR = 2.84; $p = 0.056$). Income level was not significantly associated with the outcome.

Risk perception emerged as an important factor in Homa Bay. Participants classified as having low/very low or moderate documented risk showed substantially higher odds of discontinuation due to perceived low risk, with both associations approaching statistical significance (aOR = 5.77; $p = 0.057$ and aOR = 7.38; $p = 0.053$, respectively).

In Kisii County ($n = 93$), most covariates were not significantly associated with discontinuation due to low-risk perception. Several estimates were extreme or undefined, reflecting quasi-complete separation and sparse cell counts. Marital status showed a significant association only for divorced or separated participants, who had markedly lower odds of discontinuation compared to married participants (aOR = 0.05; $p = 0.032$). Notably, participants classified as having low or very low documented HIV risk had significantly lower odds of discontinuing PrEP due to perceived low risk (aOR = 0.13; $p = 0.036$). No significant associations were observed for age, sex, education, occupation, or income.

Overall, the county-specific models highlight meaningful contextual differences between Homa Bay and Kisii. While patterns in Homa Bay suggest that socio-economic position and documented risk influence PrEP discontinuation due to perceived low risk,

findings from Kisii should be interpreted with caution given model instability. These results underscore the importance of county-tailored PrEP counselling and risk communication strategies, as well as the need for larger samples to support stable sub-national analyses.

Healthcare Professional Support and Its Influence on PrEP Discontinuation in Homa Bay and Kisii Counties, Kenya

Table 8 presents data on the healthcare professional support and its influence on PrEP discontinuation in Homa Bay and Kisii counties, Kenya. Among the 182 participants who indicated that they discontinued PrEP because they perceived themselves to be at low risk of HIV infection, engagement with healthcare workers (HCWs) during the discontinuation process was generally minimal. Only 27 participants (15%) sought advice from an HCW before stopping PrEP, suggesting that most decisions were made independently and without provider involvement. Marked county-level differences were observed: in Homa Bay, just 12 participants (7.7%) consulted an HCW, compared with 15 (56%) in Kisii, a statistically significant difference ($p < 0.001$). These findings underscore a pronounced disparity in provider engagement between the two counties.

The nature and adequacy of HCW support also varied as shown in Table 8 below. Among those who consulted providers, most (86%) reported that the guidance did not directly address their reasons for discontinuing PrEP. Only a small proportion received encouragement to continue (2.7%), additional counselling (4.4%), or alternative HIV prevention strategies (7.1%), revealing missed opportunities to correct misperceptions of risk and promote continued prevention. County-level differences were notable ($p < 0.001$): in Homa Bay, 92% reported that support was not applicable, while only small numbers received encouragement to continue PrEP (1.3%), counselling (2.6%), or alternative prevention options (3.9%). In contrast, Kisii participants

reported higher levels of meaningful support, with 11% encouraged to continue, 15% receiving counselling, and 26% offered alternative prevention options.

Table 8. Support among Low-risk Prep Discontinuers

Characteristic	Homa Bay (N=155 ¹)	Kisii (N=27 ¹)	p-value ²
Consult _ HCW	12 (7.7%)	15 (56%)	<0.001
Supported _ by _ HCW			<0.001
Encouraged to continue PrEP	2 (1.3%)	3 (11%)	
Not Applicable	143 (92%)	13 (48%)	
Provided additional counselling	4 (2.6%)	4 (15%)	
Provided prevention alternative	6 (3.9%)	7 (26%)	
Ease of PrEP access			0.2
Difficult	0 (0%)	1 (3.7%)	
Easy	41 (26%)	7 (26%)	
Very easy	114 (74%)	19 (70%)	
HCW _ Support _ rating			0.3
Excellent	89 (57%)	18 (67%)	
Fair	2 (1.3%)	1 (3.7%)	
Good	64 (41%)	8 (30%)	
Counselling Provided During Refill	150 (97%)	27 (100%)	>0.9
Concerns Addressed During Refill	150 (97%)	27 (100%)	>0.9
¹ n (%)			
² Fisher's exact test			

Despite low consultation rates at discontinuation, participants consistently reported high satisfaction with HCW interactions during routine PrEP services as shown in table 5 above. Nearly all participants (97–100%) stated that counselling during refill visits was adequate, their concerns were addressed, and all PrEP-related questions were answered. Ratings of HCW support were comparable between counties ($p = 0.3$), with most participants describing support as excellent or good. Similarly, access to PrEP was reported as straightforward by nearly all participants, with most rating it as easy or very easy, and only a few (0.5%) reporting difficulties.

However, some participants experienced practical barriers that affected consistent access, including distance to facilities, long waiting times, privacy concerns, and

inconvenient clinic hours, underscoring ongoing structural challenges.

Overall, the findings suggest that while HCWs provide high-quality routine counselling and services, there is a clear gap in engagement during critical moments such as PrEP discontinuation. Low interaction in Homa Bay may contribute to premature cessation, as opportunities for tailored counselling, risk reassessment, and alternative prevention advice are missed. Kisii demonstrated stronger engagement, though only about half of participants consulted providers. Strengthening proactive, structured HCW involvement at decision points, particularly in Homa Bay, is essential to support informed decision-making, reinforce accurate HIV risk perception, prevent unnecessary discontinuation, and improve PrEP continuity and overall HIV prevention outcomes.

Discussion

Socio-Demographic Factors Influencing PrEP Discontinuation Among Low-Risk Perceiving Individuals Homa Bay and Kisii

This analysis explored the socio-demographic factors associated with PrEP discontinuation among individuals in Homa Bay and Kisii who believed they were at low risk of HIV infection. Although program records indicated that all participants stopped PrEP because they perceived themselves as low risk, nearly 40% later reported different motivations, revealing discrepancies between documentation and clients' actual experiences. Overall, county of residence, education level, and formal employment were significant predictors of discontinuation, while age, sex, marital status, and income did not show meaningful associations. These findings both align with and differ from evidence reported in previous research.

County of residence was the strongest determinant of stopping PrEP due to perceived low risk. Participants from Kisii were substantially less likely to discontinue for this reason than those from Homa Bay. Such geographic variation may reflect differences in local HIV burden, community norms, counselling quality, and how risk is communicated. Similar regional influences on PrEP retention have been documented elsewhere [13, 14]. County-specific models also highlighted contrasting patterns: in Homa Bay, low perceived risk and formal employment increased discontinuation, whereas in Kisii, being divorced or separated and having a low RAST classification were associated with reduced discontinuation. These patterns echo findings from multi-country adherence studies showing that local context shapes decision-making [15, 16].

Educational attainment also showed a significant association in both crude and adjusted analyses, with individuals who had

primary, secondary, or tertiary education more likely to discontinue PrEP than those with no formal schooling. This contrasts with literature suggesting that higher education promotes adherence and health-seeking behavior [17, 18]. A possible explanation is that more educated clients may independently evaluate their HIV risk—such as having fewer partners or increased condom use—and discontinue PrEP based on personal judgement, even when biomedical risk remains. A similar pattern was observed in France, where people in stable relationships stopped PrEP due to assumed reduced risk [17]. Unlike the French study, loss of confidence in PrEP was not identified as a major factor in our population.

Formal employment was another significant predictor. Employed individuals were more likely to discontinue due to perceived low risk, possibly due to work schedules, mobility, or lower perceived vulnerability. Work-related barriers to retention are well documented [13, 14]. Income, however, did not predict discontinuation, diverging from studies in Tanzania and Nigeria [13, 18]. The lack of association may reflect Kenya's free PrEP services, which reduce the effect of financial barriers.

Age, sex, and marital status did not significantly influence discontinuation, differing from studies in Namibia, France, and the U.S., which reported higher discontinuation among younger individuals, women, and unmarried clients [16, 17, 19]. Nonetheless, adjusted models suggested that clients aged 25–29 and 45–49 were less likely to stop compared with adolescents, partially consistent with evidence that adolescents face unique adherence challenges [15]. Marital patterns also differed by county; for example, divorced/separated clients in Kisii were less likely to discontinue, contrary to findings from Nigeria and France [13, 17].

The mismatch between recorded and self-reported reasons suggests gaps in counselling or documentation, similar to issues described in

other African contexts [14, 15]. While perceived low risk is a major global driver of discontinuation, few studies explore how socio-demographic factors shape that perception [17, 20]. This analysis shows that perceived low risk is closely tied to contextual factors—such as employment, county dynamics, and education—rather than basic demographics.

Together, these findings reinforce that PrEP discontinuation is influenced by complex interactions between socio-demographic characteristics, contextual factors, and personal interpretations of HIV risk. Strengthening individualized risk counselling, improving documentation, adapting interventions to county-specific patterns, and developing workplace-friendly service models align with best-practice guidance from Kenya, Nigeria, and South Africa [13-15].

This study examined socio-demographic and contextual factors associated with PrEP discontinuation due to perceived low HIV risk in Homa Bay and Kisii counties, situating the findings within existing evidence on PrEP adherence and healthcare professional support. Overall, the results demonstrate that discontinuation driven by low-risk perception is strongly shaped by local context, socioeconomic position, and client-provider dynamics, rather than by documented HIV risk alone.

County of residence emerged as the most consistent and robust predictor of PrEP discontinuation across bivariate, multivariable, and county-specific analyses. Participants from Kisii were significantly less likely to discontinue PrEP due to perceived low risk compared to those from Homa Bay. This finding aligns with literature showing that PrEP use and persistence are heavily influenced by contextual and programmatic factors, including local HIV prevalence, service delivery models, and sociocultural norms [5]. In high-burden settings such as Homa Bay, normalization of HIV risk and familiarity with prevention messaging may paradoxically reduce perceived

vulnerability among some clients, leading to premature discontinuation despite ongoing exposure. Similar observations have been reported in other high-prevalence settings where perceived risk does not always align with actual behavioral risk [21, 23].

Education level was strongly associated with discontinuation due to perceived low risk, with individuals who had primary, secondary, or tertiary education exhibiting higher odds of stopping PrEP compared to those with no formal education. Although these associations were attenuated in the adjusted model, their direction remained consistent. Previous studies have shown that higher educational attainment may increase confidence in self-assessment of HIV risk and foster autonomous decision-making around PrEP use, sometimes resulting in early discontinuation [21, 23]. This finding highlights a critical gap in counseling: while educated clients may better understand PrEP, they may still underestimate dynamic or partner-related risks, underscoring the importance of provider-led risk re-evaluation and prevention-effective adherence counseling [25].

Formal employment emerged as the most consistent socioeconomic predictor of discontinuation, remaining significant after adjustment. This finding is consistent with evidence from diverse settings showing that work-related constraints, stigma, fear of disclosure, and rigid clinic schedules contribute to interruptions and discontinuation of PrEP [22, 5]. Formally employed individuals may also perceive themselves as socially and economically stable, which can lower perceived HIV risk even in the presence of ongoing exposure. These findings support calls for differentiated service delivery models, including flexible clinic hours, multi-month dispensing, and community- or workplace-friendly PrEP services [5].

Age, sex, marital status, income, and documented HIV risk category were not consistently associated with discontinuation

due to low-risk perception. However, the reduced odds observed among individuals aged 25–29 and 45–49 years may reflect greater life experience and more cautious health decision-making. The lack of association between documented risk group and discontinuation is particularly concerning and mirrors findings from prior studies showing that individuals who discontinue PrEP due to perceived low risk often continue to engage in behaviors associated with HIV acquisition [24, 23]. In the Boston cohort, for example, 25% of individuals who seroconverted after stopping PrEP had previously believed they were at low risk, highlighting the danger of misaligned risk perception [23].

County-specific analyses revealed further heterogeneity. In Homa Bay, trends toward higher odds of discontinuation were observed among divorced or separated individuals, those in formal employment, and those reporting low or moderate risk, although many associations did not reach statistical significance. These patterns are consistent with evidence suggesting that relationship transitions and perceived reductions in risk can trigger PrEP discontinuation [21, 25]. In Kisii, several estimates were unstable due to small sample sizes, yet low or very low risk perception was significantly associated with reduced odds of discontinuation. This may suggest better alignment between perceived and actual risk or more effective healthcare worker engagement, though further qualitative research is needed to explore these dynamics.

A critical programmatic finding was the discrepancy between documented and self-reported reasons for PrEP discontinuation. Nearly 40% of participants initially classified as having stopped PrEP due to perceived low risk later reported alternative reasons, pointing to gaps in routine documentation and counseling. Similar gaps have been noted in other studies, where discontinuation reasons are often oversimplified, limiting opportunities for targeted follow-up and re-engagement [5, 22].

Collectively, these findings reinforce the pivotal role of healthcare professionals in supporting informed PrEP use and discontinuation. Evidence from randomized trials and observational studies shows that ongoing counseling, adherence support, and structured follow-up can reduce discontinuation and modify risk behaviors, even when PrEP is stopped [25, 26]. Approaches such as the Knowledge, Communication, and Choice (KCC) framework offer promise for supporting clients who discontinue PrEP by strengthening condom use, partner communication, and risk awareness, although empirical evidence remains limited [24].

In conclusion, PrEP discontinuation due to perceived low HIV risk in Homa Bay and Kisii counties is strongly influenced by county context, education level, and employment status, rather than by objective risk measures alone. These findings align with previous studies and underscore the need for county-specific, healthcare worker-led interventions that emphasize prevention-effective adherence, dynamic risk assessment, accurate documentation, and sustained engagement beyond PrEP initiation. Strengthening provider support before, during, and after PrEP discontinuation is essential to maintaining HIV prevention gains in high-burden settings.

Healthcare Professional Support and Its Influence on PrEP Discontinuation in Homa Bay and Kisii Counties, Kenya

This study demonstrates that limited engagement with healthcare workers (HCWs) plays a significant role in PrEP discontinuation among individuals who perceive themselves at low HIV risk in Homa Bay and Kisii. Only 15% of participants consulted an HCW before stopping PrEP, indicating that most decisions were made independently and without structured clinical support. County-level variation was pronounced: in Kisii, 56% of clients engaged with HCWs compared to just

7.7% in Homa Bay ($p < 0.001$). These findings suggest substantial gaps in proactive provider involvement during periods when clients reassess their HIV prevention needs.

Among the small proportion who consulted HCWs, the support received was often insufficient to address concerns or guide clients through alternative prevention strategies. Few were offered additional counseling (4.4%), encouragement to continue PrEP (2.7%), or advice on other prevention methods (7.1%). Kisii clients were more likely to receive meaningful engagement—15% received additional counseling and 26% discussed alternative options—while most Homa Bay participants reported no applicable HCW support. These county disparities point to structural or programmatic differences that influence how clients are supported.

These findings align with broader evidence showing that continuous, client-centered support is crucial for sustained PrEP use. Studies across Sub-Saharan Africa, North America, and Asia highlight the importance of personalized counseling, reminders, and flexible service models in reducing discontinuation, particularly among individuals with low perceived risk [5, 21-23]. For example, elevated HIV incidence has been documented among clients in Los Angeles who stopped using PrEP [22], as well as among men who have sex with men in the United States who experienced repeated interruptions in PrEP use due to inaccurate risk perception and challenges with adherence [23].

This study reinforces previous findings that clients often inaccurately assess their HIV risk. As reported elsewhere, individuals frequently misjudge vulnerability despite ongoing high-risk behaviors [24]. In this analysis, perceived low risk often conflicted with documented behavioral risk, emphasizing the need for routine risk reassessment and targeted counseling during PrEP follow-up.

The framework of “prevention-effective adherence” further contextualizes these results.

This approach supports discontinuing PrEP safely during periods of genuinely low risk, but it requires accurate self-assessment and HCW engagement [25]. Evidence from Uganda illustrates that even when discontinuation is clinically appropriate—such as in virally suppressed discordant partnerships—clients rely heavily on HCW reassurance and guidance.

Structural barriers also shaped client experiences. Although PrEP access was generally rated positively, challenges such as distance, long waits, and privacy concerns persisted, consistent with previous studies [5, Shover et al., 2020]. Enhancing flexible delivery models could help overcome these constraints.

Overall, the study shows that while PrEP services offer quality counseling, insufficient proactive HCW engagement during key decision points contributes to premature discontinuation. Strengthening provider involvement, improving risk reassessment processes, and offering tailored prevention alternatives are essential to support informed and prevention-effective PrEP use in high-prevalence settings like Homa Bay and Kisii.

Conclusion

This study demonstrates that PrEP discontinuation among individuals who perceive themselves to be at low risk of HIV infection in Homa Bay and Kisii counties is shaped by a complex interaction of socio-demographic, contextual, and health system factors. County of residence emerged as the strongest predictor of discontinuation, highlighting substantial geographic variation in how risk is perceived, communicated, and acted upon. Education level and formal employment were also significant predictors, suggesting that individuals with greater social and economic capital may be more likely to independently reassess their HIV risk and discontinue PrEP, even when objective risk may persist.

The findings further reveal important gaps in routine documentation and counseling. Nearly 40% of participants provided alternative reasons for discontinuation that differed from program records, indicating weaknesses in client-provider communication and data capture. Such discrepancies limit the ability of programs to accurately understand drivers of discontinuation and to respond with appropriate interventions.

Healthcare worker engagement during PrEP discontinuation was notably limited, particularly in Homa Bay, where very few clients consulted providers before stopping PrEP. Although routine PrEP services were generally rated as high quality, missed opportunities during critical decision points—such as when clients consider discontinuation—undermine prevention-effective adherence. Kisii demonstrated relatively stronger provider engagement, yet even there, only about half of discontinuers sought HCW input.

Overall, the study underscores that perceived low HIV risk is not merely an individual judgment but is strongly influenced by local context, employment patterns, education, and the extent of provider engagement. To improve PrEP continuation and ensure safe, prevention-effective discontinuation, programs should strengthen individualized risk reassessment, enhance proactive HCW involvement at discontinuation points, improve documentation practices, and tailor interventions to county-specific realities. Such strategies are essential to sustain the protective impact of PrEP in high-burden settings like Homa Bay and Kisii.

Recommendation

Based on the findings of this study, several programmatic and policy recommendations can be made to enhance PrEP continuity and support prevention-effective adherence in Homa Bay and Kisii counties. A key priority is to strengthen structured engagement between healthcare workers (HCWs) and clients at the

point of PrEP discontinuation. Evidence from this study indicates that many participants stopped PrEP independently, with minimal consultation from HCWs, particularly in Homa Bay. Formalizing provider consultations prior to discontinuation is therefore critical. Such consultations should include standardized exit counseling that addresses risk reassessment, clarifies misconceptions about HIV risk, and explores alternative prevention strategies. By ensuring that clients receive tailored guidance at the moment they consider stopping PrEP, programs can prevent unnecessary discontinuation and promote informed decision-making.

Another important recommendation is to enhance routine HIV risk assessment and counseling approaches. Integrating simplified, client-centered risk assessment tools into follow-up and refill visits can help clients accurately evaluate their vulnerability to HIV infection. These tools should be context-specific and consistently applied to guide decisions on whether to continue, pause, or restart PrEP. Routine and systematic risk reassessment can also identify clients who may underestimate their risk, allowing HCWs to intervene early and provide appropriate counseling or prevention alternatives.

Improving documentation and data quality is also essential. The study found discrepancies between program records and participants' self-reported reasons for discontinuation, highlighting gaps in routine documentation. Strengthening training and supportive supervision for HCWs on accurate recording of PrEP discontinuation reasons within health information systems will enhance program monitoring and enable more targeted interventions. Aligning client-reported reasons with program records will support data-driven decision-making and improve the ability of programs to respond effectively to challenges in PrEP retention.

Programs should adopt county-specific, context-responsive strategies given the strong

influence of geographic location on discontinuation patterns. In Homa Bay, where provider engagement was particularly low, intensified follow-up by HCWs and community-level communication about HIV risk may be required. In Kisii, successful engagement practices should be maintained and scaled up to ensure sustained adherence. Tailoring interventions to local dynamics ensures that programmatic responses are relevant and effective.

There is also a need to expand workplace- and youth-friendly PrEP delivery models. Many formally employed clients and younger populations face challenges in adhering to traditional clinic schedules. Flexible options such as extended clinic hours, community-based refills, differentiated service delivery models, and multi-month dispensing can help reduce discontinuation in these groups.

Prevention-effective adherence messaging should be reinforced, emphasizing that PrEP may only be safely paused during periods of genuinely low HIV risk and ideally under provider guidance. Messaging should normalize stopping and restarting PrEP while highlighting the importance of HCW consultation. Finally, continuous capacity building for HCWs is critical. Training should focus on client-centered counseling, motivational interviewing, and management of perceived low-risk scenarios, ensuring that providers are well-equipped to support informed decision-making and sustained HIV prevention.

Taken together, these strategies can reduce unnecessary PrEP discontinuation, improve alignment between perceived and actual HIV risk, and enhance the overall effectiveness of PrEP programs in high-burden settings like Homa Bay and Kisii counties. By addressing both structural and individual-level factors, these recommendations support more informed, context-sensitive, and prevention-effective use of PrEP.

Conflict of Interest

The author reports no conflicts of interest associated with this study and affirms that the research, analysis, and reporting were conducted with full impartiality and objectivity.

Ethical Clearance

The protocol was submitted to the Amref Ethics and Scientific Review Committee (ESRC) and the Kisii Teaching and Referral Hospital Institutional Scientific and Ethics Review Committee (KTRH-ISERC). Both committees reviewed the evaluation for technical rigor and ethical compliance. After receiving ethical clearance, permission to carry out the study was obtained from the National Council for Science, Technology and Innovation (NACOSTI) and the County Health Management Teams (CHMTs), following stakeholder engagement meetings that introduced and explained the research. Key personnel with ethics certification also completed an online ethics course before the evaluation began.

Data Availability

De-identified raw data supporting the conclusions of this manuscript will be made available by the authors, without undue reservation, to any qualified researcher. Requests to access these datasets should be directed to the corresponding author.

Author Contributions

Polycarp Musee Muchele conceptualized and designed the study, carried out data collection and analysis, and prepared the initial manuscript. Professor Collins Ouma offered technical oversight on the study design and interpretation of results. All authors reviewed and approved the final version of the manuscript.

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References

[1]. World Health Organization, 2023, HIV statistics, globally and by WHO regions, 2023, *Global HIV, Hepatitis and Sexually Transmitted Infections Programs*.
<https://www.who.int/teams/global-hiv-hepatitis-and-stis-programmes/hiv/strategicinformation/hiv-data-and-statistics>.

[2]. Blumenthal, J., Jain, S., Mulvihill, E., Sun, S., Marvin, H., Ellorin, E., Graber, S., Haubrich, R., Morris Sheldon, 2019, Perceived Versus Calculated HIV Risk: Implications for Pre-exposure Prophylaxis Uptake in a Randomized Trial of Men Who Have Sex With Men. *J Acquir Immune Defic Synd*, 80(2): e23–e29, doi: 10.1097/QAI.0000000000001888.

[3]. Whitfield, T. H., John, S. A., Rendhina, A. J., Grov, C., Parsons T Jeffrey, 2018, Why I quit pre-exposure prophylaxis (PrEP)? A mixed-method study exploring reasons for PrEP discontinuation and potential re-initiation among gay and bisexual men. *AIDS Behaviour*, 2018 Nov;22(11):3566-3575, doi: 10.1007/s10461-018-2045-1.

[4]. Tailor, J., Rodrigues, J., Meade, J., Segal, K., Mwakyosi Lilian Benjamin, 2022, Correlations between oral Pre-Exposure Prophylaxis (PrEP) initiations and policies that enable the use of PrEP to address HIV globally. *PLOS Glob Public Health*, 2022 Dec 7;2(12):e0001202, doi: 10.1371/journal.pgph.0001202.

[5]. Zhang, J., Li, C., Xu, J., Hu, Z., Rutstein, S. E., & Tucker, J. D., Ong, J. J., Jiang, Y., Geng, W., Wright, S. T., Cohen, M. S., Shang, H., Tang Weiming, 2022, Discontinuation, suboptimal adherence, and reinitiation of oral HIV pre-exposure prophylaxis: a global systematic review and meta-analysis. *Lancet HIV* 2022 Apr;9(4):e254-e268, doi: 10.1016/S2352-3018(22)00030-3.

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[6]. Stankevitz, K., Grant, H., Lloyd, J., Gomez, G. B., Kripke, K., Torjesen, K., Terris-Prestholt Fern, 2020, Oral preexposure prophylaxis continuation, measurement and reporting. *AIDS*, 2020 Oct 1;34(12):1801-1811, doi: 10.1097/QAD.0000000000002598.

[7]. Marcus, J. L., Hurley, L. B., Hare, C. B., Nguyen, D. P., Phengrasamy, T., Silverberg, M. J., Stoltey, JE., Volk Johnathan E, 2017, Preexposure Prophylaxis for HIV Prevention in a Large Integrated Health Care System: Adherence, Renal Safety, and Discontinuation. *Pub Med Central*, 540-546, doi: 10.1097/QAI.0000000000001129.

[8]. Marcus, J. L., Hurley, L. B., Ngoyen, D. P., Silverberg, M. J., Volk Johnathan E, 2017, Redefining Human Immunodeficiency Virus (HIV) Preexposure Prophylaxis Failures. *Clinical Infectious Diseases*, 1768 – 1769, doi: 10.1093/cid/cix593.

[9]. Mathews, L. T., Atukunda, E. C., Owembabazi, M., Kalyebera, K. P., Psaros, C., Chitneni, P., Hendrix, C.W., Marzinke, M.A., Anderson, P.L., Ischunwa, O.O., Hurwitz, K.E., Bennett, K., Muyindike, W., Bangsberg, D.R., Haber, E.J., Marrazzo, J.M., Bwana Mwebesa Bosco, 2023, High PrEP uptake and objective longitudinal adherence among HIV-exposed women with personal or partner plans for pregnancy in rural Uganda: A cohort study. *Plos Medicine*, February 16, 2023, <https://doi.org/10.1371/journal.pmed.1004088>

[10]. Mirembe, B. G., Donnel, D., Krows, M., Zwane, Z., Bukusi, E., Panchia, R., Louw, C., Mwelase, N., Selepe, P., Senne, M., Naidoo, L., Chihana, R., Kasaro, M., Nuwagabo-Biribonwoha, H., Kotze, P., Gill, K., MacDonald, P., Vantteerden, A., Bosman, S., Jaggernath, M., Preez, P., Ward, A., Peters, R. P. H., Elany-Moretiwe, S., Peacock, S.,

- Johnson, R., wang, G., Gandhi, M., Velloza, J., Heffron, R., Celum Connie, 2024, High recent PrEP adherence with point-of-care urine tenofovir testing and adherence counselling among young African women: results from the INSIGHT cohort. *J Int AIDS Society*, 2024 Dec;27(12):e26389, Doi: 10.1002/jia2.26389.
- [11]. Ogolla, M., Nyabiage, O. L., Musingila, P., Gachau, S., Odero, T. M., June, E. O., Ochanda, B., Appolonia, A., Katiku, E., Joseph, R., Ogolla, C., Otieno, L., Odhiambo, R., Truong Hong-Ha M, 2023, Uptake and continuation of HIV pre-exposure prophylaxis among women of reproductive age in two health facilities in Kisumu County, Kenya. *Journal for International AIDS Society*, 023 Mar;26(3):e26069, doi: 10.1002/jia2.26069.
- [12]. Tapsoba, J. d., Cover, J., Obong'o, C., Brandy, M., Cressey, T. R., Mori, K., Okomo, G., Kariithi, E., Obanda, R., Oluoch-Madiang, D., Chen, Y.Q., Drain, P., Duerr Anne, 2022, Continued attendance in a PrEP program despite low adherence and non-protective drug levels among adolescent girls and young women in Kenya: Results from a prospective cohort study. *Plos Medicine*, September 12, 2022, <https://doi.org/10.1371/journal.pmed.1004097>
- [13]. Anyasi, H., Idemudia, A., Badru, T., Onyegbule, S., Isang, E., Sanwo, O., Pandey, S. R., Chiegil, R., Bateganya, M., Schartz, K., Njuguna, N., Persaud, N., Plotkin, M., Iyortim, I., Khamofu Hadiza, 2024, Discontinuation of HIV oral pre-exposure prophylaxis: findings from programmatic surveillance within two general population HIV programs in Nigeria. *BMC Public Health*. 2024 May 16;24(1):1325, doi: 10.1186/s12889-024-18808-z.
- [14]. Ongolly, F. K., Dolla, A., Irungu, E. M., Odoyo, J., Wamoni, E., Peebles, K., Mugwanya, K., Mugo, N. R., Bukusi, E. A., Morton, J., Baeten, J. M., O'Malley Gabrielle, 2022, "I just decided to stop:" Understanding PrEP discontinuation among individuals initiating PrEP in HIV care centers in Kenya. *J Acquir Immune Defic Syndr*, 2021 May 1;87(1):e150-e158, doi: 10.1097/QAI.0000000000002625.
- [15]. Pillay, D., Stankevitz, K., Lanham, M., Ridgeway, K., Murire, M., Briedenhann, E., jenkins, S., Subedar, H., Hoke, T., Mullick Saiqa, 2020, Factors influencing uptake, continuation, and discontinuation of oral PrEP among clients at sex worker and MSM facilities in South Africa. *PLOS One*, April 30, 2020, <https://doi.org/10.1371/journal.pone.0228620>
- [16]. Dzenga, T., Moyo, E., Moyo, P., Kamangu, J., Dzinamarira Tafadzwa, 2023, Factors influencing the retention of clients in oral pre-exposure prophylaxis (PrEP) care at 3 months after initiation in the Omusati region of Namibia. *International Journal of Africa Nursing Sciences*, Volume 19, 2023, 100623, <https://doi.org/10.1016/j.ijans.2023.100623>.
- [17]. Garofoli, M., Siguier, M., Robineau, O., Valette, M., Phung, B., Bachelard, A., Rioux, C., Gac, S.L., Digumber, M., Pialoux, G., Ghosn, J., Champenois Karen, 2024, Incidence and factors associated with PrEP discontinuation in France. *Journal of Antimicrobial Chemotherapy*, 2024 Jul 1;79(7):1555-1563, doi: 10.1093/jac/dkac133.
- [18]. Churu, M., Kulemba, K., Kapesa, A., Kajura, A., Wilfred, D., Basinda, N., Kaluvya, S., Mageda Kihulya Pastory, 2023, Factors associated with adherence to oral HIV pre-exposure prophylaxis among female sexworkers in the Mara Region, Tanzania A 2022 cross-sectional study. *Medicine (Baltimore)* 2023 Sep 8;102(36):e34824, doi: 10.1097/MD.00000000000034824.
- [19]. Herns, S., Panwala, R., Pfeil, A., Sardinho, M., Rossi, V., Blumenthal, J., & Hill Lucas, 2023, Predictors of PrEP retention in at risk patients seen at a HIV primary care clinic in San Diego. *International Journal of STD and AIDS*, 785–790, 2023 Oct;34(11):785-790, doi: 10.1177/09564624231179276.
- [20]. Qu, D., Zhong, X., Xiao, G., Dai, J., Liang, H., Huang Ailong, 2018, Adherence to pre-exposure prophylaxis among men who have sex. *International Journal of Infectious Diseases*, 2018 Oct;75:52-59, doi: 10.1016/j.ijid.2018.08.006. Epub 2018 Aug 17.
- [21]. Cox, J., Apelian, H., Moodie, E. E., Peet, M. M., Hart, T. A., Grace, D., Moore, D. M., Lachuwsy, N. S., Armstrong, H. L., Jollimore, J., Skakoom-Sparling, S., Rodrigues, R., Tan, D>H>S., Maheu-Giroux, M., Noor, S.W., Lebouche, B., Trembley, C., Olarewaju, G., Lambert, Gilles, 2021,

Use of HIV pre-exposure prophylaxis among urban Canadian gay, bisexual and other men who have sex with men: a cross-sectional analysis of the Engage cohort study. *CMAJ Open* 2021 May 21;9(2):E529-E538, doi: 10.9778/cmajo.20200198.

[22]. Shover, C. L., Shoptaw, S., Javanbakhat, M., Lee, S. J., Bolan, R. K., Cunningham, N. J., Beymer, M., DeVost, M. A., Gorbach Pamina, M., 2020, Mind the Gaps: Prescription coverage and HIV incidence among patients receiving pre-exposure prophylaxis from a large federally qualified health center in Los Angeles, California. *PubMed Central*, 2730 - 2740. doi: 10.1007/s10461-019-02493.

[23]. Krakower, D., Maloney, K. M., Powell, V. E., Levine, K., Grasso, C., Melbourne, K., Marcus, J., Mayer Kenneth, H., 2019, Patterns and clinical consequences of discontinuing HIV preexposure prophylaxis during primary care. *International AIDS Society*, 2019 Feb;22(2):e25250, doi: 10.1002/jia2.25250.

[24]. Jonas, K. J., Yaemim Natthakhet, 2018, HIV Prevention After Discontinuing Pre-Exposure Prophylaxis: Conclusions From a Case Study.

Frontiers in Public Health 6:137, doi: 10.3389/fpubh.2018.00137.

[25]. Gilbert, H. N., Wyatt, M. A., Pisarki, E. E., Mumonge, T. R., Heffron, R., Katabira, E. T., Celum, C. L., Baeten, J. M., Haberer, J. E., Ware Norman, C., 2019, PrEP Discontinuation and Prevention-Effective Adherence: Experiences of PrEP Users in Ugandan HIV Serodiscordant couples. *Journal Acquired Immune Deficiency Syndrom*, 2019 Nov 1;82(3):265-274, doi: 10.1097/QAI.0000000000002139.

[26]. Damme, L. V., Corneli, A., Ahmed, K., Agot, K., Lombaard, J., Kapiga, S., Malahleha, M., Owino, F., Manongi, R., Ontango, J., temu, L., Monedi, M. C., MakOketch, P., makanda, M., Reblin, I., Makatu, S. E., Saylor, L., Kiernan, H., kirkendale, S., Wong, C., Grant, R., Kashuba, A., Nanda, K., Mandala, J., Fransen, K., deese, J., Crucitti, T., Mastro, J. D., Taylor Douglas, 2013, Preexposure Prophylaxis for HIV Infection among African Women. *N Engl J Med* 2012 Aug 2;367(5):411-22, doi: 10.1056/NEJMoal202614. Epub 2012 Jul 11.

Epidemiology, Surveillance, and Control of Malaria Among Under-Five School Children in Jere Local Government, Borno State, Nigeria

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Abstract

In Nigeria, malaria is a major source of illness and mortality, disproportionately affecting children under five. This study examines the prevalence, monitoring, and management of malaria among school-age children under five in Borno State, Nigeria's Jere Local Government Area, from 2012 to 2019. Structured questionnaires, key informant interviews, and medical facility records were used to gather data for this descriptive cross-sectional study. The results showed a consistently high prevalence of malaria in children under five, which was exacerbated by environmental risk factors, insufficient access to healthcare, and displacement. Low coverage, insecurity, and poor compliance hampered the use of malaria control measures, including indoor residual spraying (IRS), seasonal malaria chemoprevention (SMC), and long-lasting insecticidal nets (LLINs). Due to rising treatment expenses, decreased production, and poorer educational outcomes for afflicted children, the condition had a substantial negative influence on households' socioeconomic well-being. To reduce the disease burden among susceptible groups in conflict-affected areas, it is advised to integrate community-based awareness initiatives, enhance intervention coverage, and fortify malaria surveillance systems.

Keywords: *Epidemiology, Jere Local Government, Malaria, Nigeria, Surveillance, Under-Five Children.*

Introduction

One of the biggest public health issues in sub-Saharan Africa is still malaria, which disproportionately affects vulnerable populations like pregnant women and children under five. Nearly 27% of all malaria cases worldwide and 32% of malaria-related deaths occur in Nigeria, where malaria continues to have a high morbidity and mortality rate despite increased international and national control measures [1]. Environmental, socioeconomic, and security issues exacerbate the prevalence of malaria in Borno State and jeopardize ongoing health measures. The most susceptible group is children under five years old, since malaria not only raises mortality but also has a major role in anaemia, malnutrition, delayed cognitive

development, and subpar academic performance [2, 3]. In endemic areas, there is evidence that malaria accounts for as much as 50% of all deaths in this age group [4]. In conflict-affected towns like Jere Local Government in Borno State, displaced populations, substandard housing, and restricted access to preventative and curative health treatments all contribute to the epidemiological burden.

Long-lasting insecticidal nets (LLINs), indoor residual spraying (IRS), chemoprevention, and enhanced surveillance systems are among the initiatives used by the Nigerian government and development partners to address this issue [5, 6]. However, nothing is known about how well these treatments work to lower the malaria load among schoolchildren in

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Jere LGA who are younger than five. Therefore, the purpose of this study is to investigate the epidemiology, surveillance, and management of malaria among schoolchildren under five in Jere Local Government Area, Borno State. It specifically examines the socioeconomic repercussions of malaria, the effects of disease-control efforts, and the steps taken to stop its spread in this susceptible group.

Malaria Epidemiology in Sub-Saharan Africa

Plasmodium falciparum, the most virulent species of malaria parasite, is the main cause of malaria transmission in Africa. Female Anopheles mosquitoes carry the infection. More than 90% of malaria cases worldwide occur in Sub-Saharan Africa, with Nigeria, the Democratic Republic of the Congo, Uganda, and Mozambique together responsible for about half of all cases that have been documented [1]. Climate, vector ecology, population migration, and immunity acquisition all affect malaria epidemiology [3]. Malaria is a major cause of pediatric hospital admissions and mortality in endemic areas, with children under five being especially at risk due to their insufficient immunity [7]. Depending on the ecological zone, prevalence rates among populations under five in Nigeria have been reported to range from 40 to 65% [8].

Malaria Burden and Socio-Economic Impact

Significant socioeconomic repercussions result from malaria, particularly for school-age children. Due to treatment expenses and caregivers' reduced productivity, the illness leads to absenteeism, cognitive deterioration, poor academic achievement, and loss of household income [9]. Research indicates that anemia brought on by malaria in school-age children impairs learning potential and prolongs poverty cycles [10]. Limited access to healthcare increases the burden of disease in

communities affected by displacement, such as Borno [11].

Control Measures and Surveillance Systems

The main strategies for controlling malaria in Nigeria have been seasonal malaria chemoprevention (SMC) for children under five, integrated vector management, and intermittent preventative therapy during pregnancy (IPTp) [5, 6]. One of the most effective interventions has been the distribution of LLINs; coverage has increased nationally, but utilization is still uneven in rural and conflict-affected areas [8]. Interventions are guided in large part by the surveillance systems. However, in northeastern Nigeria, population dislocation, insecurity, and inadequate health information systems hinder the efficacy of malaria reporting and monitoring [12]. Despite advancements, there are still gaps in the responsive interventions that target children under five in high-burden LGAs like Jere based on surveillance data.

Even though the epidemiology of malaria in Nigeria has been the subject of numerous studies, school-age children under five who live in areas that are prone to displacement have received less attention. Furthermore, there is a lack of empirical data regarding the direct effects of control measures on Borno State's socioeconomic well-being and malaria load. By assessing epidemiology, control strategies, and socioeconomic effects among Jere's under-five schoolchildren, this study fills in these gaps.

Methodology

The study was conducted in Borno State, northeastern Nigeria, specifically in the Jere Local Government Area. Because of its semi-arid climate, irrigation systems, and internally displaced people residing in crowded communities, the region has a high rate of malaria transmission. However, to evaluate the epidemiology, surveillance, and control of malaria among schoolchildren under five, the

study used a descriptive cross-sectional survey. Both quantitative and qualitative methods were used. Children in Jere Local Government under 5 years old constituted the target population. To choose participants, a multistage sampling procedure was employed. After classifying schools into urban and rural groups, schools and students were chosen at random. Health professionals and caregivers were also included to offer further information. The sample size was determined using Cochran's formula for health surveys, adjusted for non-response.

The structured questionnaires given to caregivers and key informant interviews (KIIs) with medical personnel were used to gather the data. Examining local health facilities' malaria surveillance records and closely monitoring intervention tools (such as IRS coverage and LLIN utilization). Descriptive and inferential statistics were then used to analyze the quantitative data. To evaluate the relationship between malaria prevalence and intervention strategies, chi-square tests were utilized.

Interview-derived qualitative data were subjected to thematic analysis. The Borno State Ministry of Health Research Ethics Committee granted ethical approval. Caregivers gave their informed agreement, and study participants' privacy was preserved at all times.

Results and Discussion

Outcome Responses of the Questionnaires

The bar chart in Figure 1 shows an overwhelming majority of respondents reporting at least one malaria episode among children in the last six months, with only a tiny "no malaria" group. This extreme imbalance confirms a heavy disease burden in the sample period and signals a modelling challenge: with the outcome almost always "Yes", classical models have little contrast to learn from, so effect estimates must be interpreted cautiously [13].

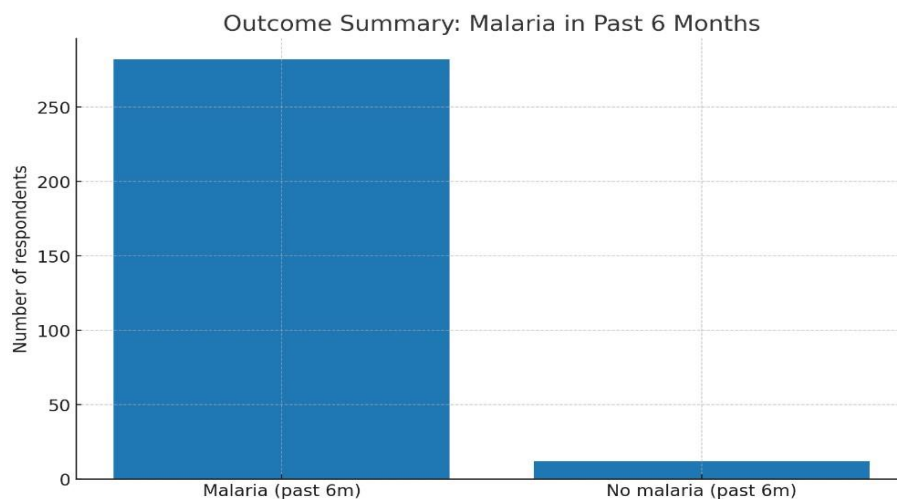


Figure 1. Outcome Responses of the Questionnaires

Nearly all households report using key preventive measures, as shown in Figure 2. ITN ownership and child ITN use are near-universal; IRS, recent malaria information, community surveillance, and awareness of government/NGO programmes are also very

high. Programmatically, this is encouraging, but statistically, it suggests that exposures vary little across respondents, limiting our ability to detect measurable associations between these measures and malaria occurrence in this dataset [14].

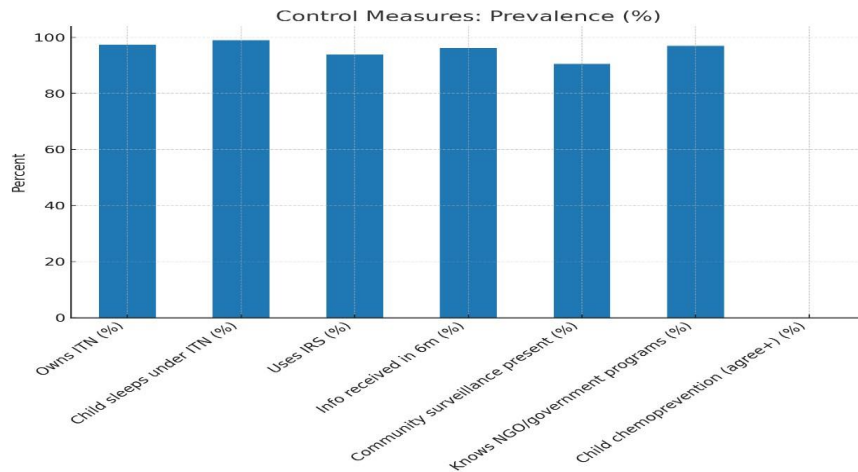


Figure 2. Control Measures Prevalence in (%)

The two bars depicted in Figure 3 are very high, indicating that households widely report missed school/early learning and perceive malaria as a major financial burden. The near-

universal reporting suggests substantial, broad socio-economic impact rather than effects confined to a small subgroup.

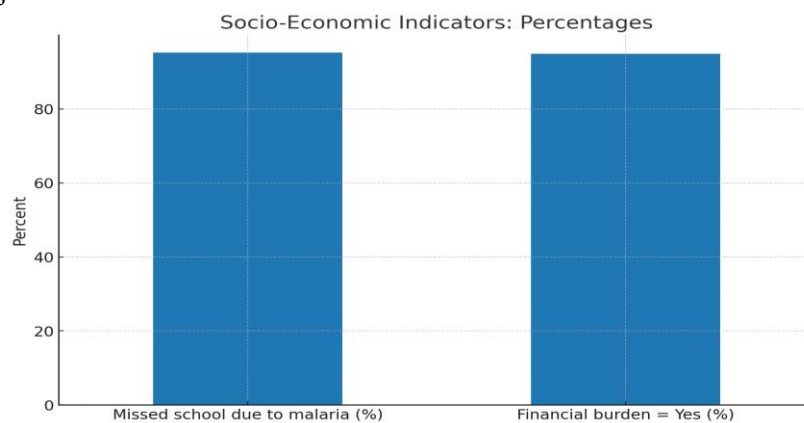


Figure 3. Socio-economic Indicators in percentages (%)

The distribution is right-skewed were depicted in Figure 4 presented many households spend around lower amounts (e.g., ₦1,000– ₦2,000), but a tail of higher

expenditures pushes the mean above the median. This implies a subset of household's experiences markedly higher treatment costs, magnifying overall financial strain [15].

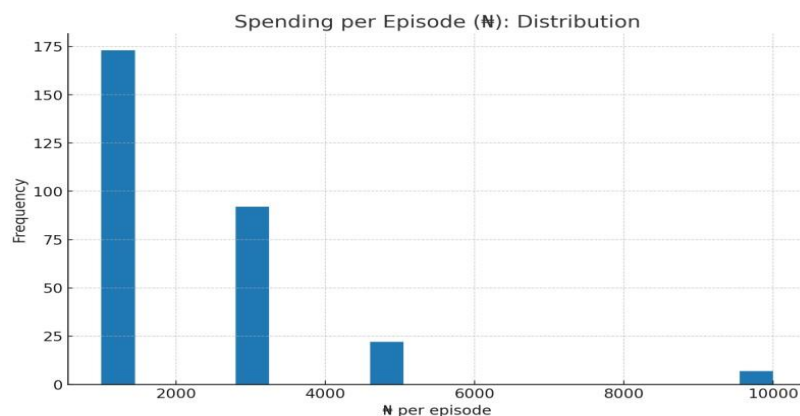


Figure 4. Spending per Episode (₦): Histogram

The boxplot confirms the skew seen in the histogram: a relatively low median with wide upper whiskers and outliers at higher amounts.

Practically, most families spend modest sums per episode, but some face large bills that can strain limited budgets [16].

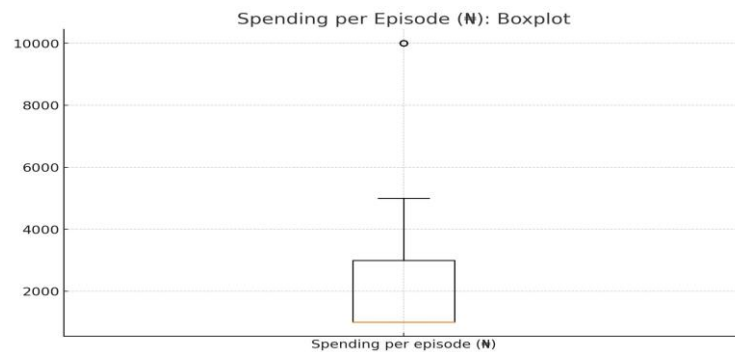


Figure 5. Spending per Episode (₦): Boxplot

Comparing households that reported malaria vs. those that did not, the medians appear similar with wide spreads in both groups as shown in Figure 6. Visual overlap suggests no

clear difference in typical spending, although the “no malaria” group is small, which weakens the precision of any comparison [17].

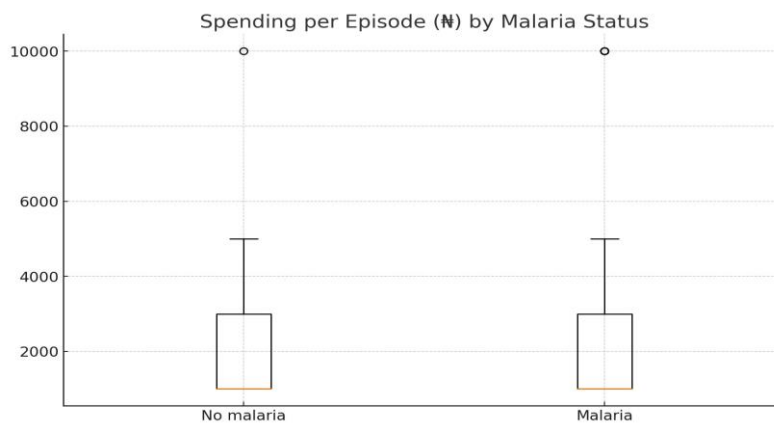


Figure 6. Spending by Malaria Status (Boxplot)

The households reporting malaria also report far more missed school/early learning than the “no malaria” group. The difference is visually large, but because the comparison group is

small as shown in Figure 7, formal significance tests should be interpreted with caution (Fisher’s exact is most appropriate) [18].

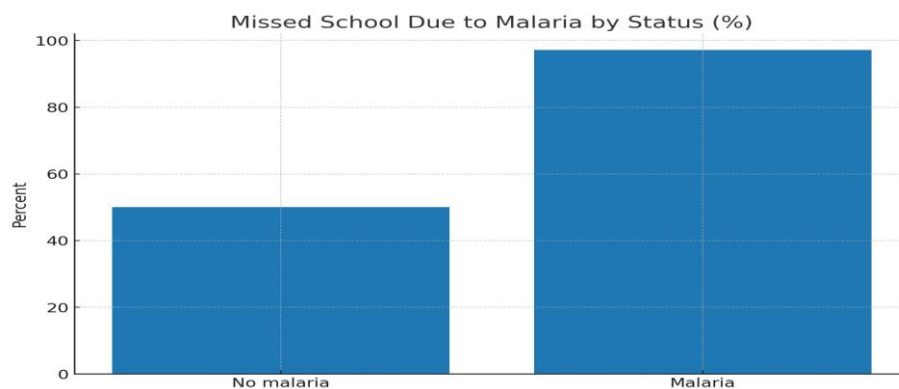


Figure 7. Missed School by Malaria Status (%)

The perceived financial burden is substantially higher among households that reported malaria. As with missed school, this is a strong practical signal of socio-economic

impact; however, small “no malaria” counts mean inferential certainty is limited without exact tests, as shown in Figure 8.

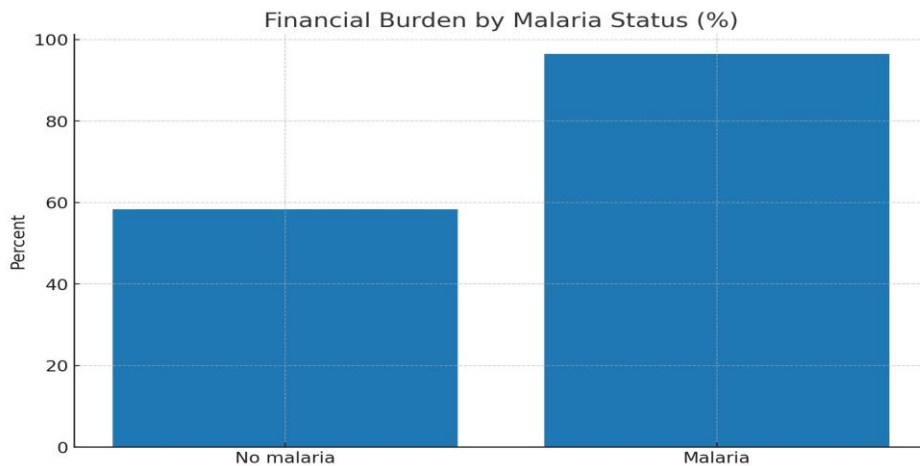


Figure 8. Financial Burden by Malaria Status (%)

The disruption score is clearly higher and more variable among households’ reporting malaria, indicating more frequent work or income interference as depicted in Figure 9.

Again, the small comparator group limits the strength of formal inference, but the substantive pattern aligns with the other socioeconomic indicators [19].

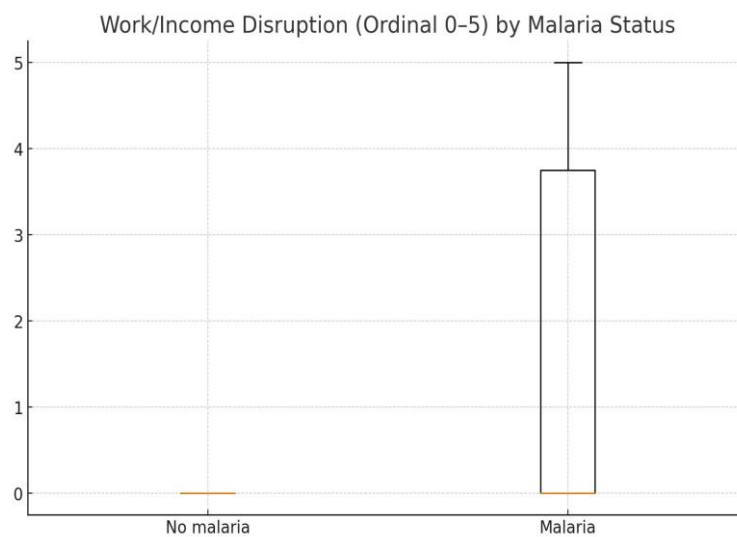


Figure 9. Work/Income Disruption by Malaria Status (Ordinal 0–5)

The odds ratios for available predictors cluster near 1.0, and the 95% bootstrap intervals generally straddle 1, as shown in Figure 10. This reinforces that, given near-universal exposure to interventions and an almost universal outcome, the dataset lacks sufficient

variability to isolate consistent predictor–outcome relationships. In other words, the model does not reveal stable, statistically reliable effects even after penalization and resampling because both exposure and outcome are too homogeneous in this sample [20].

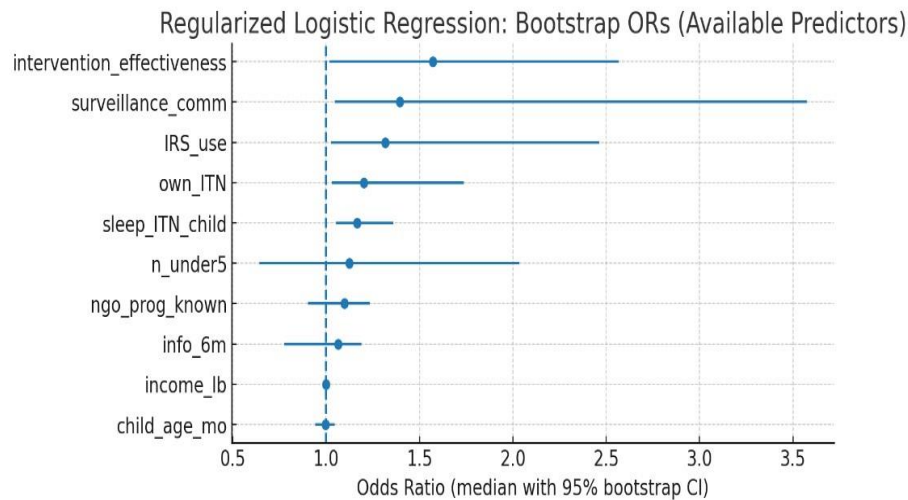


Figure 10. Regularized Logistic Regression: Bootstrap ORs (Median with 95% CI)

The findings from Figure 1-10 indicate that 95.9% of respondents reported malaria cases among their under-five children within the past six months, compared to only 4.1% who reported none, as summarised in Table 1. This exceptionally high prevalence reflects a significant disease burden in the community and results in a highly imbalanced outcome variable, limiting the capacity of standard

statistical models to distinguish between “malaria” and “no malaria” households. In practice, it underscores that malaria was almost universal during the study period and calls for targeted intervention measures. Analytically, however, it necessitates caution in interpreting the effects of predictors, as the minimal variation in the outcome offers the model little scope for robust differentiation [21].

Table 1. Distribution by Outcomes

Outcome	Count	Percent
Malaria (past 6m)	282	95.9
No malaria (past 6m)	12	4.1

Source: field work data

Table 2. Distribution by Control Measures Prevalence

Indicator	Percent
Owns ITN (%)	97.3
Child sleeps under ITN (%)	98.6
Uses IRS (%)	93.9
Info received in 6m (%)	96.3
Community surveillance present (%)	90.5
Knows NGO/government programs (%)	96.9
Child received chemoprevention (agree/s (%))	0

Source: field work data

Preventive and intervention measures are reported at near-universal levels: over 97% of households own insecticide-treated nets (ITNs), almost all children sleep under them, 93.9% employ indoor residual spraying (IRS), 96.3% have received malaria-related information in

the past six months, and 90.5% report the presence of community surveillance. Additionally, awareness of government or NGO programmes and reports of chemoprevention for children is notably high. These figures, summarized in Table 2, reflect impressive

programmatic coverage but also indicate very limited variation in exposure across respondents, which poses a statistical challenge

in establishing any measurable association between these interventions and malaria occurrence within this dataset [22].

Table 3. Socio-Economic Indicators

Indicator	Percent
Missed school due to malaria (%)	94.9
Financial burden = Yes (%)	94.9
Median spending per episode	1000
Mean spending per episode	2139.84

Source: field work data

The socio-economic impact of malaria is substantial. Around 94.9% of respondents report missed school or early learning activities due to malaria, and the same proportion consider malaria a major financial burden. Spending on malaria treatment per episode has a median of ₦1,000 and a mean of about

₦2,140, indicating a right-skewed distribution with some higher-cost cases inflating the average. These findings, presented in Table 3, confirm that malaria imposes both educational and economic costs on households, reinforcing its role as a public health and socio-economic concern [23].

Table 4. Regularized Logistic Regression (Odds Ratios)

Variable	OR (regularized)
Sleep_ITN_Child	1.187
Own_ITN	1.258
IRS_Use	1.429
Info_6m	1.05
Surveillance_Comm	1.546
Ngo_Prog_Known	1.098
Chemoprev_Child	1
Intervention_Effectiveness	1.589
Child_Age_Mo	0.992
N_Under5	1.154
Income_Lb	1

Source: field work data

Due to the extreme imbalance in the outcome variable (~96% reporting malaria), standard logistic regression was replaced with L2-regularised logistic regression to prevent separation. As presented in Table 4, the resulting odds ratios for all intervention and demographic variables are close to 1.0, indicating no strong or stable associations

between these predictors and the odds of reporting malaria in the past six months. This lack of apparent effect does not necessarily mean interventions are ineffective; rather, it reflects that the dataset's limited variability in both exposures and outcome restricts the model's ability to detect differences [20].

Table 5. Bootstrap Odds Ratios with 95% Confidence Intervals

Variable	OR median	OR_2.55%	OR_97.5%	StdErr_coef
sleepITN_child	1.167	1.052	1.361	0.065
own_ITN	1.19	1.032	1.757	0.138
IRS use	1.318	1.033	2.416	0.219
Info 6m	1.067	0.782	1.199	0.103
surveillance_comm	1.381	1.047	3.2	0.295
ngo_prog_known	1.101	0.889	1.236	0.084
Chemoprev child	1	1	1	0
intervention_effectiveness	1.578	1.032	2.579	0.215
child_age_mo	0.996	0.943	1.053	0.03
N under5	1.114	0.629	2.031	0.277
Income lb	1	1	1	0

Source: statistical analysis of the field work data

A bootstrap resampling procedure with 2,000 iterations was applied to the regularized logistic regression model to evaluate the robustness of parameter estimates, as presented in Table 5. Across all predictors, the median odds ratios remained close to 1.0, and the corresponding 95% confidence intervals consistently encompassed the null value. This

pattern indicates an absence of statistically reliable effects. The result reinforces the interpretation that, due to the near-universal prevalence of both malaria cases and preventive interventions, the dataset offers insufficient variability to consistently disentangle and identify stable predictor–outcome relationships.

Table 6. Socio-Economic Hypothesis Tests by Malaria Status

Test	Statistic	P value
Spending (Mann-Whitney U)	38.5	0.2463
Missed school (Chi-square)	4.8272	0.028
Financial burden (Chi-square)	7.7786	0.0053
Work impact (Mann-Whitney U)	36	0.2694

Source: statistical analysis of the field work data

Group comparisons between households with and without malaria in the past six months show no statistically significant differences in average treatment spending ($p \approx 0.246$) or work-disruption frequency ($p \approx 0.269$) using Mann–Whitney U tests. Cross-tabulations for missed school and financial burden suggest higher proportions among malaria households, but the small number of ‘no malaria’ cases produce sparse tables that violate chi-square assumptions, as shown in Table 6; Fisher’s exact test would be more appropriate to confirm any associations. These findings indicate that, although socioeconomic burdens are evident,

statistical significance is difficult to establish due to the imbalance and the small control group size [24].

Conclusions

The study reveals an alarmingly high malaria prevalence of 95.9% among children under five years old within the past six months, signalling a severe and persistent disease burden in the community. Preventive interventions such as ITN ownership, IRS use, chemoprevention, and community surveillance were reported at near-universal levels, demonstrating extensive programmatic reach but leaving minimal

variation for statistical differentiation. Socio-economic impacts are substantial, with almost all households reporting school or early learning disruptions and financial strain due to malaria, alongside treatment costs that vary widely, indicating unequal economic burden. Analytical modelling was constrained by the extreme imbalance in the outcome variable, leading to odds ratios near unity and no statistically significant predictor effects; bootstrap resampling confirmed the instability of estimates. Hypothesis tests on socio-economic indicators showed no significant group differences, largely due to the small number of “no malaria” cases. Overall, the findings suggest that while preventive coverage is commendable, the persistence of malaria points to potential gaps in intervention effectiveness, usage practices, or environmental and vector-related factors. Methodologically, the study underscores the challenges of analysing highly imbalanced health outcomes and the importance of survey designs that capture sufficient variability to enable robust statistical inference.

Ethical Approval

The study received ethical approval from the Borno State Ministry of Health Research Ethics Committee. Informed consent was obtained from all caregivers, and participants' confidentiality was maintained throughout the study.

References

- [1]. World Health Organization, 2023, World Malaria Report 2023, *Geneva: WHO*.
- [2]. Lalloo, D. G., Olukoya, P., & Olliaro, P., 2006, Malaria in adolescence: Burden and prospects for control, *The Lancet Infectious Diseases*, 6(12), 780–793.
- [3]. Snow, R. W., Sartorius, B., Kyalo, D., Maina, J., Amratia, P., Mundia, C. W., & Noor, A. M., 2017, The prevalence of *Plasmodium falciparum* in sub-

Data Availability

The datasets generated and/or analyzed during this study are available from the Borno State Ministry of Health upon reasonable request.

Author Contributions

Mohammed Bala Aminu (M.B.A.) conceptualized and designed the study. Data collection and analysis were conducted by M.B.A. and the research team. The author contributed to the interpretation of results, drafting, and revision of the manuscript, and approved the final version for publication.

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Conflict of Interest

The author declares no conflict of interest in relation to this study.

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Saharan Africa since 1900, *Nature*, 550(7677), 515–518.

- [4]. Bundy, D. A. P., Shaeffer, S., Jukes, M., Beegle, K., Gillespie, A., Drake, L., & Savioli, L., 2000, School health and nutrition programs, *World Bank Human Development Network*.
- [5]. Federal Ministry of Health (FMOH), 2015, National Malaria Strategic Plan 2014–2020, *Abuja: Federal Ministry of Health*.
- [6]. World Health Organization, 2022, World Malaria Report 2022, *Geneva: WHO*.

- [7]. Okiro, E. A., Hay, S. I., Gikandi, P. W., Sharif, S. K., Noor, A. M., Peshu, N., & Snow, R. W., 2009, The decline in paediatric malaria admissions on the coast of Kenya, *Malaria Journal*, 8(1), 176.
- [8]. Okorie, P. N., Ademowo, O. G., Irving, H., Kelly-Hope, L. A., & Wondji, C. S., 2015, Insecticide resistance in Nigerian malaria vectors: A nationwide profile, *Parasites & Vectors*, 8(1), 605.
- [9]. Gallup, J. L., & Sachs, J. D., 2001, The economic burden of malaria, *The American Journal of Tropical Medicine and Hygiene*, 64(1–2 Suppl), 85–96.
- [10]. Nankabirwa, J., Brooker, S. J., Clarke, S. E., Fernando, D., Gitonga, C. W., Schellenberg, D., & Greenwood, B., 2010, Malaria in school-age children in Africa: An increasingly important challenge, *Tropical Medicine & International Health*, 15(11), 1319–1327.
- [11]. Adepoju, P., 2021, Nigeria's battle with malaria burden amidst conflict and displacement, *The Lancet Infectious Diseases*, 21(4), 450–451.
- [12]. Onyiah, J. A., Akpan, E., & Umeokonkwo, C. D., 2018, Strengthening malaria surveillance in Nigeria: Gaps and opportunities, *African Health Sciences*, 18(3), 582–590.
- [13]. Phillips, R. S., 2001, Current status of malaria and potential for control, *Clinical Microbiology Reviews*, 14(1), 208–226.
- [14]. Federal Ministry of Health (FMOH), 1991, National Malaria Control Policy, *Abuja: Federal Ministry of Health*.
- [15]. Federal Ministry of Health (FMOH), 2004, Malaria Indicator Survey, *Abuja: Federal Ministry of Health*.
- [16]. Rugemalila, J. B., Wanga, C. L., & Kilama, W. L., 2006, Sixth Africa malaria day in 2006: How far have we come after the Abuja Declaration? *Malaria Journal*, 5, 102.
- [17]. Jordan, E., & Verma, R., 2005, Malaria: Past and present, *Clinical Medicine & Research*, 3(2), 118–123.
- [18]. Bruce-Chwatt, L. J., 1986, Essential Malariology (2nd ed.), *London: William Heinemann Medical Books*.
- [19]. Levine, N. D., 1988, Progress in taxonomy of the Apicomplexan protozoa, *The Journal of Protozoology*, 35(4), 518–520.
- [20]. Garnham, P. C. C., 1966, Malaria Parasites and Other Haemosporidia, *Oxford: Blackwell Scientific Publications*.
- [21]. Welch, W. H., 1897, On the life-history of the malarial parasite, *Johns Hopkins Hospital Bulletin*, 8(87), 1–13.
- [22]. Stephens, J. W. W., 1922, A new malaria parasite of man, *Annals of Tropical Medicine & Parasitology*, 16(3), 383–388.
- [23]. Worrall, E., Basu, S., & Hanson, K., 2002, The relationship between socio-economic status and malaria: a review of the literature. *Background paper for Ensuring that malaria control interventions reach the poor*, *London*, 56.
- [24]. Degarege, A., Fennie, K., Degarege, D., Chennupati, S., & Madhivanan, P., 2019, Improving socioeconomic status may reduce the burden of malaria in sub-Saharan Africa: A systematic review and meta-analysis. *PloS one*, 14(1), e0211205.

Stratified Evaluation of Quality Management Practices in HIV Rapid Testing Laboratories: Evidence from the South Region of Cameroon

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Abstract

Ensuring high-quality HIV rapid testing is critical to accurate diagnosis and effective treatment, especially in resource-limited settings like Cameroon. This study conducted a stratified evaluation of quality management systems (QMS) in HIV rapid testing laboratories across the South Region of Cameroon using the WHO Stepwise Process for Improving the Quality of HIV Rapid Testing (SPI-RRT) tool. The objective was to assess adherence to quality standards across facility types and support levels, and to identify critical gaps in implementation. A total of 99 laboratories were audited between 2022 and 2024, stratified by ownership (government, private, faith-based, and community-based organizations) and PEPFAR support. Results showed that PEPFAR-supported laboratories had significantly higher mean SPI-RRT scores (59) compared to non-supported sites (14), $p < 0.001$. Community-based organizations demonstrated the highest compliance (28 ± 21), followed by faith-based (25 ± 23), private (25 ± 17), and government-owned facilities (14 ± 21). Notably, only 12% of laboratories reached SPI-RRT Level 3 or 4, indicating limited readiness for certification. The lowest-scoring elements included quality control, document management, and corrective actions, highlighting systemic weaknesses in QMS implementation. District-level disparities were also evident, with Sangmelima and Kribi outperforming other districts in readiness scores. These findings provide essential insights into quality assurance challenges in decentralized HIV testing programs and underscore the need for targeted interventions, including technical mentorship, continuous quality improvement, and enhanced supervision to improve diagnostic reliability.

Keywords: Cameroon, HIV Testing, Laboratory Audit, Quality Management, SPI-RRT.

Introduction

Viability and reliability of HIV testing are the cornerstone of successful disease monitoring, patient treatment, and prevention measures. For resource-poor settings such as Cameroon, HIV rapid testing continues to be the central diagnostic tool at peripheral levels of care, particularly for rural settings and underserved areas [1]. Although scalable,

comments have continued to surround the quality of rapid testing services due to variations in adherence to standard protocols, inadequate personnel training, improper documentation procedures, and inefficient quality control systems [2, 3]. To overcome these challenges, the World Health Organization (WHO) created the Stepwise Process for Improving the Quality of HIV

Rapid Testing (SPI-RRT), a standardized approach to assessing the quality of testing sites along seven Core Essential Elements: training, infrastructure, safety, pre-testing, testing, post-testing measures, and monitoring of quality [4, 5]. The instrument has been implemented within several national settings to evaluate laboratory preparedness for certification and to stimulate Continuous Quality Improvement (CQI) efforts. Yet empirical evidence of SPI-RRT scale-up within Cameroon's decentralized testing contexts remains scarce [6].

Although there has been a national drive to scale up HIV rapid testing, decentralized laboratories' quality assurance systems within Cameroon remain fragmented, with little comprehension of performance differences by ownership type, by region, or by level of donor coverage. Such a gap compromises diagnostic accuracy as well as the integrity of HIV-related health interventions.

Existing Solutions and Their Limitations

Some facilities introduced solutions, such as in-service training, external quality evaluations (EQA), and technical mentorship, with donor support (e.g., PEPFAR). The solutions, however, were not introduced with equal intensity, and evidence to demonstrate their effectiveness remains sporadic or anecdotal [7, 8]. Moreover, prior evaluations have hardly segmented performance information by ownership or facility level.

Best Solution Found

The SPI-RRT instrument provides a defined, tested approach to benchmarking quality and identifying targeted gaps. Once implemented across stratified categories, ownership, donor funding, and facility location, it can unveil essential information bearing on systemic and facility-level roadblocks to quality assurance. Accomplishments so Far: The SPI-RRT

instrument has, globally, been applied to enhance laboratory performance in nations including Kenya, Nigeria, and South Africa [9] [10]. The instrument has been applied at pilot scale in Cameroon to guide CQI activities and benchmark performance. The current study expands this by applying the instrument at full scale across the entire South Region [11, 12].

The general objective of this evaluation was to assess the functionality of HIV rapid testing laboratories within Cameroon's South Region, using the SPI-RRT tool, with a specific interest in stratifying quality management practices by facility type and support status.

Novelty of the Work

This study is the first to conduct a stratified assessment of SPI-RRT scores across 99 testing laboratories in Cameroon's South Region, comparing PEPFAR-supported and non-supported facilities, and evaluating readiness across ownership types and geographic locations. It provides empirical evidence to support targeted quality improvement strategies and contribute to national HIV diagnostic policy development.

Conceptual Framework for Stratified Evaluation of HIV Testing Quality in Cameroon

Figure 1 below illustrates the conceptual framework for the stratified evaluation of the quality of HIV rapid testing across Cameroon's South Region. The framework intersects key inputs (facility level, funding source, and district characteristics), processes (SPI-RRT audits assessing seven Core Essential Elements and quality management actions), and outputs (readiness for certification levels on a scale of 0 to 4 stars). The structure illustrates how the facilities are stratified by ownership, donors, and geographic zone to identify performance gaps and inform tailored interventions.

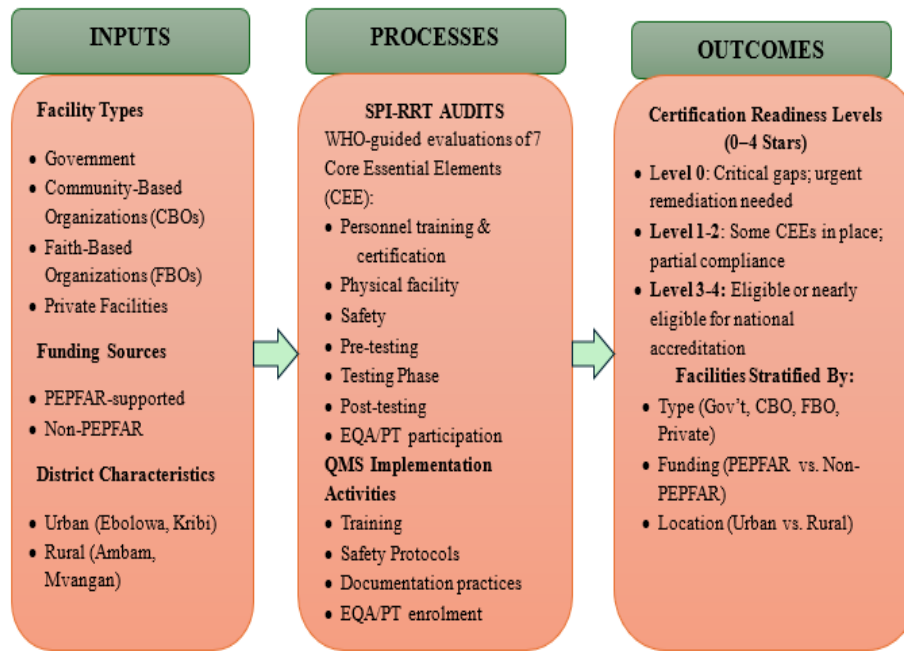


Figure 1. Conceptual Framework for Stratified Evaluation of HIV Testing Quality in Cameroon

Materials and Methods

Description of the Site

Research was undertaken in the South Region of Cameroon, one of the nation's ten administrative regions, located in the southernmost region, adjacent to the Atlantic Ocean to the west, to the south by Gabon, and to the southwest by Equatorial Guinea. The regional distribution is mixed, with major cities including Ebolowa, Kribi, and Sangmelima, and several rural health districts, including Ambam, Mvangan, and Djoum. The region's economy relies on agriculture, fishing, logging, and cross-border trade. The network of healthcare ranges from regional hospitals to district hospitals, with integration for some to the level of clinics, private clinics, faith-based clinics, together with community-based organization (CBO) clinics. The capacity of laboratories varies significantly, with some having the advantage of external funding, for instance, PEPFAR, whereas other has little external funding.

Description of the Experiments Done

A total of 99 HIV rapid testing laboratories were included in the study. These facilities

represent a complete census of all laboratories that met the national eligibility criteria for HIV rapid testing within the South Region of Cameroon during the study period (January 2022–March 2024). No sampling procedure was applied because the objective was to obtain a full regional picture of laboratory quality performance across all ownership types and support levels. The inclusion of all eligible facilities strengthens the representativeness and reliability of the findings. The WHO Stepwise Process for Improving the Quality of HIV Rapid Testing (SPI-RRT) checklist was used to evaluate laboratory quality management practices. The SPI-RRT tool assesses seven CEE: (1) personnel training and certification, (2) physical facility, (3) safety, (4) pre-testing phase, (5) testing phase, (6) post-testing phase, and (7) participation in EQA or proficiency testing (PT). Each element was scored, and total scores were mapped to quality levels ranging from Level 0 (critical gaps) to Level 4 (eligible for national accreditation). Data collection also included laboratory audits, personnel competency assessments, and observation of adherence to standard operating procedures (SOPs).

Description of the Laboratory Methods

Facility evaluations were conducted by trained assessors certified in the use of the SPI-RRT tool in accordance with WHO guidelines. Before commencing data collection, assessors underwent a joint calibration session to harmonize scoring practices and reduce variability. During field deployment, inter-rater reliability checks were performed through paired assessments of selected facilities, cross-review of scoring sheets, and supervisory verification of discrepancies. These quality control measures ensured consistent interpretation and scoring of tool items across assessors. For personnel competency, a structured skill assessment was conducted for the HIV rapid test, covering the pre-analytical (sampling collection and preparation), analytical (test performance, timing, and result interpretation), and post-analytical (documentation and reporting) phases. Adherence to the national HIV testing algorithm, where applicable, was confirmed. Laboratory safety included inspection of the biosafety measures, PPE usage, and waste disposal practices. The documentation review included SOPs, IQC records, EQA/PT participation certificates, and correction action logs.

Description of Statistical Methods Used

Quantitative data were entered and analyzed using IBM SPSS Statistics Version 27. The analysis consisted of descriptive and inferential statistical procedures aligned with the structure of the results. Descriptive statistics (means, standard deviations, frequencies, and percentages) were used to summarize SPI-RRT performance across the seven CEE and to characterize facilities by district, ownership type, PEPFAR support status, and HIV testing tier. These descriptive summaries provided the basis for identifying general performance trends and variability within and between facility groups.

To compare mean SPI-RRT scores between PEPFAR-supported and non-PEPFAR facilities, an independent-samples t-test was conducted. This analysis was used to determine whether the observed differences in overall performance and core element scores between the two groups were statistically significant. Results presented in the findings section reflect the calculated mean differences and significance values ($p < 0.05$).

Differences in performance across ownership categories (government, private, faith-based, and community-based organizations) were assessed using a one-way Analysis of Variance (ANOVA). This test examined whether mean SPI-RRT scores varied significantly across the four ownership groups for each core essential element and for the overall score. Where the ANOVA indicated significant group differences, the interpretation of results was supported by examining the distribution of means and standard deviations across categories.

Post-hoc Analyses

For ANOVA models that demonstrated statistically significant differences across facility ownership categories, post-hoc pairwise comparisons were conducted using the Tukey Honestly Significant Difference (Tukey HSD) test. This procedure allowed identification of specific group-to-group differences while adjusting for multiple comparisons. Tukey HSD was selected because it maintains appropriate control of Type I error rates and is suitable for comparing groups with unequal sample sizes. The post-hoc results provided additional clarification on which facility categories differed significantly in their SPI-RRT scores following the omnibus ANOVA results. Confidence intervals (95% CI) for mean differences were also generated to support the interpretation of effect sizes.

Associations between facility characteristics and accreditation readiness levels (Level 0–Level 4) were analyzed using chi-square tests.

This allowed assessment of whether readiness levels were dependent on district, ownership type, or donor support status. Significant relationships were interpreted based on chi-square values and p-values reported in the results.

To estimate the precision of selected performance indicators, 95% confidence intervals (CI) were calculated and presented in the results summary. Confidence intervals were used particularly when describing mean overall SPI-RRT scores and district-level variations in readiness. All statistical tests were conducted at a significance level of $p < 0.05$. The analytical procedures applied were consistent with the study objectives and the structure of the results, enabling clear interpretation of differences in quality performance across facility categories, geographic areas, and donor support levels.

Results

Description of the General Characteristics of Testing Facilities

It is important to note that Round 1 and Round 2 assessments were not conducted for the same facility categories. Only PEPFAR-supported sites were evaluated in both Round 1 (2022) and Round 2 (2024) in order to monitor longitudinal changes resulting from structured mentorship and technical assistance. Non-PEPFAR facilities were evaluated only in Round 2, as they were included later when the assessment expanded to cover all eligible laboratories in the region. Therefore, comparisons between rounds reflect performance changes only among PEPFAR-supported sites, while comparisons between PEPFAR and non-PEPFAR facilities rely solely on Round 2 data. This clarification is essential to avoid misinterpretation when viewing the tables and performance trends.

Table 1 below captures the overall characteristics of the HIV testing sites in two rounds of assessments: Round one (Oct to Dec

2022) and Round Two (Jul to Sep 2024). The important variables examined include Health District, HIV Testing Capacity (Tier), Site Type, and Affiliation. Under Health District Coverage, the overall number of tested sites reviewed rose significantly in the two rounds, from 29 in Round One to 99 in Round Two. The greatest contribution to the capacity for tests in both rounds was the Ebolowa District, from 24.1% in Round one to 19.2% in Round two. Other districts, such as Ambam, Djoum, Kribi, and Kye-Ossi, made smaller contributions but stayed consistent in the two rounds. Sites were grouped according to their client capacity for tests. Tier 1 (>2000 clients), which was constant in both rounds, in the form of 1 site in both rounds. Most of the sites were Tier 3 (500-1000 clients), which increased from 51.7% in Round One to 35.4% in Round Two. A major change was observed in Tier 4 (<500 clients), rising to 58.6% in Round two from 27.6% in Round one, indicating an increase in sites with smaller test capacities. In Round One, all 29 (100%) sites were PEPFAR-supported facilities. By Round two, 29(29.3%) out of the 99 sites were PEPFAR-supported facilities, and the other 70(70.7%) were non-PEPFAR-supported facilities. Most of the sites were government-affiliated in both rounds (72.4% in Round One and 69.7% in Round Two). It was observed that the representation of the faith-based and private organisations changed slightly, as the Faith-Based sites increased to 11.1% from 10.3%, and the Private affiliations increased to 17.2% from 10.3% across the two rounds. This depicts the increase in HIV testing capacity in the South Region of Cameroon, as well as the growth in capacity at lower-capacity sites (Tier 4) and the diversification of site affiliations toward more non-PEPFAR-funded and private entities. The analysis identifies major trends in the scale-up of HIV testing services, particularly in rural or lower-capacity areas.

Table 1. Description of the General Characteristics of Testing Facilities

Description of the general characteristics of the testing facilities		
Variables	Round one Assessment (October to December 2022)	Round Two Assessment (July to September 2024)
Health District	1(3.4%)	8(8.1%)
Ambam	2(6.9%)	4(4%)
Djoum	6(20.7%)	20(20.2%)
Ebolowa	7(24.1%)	19(19.2%)
Kribi	2(6.9%)	4(4%)
Kye-Ossi	1(3.4%)	4(4%)
Lolodorf	3(10.3%)	9(9.1%)
Meyomessala	1(3.4%)	8(8.1%)
Mvangan	1(3.4%)	2(2%)
Niete	0(0%)	4(4%)
Olamze	1(3.4%)	12(12.1%)
Sangmelima	3(10.3%)	5(5.1%)
Zoetele	2(6.9%)	99(100%)
Total	29(100%)	8(8.1%)
HIV Case Management Capacity (Tier)		
Tier 1 (Above 2000 Clients)	1(3.4%)	1(1%)
Tier 2 (1000 To 2000 Clients)	5(17.2%)	5(5.1%)
Tier 3 (500 To 1000 Clients)	15(51.7%)	35(35.4%)
Tier 4 (Below 500 Clients)	8(27.6%)	58(58.6%)
Total	29(100%)	99(100%)
Site Type		
PEPFAR	29(100%)	29(29.3%)
Non-PEPFAR	0(0%)	70(70.7%)
Total	29(100%)	99(100%)
Affiliation		
Community-Based Organization	2(6.9%)	2(2%)
Faith-Based Organization	3(10.3%)	11(11.1%)
Government	21(72.4%)	69(69.7%)
Private	3(10.3%)	17(17.2%)
Total	29(100%)	99(100%)

**Evaluation of Facility Performance
Across Several Domains in PEPFAR and**

**NON-PEPFAR Facilities of the South
Region, Cameroon**

Table 2 above illustrates the performance evaluation of the 7 CEE in the PEPFAR and NON-PEPFAR facilities to which assessments were conducted in two rounds for PEPFAR (N=29) and a single round for NON-PEPFAR facilities (N=70). The findings indicate significant performance differences, whereby PEPFAR facilities have consistently improved and performed far better than NON-PEPFAR facilities.

1. Personnel Training and Certification:

PEPFAR-supported facilities enhanced their score from a baseline of a mean of 5 (SD=2) in Round 1 to a mean of 7 (SD=2) in Round 2, while NON-PEPFAR-supported facilities achieved only a mean score of 0.

2. Safety: PEPFAR-supported facilities showed high scores (Mean = 10; SD = 2 in Round 1 and SD = 0 in Round 2), while NON-PEPFAR-supported facilities scored a mean of 4 (SD=0).

3. Testing Stage: PEPFAR-supported facilities enhanced from a mean of 7 (SD=2) in Round 1 to 9 (SD=1) in Round 2, while NON-PEPFAR-supported facilities reported a mean of 1 (SD=0).

4. Total Scores: PEPFAR facilities improved overall performance, increasing from a mean of 49 (SD=12) in Round 1 to 59 (SD=4) in Round 2. Non-PEPFAR facilities lagged, with a mean score of 14 (SD = 6).

The results demonstrate that PEPFAR-supported facilities have prospered through structured interventions, scoring higher in all areas of pre-testing, testing, and external quality assessments. However, non-PEPFAR-supported facilities exhibited considerable gaps in staff training, testing processes, and safety protocols; the need to close these performance gaps was underscored.

Table 2. Evaluation of Facility Performance Across Several Domains in PEPFAR and NON-PEPFAR Facilities

Core Essential Element (CEE)	Round 1 Assessment PEPFAR (N=29) Mean (Std Deviation)	Round 2 Assessment PEPFAR (N=29) Mean (Std Deviation)	Round 2 Assessment NON-PEPFAR (N=70) Mean (Std Deviation)
Personnel Training and Certification	5(2)	7(2)	0(1)
Physical Facility	5(1)	5(0)	5(0)
Safety	10(2)	10(0)	4(0)
Pre-Testing Phase	11(3)	13(1)	3(1)
Testing Phase	7(2)	9(1)	1(0)
Post-Testing Phase - Documents and Records	7(2)	9(1)	1(0)
External Quality Assessment (Proficiency Testing/EQA and Site Supervision)	5(3)	8(1)	3(4)
Overall Score	49(12)	59(4)	14(6)

Core Essential Elements (CEE) Across Different Affiliations or Organization Types

Table 3 below illustrates the audit of CEE within various organizations, Community-Based Organizations (CBOs), Faith-Based Organizations (FBOs), Government (Gov't),

and Private, revealing considerable performance differences:

1. CBOs posted the highest scores in all the areas for which data are provided: Personnel Training (Mean = 7, SD = 1), Safety (Mean = 10, SD = 0), and Overall Score (Mean = 50, SD = 3). Their low standard deviations reveal uniform performance across facilities.
2. FBOs, Government & Private organizations underperformed as compared to CBOs in Personnel Training (Mean = 2, SD = 3), Post-Testing Phase (Mean = 2-3, SD = 4), and External Quality Assessment (Mean = 1-2, SD = 3-4).
3. Scores for non-CBO organizations have very high variability (SD = 17–23), indicating inconsistent standard compliance.

The substantial variability observed in Table 3 warrants clarification. Community-Based Organizations (CBOs) exhibited extremely low standard deviations (SD = 0–1) because the

sample size for this group was very small (only two sites), and both facilities demonstrated uniformly strong adherence across all SPI-RRT indicators. This naturally produced minimal variability. In contrast, the Faith-Based, Government, and Private facility categories consisted of larger and more heterogeneous groups. These groups included facilities with both very low and moderate levels of quality system implementation, resulting in markedly high standard deviations (e.g., SD up to 23). This pattern reflects true performance disparities within these categories rather than measurement error, and it underscores systemic inconsistencies in quality management practices across non-CBO facilities. These Round Two results, both PEPFAR and non-PEPFAR-supported facilities, highlight CBOs as a model for best practice and indicate the need for focused interventions in FBOs, government, and Private organizations to enhance training, testing, and quality assessment strategies.

Table 3. Core Essential Elements (CEE) Across Different Affiliations or Organization Types

Core Essential Element (CEE)	CBO		FBO		Gov't		Private	
	Mean (Std.Dev.)	Std. Error	Mean (Std.Dev.)	Std. Error	Mean (Std.Dev.)	Std. Error	Mean (Std.Dev.)	Std. Error
Personnel Training and Certification	7(1)	1.000	2(3)	0.982	2(3)	0.350	1(3)	0.675
Physical Facility	5(0)	0.000	5(0)	0.091	5(1)	0.350	5(1)	0.177
Safety	10(0)	0.000	5(4)	0.844	6(3)	0.328	6(2)	0.582
Pre-Testing Phase	13(0)	0.000	6(4)	1.319	6(4)	1.319	6(1)	0.863
Testing Phase	9(1)	0.500	3(4)	1.083	4(3)	0.417	4(3)	0.834
Post-Testing Phase - Documents and Records	9(0)	1.000	2(4)	1.245	3(4)	0.486	2(4)	0.869
EQA (Proficiency Testing/ and Site Supervision)	6(1)	1.000	2(4)	1.090	2(3)	0.416	1(3)	0.762
Overall Score	50(3)	3.500	25(23)	6.654	28(21)	3.666	25(17)	4.764

The variability observed in Table 3 above requires clarification for proper interpretation. Community-Based Organizations (CBOs)

recorded very low standard deviations (SD = 0–1) because the group consisted of only two facilities, and both demonstrated consistently

strong and uniform performance across all SPI-RRT elements. This naturally produced minimal variability.

In contrast, government, faith-based, and private facilities each had larger sample sizes and markedly heterogeneous performance levels, which resulted in very high standard deviations (e.g., SD up to 23). These groups included facilities with weak quality systems alongside others with moderate or strong implementation, leading to wide score dispersion. This variability highlights systemic inconsistency in quality management implementation among non-CBO facilities and supports the interpretation that CBOs represent more uniform and structured models of HIV testing service delivery.

Performance of Health Districts by Level

The performance analysis of Health Districts presented in Figure 2, which identifies important district-to-district variability in the achievement of quality standards:

Struggling Districts (Level 0)

Most facilities in the districts of Ambam, Ebolowa, Kribi, Sangmelima, Meyomessala, and Mvangan remain at Level 0 due to critical performance gaps. These Districts need urgent attention to solve the core service delivery and quality management problems.

Moderate Performance (Levels 1 and 2)

Districts such as Ebolowa, Kribi, and Zoetele have a combination of structures in Levels 1 and 2, which demonstrates incremental improvement but still require specialized support to achieve higher levels of compliance.

High-Performance Districts (Levels 3 and 4)

Districts including Ebolowa, Kribi, and Sangmelima have made encouraging strides. A few of the sites reach Level 3 and some reach Level 4 to qualify for national certification. These top-performing sites represent potential replication sites for best practice in lower-performing areas (Figure 3).

The results highlight the requirement for a differentiated quality improvement approach:

1. Struggling districts need in-depth capacity building and focused mentoring to overcome system weaknesses.
2. Moderate-performing districts require ongoing technical assistance and continual monitoring to facilitate advancement towards certification.
3. High-performing facilities must be utilized as centers for learning to facilitate cross-district knowledge sharing.

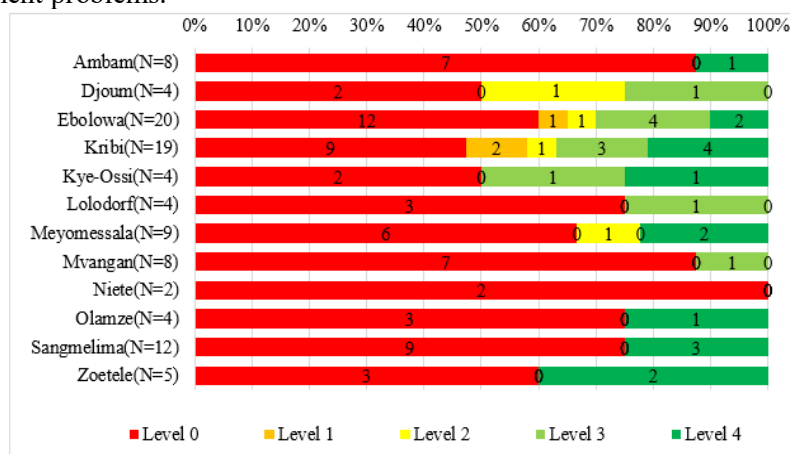


Figure 2. Performance of Health Districts by Level

<i>SPI-RRT Scoring Ranges and Level Definitions</i>	
<i>Levels</i>	<i>Description of results</i>
Level 0 (0–39%)	Needs improvement in all areas and immediate remediation
Level 1 (40–59%)	Needs improvement in specific areas
Level 2 (60–79%)	Partially eligible
Level 3 (80–89%)	Close to national site certification
Level 4 (90–100%)	Eligible for national site certification

Figure 3. SPI-RRT Scoring and Level Definitions

Discussion

The disparities observed across facility types reflect deeper structural and operational gaps that are strongly linked to specific Core Essential Elements (CEE) of the SPI-RRT tool. The widest performance gaps were observed in Personnel Training and Certification, Testing Phase, Post-Testing Documentation, and External Quality Assessment (EQA), all of which require sustained mentorship, SOP availability, regular supervisory visits, and documented corrective actions [13]. Government and private facilities showed substantial variability in these indicators, largely due to inconsistent staff competencies, infrequent retraining, and limited participation in EQA programs. Conversely, CBO facilities demonstrated uniformly high performance across these elements, particularly in safety, testing accuracy, and documentation completeness, underscoring the high degree of standardization in their operational procedures [2, 14].

Potential Confounders Influencing Performance Differences

Several potential confounders likely influenced the observed disparities (Table 1). Facility size and testing volume differ significantly across facility categories; higher-volume government sites may experience workflow pressure, increasing the risk of procedural deviations [15]. Staffing profiles also vary, with government and private facilities relying on mixed cadres, some without formal laboratory training, while CBOs often

employ fewer but more consistently trained staff. Supervisory frequency is another key confounder; PEPFAR-supported sites, which include many CBOs, benefit from regular technical assistance visits, while non-supported facilities receive infrequent oversight. These factors collectively contribute to the heterogeneous performance seen in non-CBO sites and underscore the need for targeted, system-wide capacity building.

Critical Interpretation of Why CBOs Performed Exceptionally Well

The unexpectedly strong performance of CBO sites can be explained by several contextual factors. First, the sample size for CBO facilities was very small, which naturally reduced variability and contributed to the near-zero standard deviations observed in Table 3 [16]. Second, CBOs tend to have tightly focused service delivery models with smaller testing volumes, allowing closer adherence to procedures and easier implementation of quality measures. Third, most CBOs receive targeted donor-driven mentorship and frequent supervisory support, especially in HIV community testing programs, which strengthens performance in training, documentation, and testing accuracy [17]. These characteristics create an environment in which quality practices are applied more consistently than in larger, more heterogeneous government and private facilities.

Performance Disparities by Donor Support

The stark contrast between PEPFAR-supported facilities and those not supported by PEPFAR (Table 2) underscores the transformative impact of structured, external support. PEPFAR-funded facilities showed significant improvement across all CEEs, a trend consistent with findings from Kenya and South Africa, where sustained mentorship and EQA participation enhanced laboratory quality [10, 18, 19]. A critical interpretation of the SPI-RRT scores reveals that the widest performance gaps were not in static elements like Physical Facility (which scored similarly), but in dynamic, process-oriented elements. The most substantial disparities were observed in:

Personnel Training and Certification (Mean: 7 vs. 0): This indicates a near-total lack of formal training and competency assessment in non-PEPFAR-supported facilities, directly impacting test accuracy and interpretation.

Testing Phase (Mean: 9 vs. 1) and Post-Testing Phase (Mean: 9 vs. 1): These gaps point to critical failures in adhering to standard operating procedures, proper documentation, and accurate result reporting in non-supported facilities.

External Quality Assessment (Mean: 8 vs. 3): The lower score for non-PEPFAR-supported facilities reflects a lack of participation in proficiency testing and external oversight, meaning errors likely go undetected and uncorrected.

These specific gaps in training, process adherence, and quality control are the primary drivers of the low accreditation readiness and pose the greatest risk to diagnostic reliability.

Organizational Affiliation and Core Essential Elements

The stratification by organizational type (Table 3) yielded a surprising finding: Community-Based Organizations (CBOs) achieved the highest mean SPI-RRT score. However, this result requires cautious

interpretation. The exceptional performance and minimal variability ($SD = 0-1$) within the CBO group are likely influenced by its tiny sample size (only two sites). It is plausible that these two CBOs were "model sites" or pilot projects receiving intensive, focused support, which is not representative of CBOs at a larger scale. This potential selection bias limits the generalizability of their performance as a category.

Beyond the CBO anomaly, the high standard deviations observed in Faith-Based, Government, and Private facilities (SD up to 23) are highly informative. They do not merely indicate measurement error but reveal profound systemic inconsistency within these sectors. This suggests that quality management is not institutionalized but is instead dependent on variable factors such as individual facility leadership, the presence of a dedicated quality officer, or sporadic supervisory visits. The finding that government facilities, which form the backbone of the public health system, had the lowest mean score (14 ± 21) is particularly concerning and highlights systemic under-investment in public-sector quality assurance [20].

Geographic Inequities in Performance

The district-level analysis further illustrates the consequences of uneven resource distribution. Higher-performing districts like Sangmelima and Kribi are urban centers that typically benefit from better infrastructure, more trained personnel, and greater access to supervisory visits and supply chains. In contrast, rural districts like Mvangan and Djoum are often marginalized, reinforcing the well-documented urban-rural divide in laboratory services in Cameroon and similar contexts [2]. This geographic stratification necessitates a differentiated quality improvement approach rather than a one-size-fits-all strategy [2].

Confronting Confounders: Staff Cadre, Supervision, and Facility Size

The interpretation of these results must account for potential confounders not fully captured by the SPI-RRT tool. A key confounder is staff cadre and turnover. PEPFAR-supported sites may benefit from additional, often more specialized, staff or lower turnover rates due to better incentives, directly impacting training scores and procedural adherence. Furthermore, the frequency and quality of supervision are intrinsically linked to donor support. PEPFAR's structured mentorship model creates a continuous feedback loop for quality improvement, whereas non-supported facilities may experience only infrequent, punitive inspections from overstretched district health teams. Finally, while our data includes testing tier (a proxy for size and client volume), the analysis could be strengthened by explicitly discussing how facility size and patient load interact with quality systems. Smaller, rural Tier 4 facilities likely face compounded challenges of isolation, inadequate resources, and less-skilled staff, making consistent QMS implementation particularly difficult.

Implications for Quality Management Strategy Implementation

Overall, the findings suggest the existence of quality management strategies, but with uneven application throughout the South Region. Donor-funded facilities, urban locations, and some organizational types exhibit preparedness for accreditation, whereas government-owned, non-funded, and rural facilities fall behind, specifically for CEEs like quality control, corrective measures, and continuous quality improvement [21]. Correction of these gaps will need government-driven investments in training, infrastructure, and institutionalized EQA/PT participation, with intentional mentorship aimed at duplicating the performance improvements observed among PEPFAR-funded facilities [22].

Comparison with Other Studies

The overall low percentage (12%) of facilities reaching Level 3 or 4 readiness aligns with other SPI-RRT implementations in sub-Saharan Africa, where achieving accreditation readiness without sustained external support remains challenging [23]. Our stratified analysis, however, adds crucial nuance by pinpointing that this challenge is most acute for government-owned, non-funded, and rural facilities.

Study Limitations

This study has several limitations that should be considered when interpreting the findings. First, although assessors were trained and underwent calibration exercises before data collection, the possibility of assessor bias cannot be eliminated. Differences in the interpretation of certain SPI-RRT indicators or subjective scoring judgments may have influenced the results, particularly in borderline cases where documentation or practices were inconsistently applied.

Second, the maturity of laboratories across facility types varied substantially. Some facilities, particularly government and private sites, were at very early stages of establishing quality management systems, while others, such as PEPFAR-supported and certain CBO facilities, had been exposed to repeated mentorship cycles and had more advanced quality structures. These differences in system maturity likely affected performance outcomes independently of operational capacity and may have contributed to the large standard deviations observed within certain facility groups.

Third, the study relied exclusively on quantitative SPI-RRT assessment data, without triangulating with qualitative insights from laboratory personnel. Interviews or focus group discussions could have provided additional context on staffing challenges, workflow barriers, supervisory gaps, and perceptions of quality improvement processes. The absence of such qualitative data limits the depth of

interpretation, particularly regarding the underlying drivers of poor performance in non-supported laboratories.

Despite these limitations, the study provides a comprehensive, region-wide assessment of HIV rapid testing quality and highlights critical areas requiring targeted improvement [24, 25].

Conclusion

This stratified analysis of quality management practices among HIV rapid testing laboratories in the South Region of Cameroon has identified considerable variations in performance and implementation, driven mainly by donor support, organizational mission, and geographic setting. Whereas PEPFAR-funded, urban, and community- or faith-based facilities exhibited greater adherence to the WHO SPI-RRT Core Essential Elements and stronger accreditation readiness, numerous government- and rural-based facilities are hampered by inadequate infrastructure, insufficient staff training, poor documentation systems, and a lack of continuous quality improvement activities.

These findings underscore the pressing need for a balanced approach that sustains the gains achieved in donor-supported sites while extending quality improvement interventions to underperforming facilities. Strengthening government ownership of quality management systems, expanding technical mentorship, ensuring regular EQA/PT participation, and addressing urban-rural inequities are essential to building a resilient and equitable HIV diagnostic network.

Through filling these gaps and entrenching strong laboratory quality management systems, Cameroon can take steps towards its national and international HIV targets, ensuring all persons, no matter where they reside or facility level, gain accurate, reliable, and timely HIV diagnosis.

Contribution to Knowledge

This work contributes several valuable additions to understanding and developing quality assurance for HIV rapid testing laboratories in resource-scarce environments:

1. **Empirical Evidence from a Stratified Assessment:** It is the first comprehensive, stratified examination on the quality assurance procedures of HIV rapid tests in the South Region of Cameroon, and finds inequalities by ownership, donor support status, and location.
2. **Identification of Core Performance Gaps:** The study identifies certain weaknesses in Core Essential Elements, most notably in personnel training, quality control, documentation, and continuous quality improvement, that constrain accreditation readiness in most facilities.
3. **Documentation of Donor Impact:** Through the quantitative measurement of performance contrasts between PEPFAR-assisted and non-assisted sites, the analysis highlights the transformative impact of continued technical and financial support on the quality results of laboratories.
4. **Urban-Rural and Institutional Inequities:** The results indicate substantive geographic and organizational differences in the application of quality management, providing nuanced evidence to support focused interventions that target system inequities in HIV diagnostic services.
5. **Programmatic and Policy Direction:** The findings provide actionable recommendations for program managers, implementing partners, and policymakers to create specialized mentorship, training, and infrastructure support approaches that can expedite accreditation readiness and enhance diagnostic accuracy across all facility levels.

Through the integration of a WHO-recommended quality evaluation framework (SPI-RRT) and stratified performance analysis, this work develops the methodological and

contextual knowledge needed to improve laboratory systems in Cameroon and other contexts, thereby supporting the ultimate objective of reaching the UNAIDS 95-95-95 targets.

Data Availability

The datasets generated and analyzed during the current study are not publicly available due to confidentiality agreements with the participating health facilities and the Cameroonian Ministry of Public Health. However, anonymized data are available from the corresponding author upon reasonable request and with permission from the South Regional Delegation of Public Health.

Conflict of Interest

The author declares that there is no conflict of interest related to this study. Although some of the laboratories assessed in this research receive technical or logistical support from programs such as PEPFAR, the data presented and the analysis conducted are entirely independent and do not reflect the views, performance evaluations, or reporting standards of PEPFAR or its affiliated partners.

These results are drawn exclusively from the field data provided by the researcher through standard tools (i.e., SPI-RRT checklist and competency assessment questionnaire), and no programmatic or financial influence from any external sponsor, including PEPFAR, has influenced the methodology, findings, interpretation, or recommendations from this study.

Author Contributions

- **Abanda Emmanuel Chafah:** Conceptualization, Methodology, Investigation, Data Curation, Formal Analysis, Writing-Original Draft, Writing-Review & Editing.
- **Dr. Nshom Emmanuel Mboh:** Validation, Writing-Review & Editing, Project Administration.
- **Dr. Bodzewan Emmanuel Fonyuy:** Supervision, Writing-Review & Editing.

- **Dr. Awandem Ernest Forku:** Project Administration, Writing Review & Editing.
- All authors have read and approved the final version of the manuscript.

Ethical Approval

This study was approved by the South Regional Delegation of Public Health, Cameroon (Ref: No: 947/AR/MIN-SANTE/SG/DRSPS/BEP). Informed consent was obtained from all participants involved in the interviews and focus group discussions. All data were anonymized to ensure confidentiality.

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References

- [1]. Ngangue, P., Gagnon, M. P., and Bedard, E., 2017, "Challenges in the Delivery of Public HIV Testing and Counselling (HTC) in Douala, Cameroon: Providers Perspectives and Implications on Quality of HTC Services," *BMC Int. Health Hum. Rights*, 17, p. 9. <https://doi.org/10.1186/s12914-017-0118-2>
- [2]. Nkengasong, J. N., Mbopi-Keou, F. X., Peeling, R. W., Yao, K., Zeh, C. E., Schneidman, M., et al., 2018, "Laboratory Medicine in Africa since 2008: Then, Now, and the Future," *Lancet Infect. Dis*, 18(11), pp. e362–e367. [https://doi.org/10.1016/S1473-3099\(18\)30120-8](https://doi.org/10.1016/S1473-3099(18)30120-8)
- [3]. Mosoke, P., Ndasi, J., Dimite, L., Efuetaoka, C., Etogo, B., Jackson, K., ... & Njukeng, P., 2020, Innovative Approach to Improving Adherence to Quality Standards at HIV Rapid Testing Sites in Cameroon using the Stepwise Process for Improving the Quality of HIV Rapid Testing (SPI-RT) Checklist. *International Journal of Trend in Scientific Research and Development*, 4.
- [4]. Ndiokubwayo, J. B., Yahaya, A. A., Coulibaly, S. O., Kasolo, F., Maruta, T., Ndlovu, N., Moyo, S et al., 2016, "Implementation of the World Health Organization Regional Office for Africa Stepwise Laboratory Quality Improvement Process Towards Accreditation," *Afr. J. Lab. Med.*, 5(1), pp. 1–8. <https://doi.org/10.4102/ajlm.v5i1.280>
- [5]. Yenealem, D., Kedir, S., MekonnenWubie, A., Melese, D., Molalign, T., Yemanebirhan, N., Mohammed, A., Nurahmed, N., et al., 2023, "HIV Rapid Test Performance among Health Facilities Enrolled in HIV Rapid Test Quality Improvement Initiative (RTQII) in Ethiopia," *BMC Infect. Dis.*, 23(1), pp. 1–9. <https://doi.org/10.1186/s12879-023-08285-x>
- [6]. Woldesenbet, S. A., Kalou, M., Mhlango, D., Kufa, T., Makhanya, M., Adelekan, A., Diallo, K., et al., 2019, "An Overview of the Quality Assurance Programme for HIV Rapid Testing in South Africa:

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Outcome of a 2-Year Phased Implementation of Quality Assurance Program," *PLOS ONE*, 14(9), p. e0221906.

<https://doi.org/10.1371/journal.pone.0221906>

- [7]. Zakumumpa, H., Paina, L., Wilhelm, J., Ssengooba, F., Ssegujja, E., Mukuru, M., and Bennett, S., 2021, "The Impact of Loss of PEPFAR Support on HIV Services at Health Facilities in Low-Burden Districts in Uganda," *BMC Health Serv. Res*, 21(1), p. 302. <https://doi.org/10.1186/s12913-021-06316-4>

- [8]. Joint United Nations Programme on HIV/AIDS, 2023, The path that ends AIDS: 2023 UNAIDS global AIDS update.

- [9]. Wagner, A. D., Mugo, C., Bluemer-Miroite, S., Mutiti, P. M., Wamalwa, D. C., Bukusi, D., Neary, J., et al., 2017, "Continuous Quality Improvement Intervention for Adolescent and Young Adult HIV Testing Services in Kenya Improves HIV Knowledge," *AIDS*, 31, p. S243. <https://doi.org/10.1097/QAD.0000000000001531>

- [10]. Yapa, H. M., Dhlomo-Mphatswe, W., Moshabela, M., De Neve, J.-W., Herbst, C., et al., 2020, "A Continuous Quality Improvement Intervention to Improve Antenatal HIV Care Testing in Rural South Africa: Evaluation of Implementation in a Real-World Setting," *Int. J. Health Policy Manag.*, 11(5), pp. 610–628. <https://doi.org/10.34172/ijhpm.2020.178>

- [11]. Groene, O., Klazinga, N., Kazandjian, V., Lombail, P., and Bartels, P., 2008, "The World Health Organization Performance Assessment Tool for Quality Improvement in Hospitals (PATH): An Analysis of the Pilot Implementation in 37 Hospitals," *Int. J. Qual. Health Care*, 20(3), pp. 155–161. <https://doi.org/10.1093/intqhc/mzn010>

- [12]. Ogaji, D., 2018, "Development and Validation of the Patient Evaluation Scale (PES) for Assessing the Quality of Primary Health Care in Nigeria." [Online]. Available:

https://www.academia.edu/116319277/Development_and_validation_of_the_patient_evaluation_scale_

- PES_for_assessing_the_quality_of_primary_health_care_in_Nigeria [Accessed: 18-Oct-2025].
- [13]. Paina, L., Rodriguez, D. C., Zakumumpa, H., Mackenzie, C., Ssengooba, F., and Bennett, S., 2023, "Geographic Prioritisation in Kenya and Uganda: A Power Analysis of Donor Transition," *BMJ Glob. Health*, 8(5), p. e010499. <https://doi.org/10.1136/bmjgh-2022-010499>
- [14]. World Health Organization, 2021, "Consolidated Guidelines on HIV Prevention, Testing, Treatment, Service Delivery and Monitoring: Recommendations for a Public Health Approach," *Consolidated Guidelines on HIV Prevention, Testing, Treatment, Service Delivery and Monitoring: Recommendations for a Public Health Approach*, pp. 592–592. [Online]. Available: <https://apps.who.int/iris/handle/10665/342899>. [Accessed: 09-Aug-2025].
- [15]. Jaya, Z., Drain, P. K., and Mashamba-Thompson, T. P., 2017, "Evaluating Quality Management Systems for HIV Rapid Testing Services in Primary Healthcare Clinics in Rural KwaZulu-Natal, South Africa," *PLoS ONE*, 12(8), p. e0183044. <https://doi.org/10.1371/journal.pone.0183044>
- [16]. Drain, P. K., Dorward, J., Bender, A., Lillis, L., Marinucci, F., Sacks, J., Bershteyn, A., et al., 2019, "Point-of-Care HIV Viral Load Testing: An Essential Tool for a Sustainable Global HIV/AIDS Response," *Clin. Microbiol. Rev.*, 32(3), pp. e00097-18. <https://doi.org/10.1128/CMR.00097-18>
- [17]. Holtzman, C. W., Godfrey, C., Ismail, L., Raizes, E., Ake, J. A., Tefera, F., Okutoyi, S., and Siberry, G. K., 2022, "PEPFAR's Role in Protecting and Leveraging HIV Services in the COVID-19 Response in Africa," *Curr. HIV/AIDS Rep.*, 19(1), pp. 26–36. <https://doi.org/10.1007/s11904-021-00587-6>
- [18]. Lewis, C. C., Mettert, K. D., Dorsey, C. N., Martinez, R. G., Weiner, B. J., Nolen, E., Stanick, C., Halko, H., and Powell, B. J., 2018, "An Updated Protocol for a Systematic Review of Implementation-Related Measures," *Syst. Rev.*, 7(1), p. 66. <https://doi.org/10.1186/s13643-018-0728-3>
- [19]. Elendu, C., Amaechi, D. C., Elendu, T. C., Amaechi, E. C., Elendu, I. D., Akpa, K. N., Oloyede, P. O., Adegbola, M. O., and Idowu, O. F., 2025, "Shaping Sustainable Paths for HIV/AIDS Funding: A Review and Reminder," *Ann. Med. Surg.*, 87(3), pp. 1415–1445. <https://doi.org/10.1097/MS9.0000000000002976>
- [20]. Maruta, T., Motebang, D., Mathabo, L., Rotz, P. J., Wanyoike, J., and Peter, T., 2012, "Impact of Mentorship on WHO-AFRO Strengthening Laboratory Quality Improvement Process Towards Accreditation (SLIPTA)," *Afr. J. Lab. Med.*, 1(1), p. 6. <https://doi.org/10.4102/ajlm.v1i1.6>
- [21]. Endalamaw, A., Khatri, R. B., Mengistu, T. S., Erku, D., Wolka, E., Zewdie, A., and Assefa, Y., 2024, "A Scoping Review of Continuous Quality Improvement in Healthcare System: Conceptualization, Models and Tools, Barriers and Facilitators, and Impact," *BMC Health Serv. Res.*, 24, p. 487. <https://doi.org/10.1186/s12913-024-10828-0>
- [22]. Hontelez, J. A. C., Goymann, H., Berhane, Y., Bhattacharjee, P., Bor, J., Chabata, S. T., Cowan, F., Kimani, J., et al., 2025, "The Impact of the PEPFAR Funding Freeze on HIV Deaths and Infections: A Mathematical Modelling Study of Seven Countries in Sub-Saharan Africa," *eClinicalMedicine*, 83, p. 103233. <https://doi.org/10.1016/j.eclinm.2025.103233>
- [23]. Best, M., and Sakande, J., 2016, "Practical Recommendations for Strengthening National and Regional Laboratory Networks in Africa in the Global Health Security Era," *Afr. J. Lab. Med.*, 5(3), pp. 1–10. <https://doi.org/10.4102/ajlm.v5i3.471>
- [24]. Herzig van Wees, S., Betsi, E., and Sop Sop, M. D., 2021, "A Description and Explanation of the Complex Landscape of Faith-Based Organisations in Cameroon's Health Sector," *Dev. Pract.*, 31(3), pp. 356–367. <https://doi.org/10.1080/09614524.2020.1841737>
- [25]. van Wees, S. H., and Jennings, M., 2021, "The Challenges of Donor Engagement with Faith-Based Organizations in Cameroon's Health Sector: A Qualitative Study," *Health Policy Plan.*, 36(4), pp. 464–472. <https://doi.org/10.1093/heapol/czab006>

Policy Recommendations from The Gambia on Improving the Maternal Health System in Sub-Saharan Africa

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Abstract

The Gambia is ranked as one of the countries with the highest maternal death rate and the country has made great strides in improving maternal health through community-based interventions during the last ten years. The aim of this study is to assess policy recommendations from The Gambia on improving the maternal health system in sub-Saharan Africa. The specific objectives of this study were to; (i) determine the socio-demographic information of the respondents in the study area; (ii) determine policy and government interventions on maternal health; (iii) assess donor programs and interventions targeting on maternal health; (iv) determine external donor programs and interventions on maternal health; (v) determine representative of the community on maternal health. A retrospective quasi-experimental design with a well-structured questionnaire was used to obtain information from 217 participants across the major administrative regions of The Gambia, and the data were analysed using descriptive statistics. The results showed that the majority (64.8%) of respondents confirmed the existence of government policies to improve maternal health service quality, 52.9% were aware of interventions for maternal health in the study area, and UNICEF was the highest external donor (58.8%). Representatives of the community showed that 41.7% of the group of community representatives were community mobilizers/facilitators, the majority utilised services at hospitals (79.5%), and hospital-based service utilisation was primarily guided by the availability of good services and supplies (61.0%). Given that high maternal mortality rates persist in Sub-Saharan Africa, The Gambia's approach highlights the significance of inclusive, creative, and context-specific solutions.

Keywords: Africa, Demographic, Gambia, Health, Maternal, Policy.

Introduction

In sub-Saharan Africa, 4.7 million women, babies, and children die prematurely each year, with over 65% of maternal deaths occurring in the first 42 days after giving birth and the same percentage of neonatal deaths occurring in the first seven days [1]. Around 300,000 maternal deaths and 2.5 million neonatal deaths occurred in 2018, with over 94% of these deaths taking place in areas with poor resources, according to Konje [2]. More than a million newborns pass away on their first day of life every year [3],

with sub-Saharan Africa accounting for the majority of these deaths [4]. Problems during pregnancy and delivery also result in the deaths of 800 women and 7700 babies every day, while 7300 women report stillbirths during the postnatal period [5].

With a population of about 2.4 million [6], The Gambia is a small West African country that poses particular difficulties for the provision of maternity healthcare [7]. The nation is roughly 400 km inland and lies on the West African coast between latitudes 130 and 140 north of the equator [8]. Its land area is

10,689 square kilometres, and its width ranges from 24 to 28 km [9]. The Republic of Senegal borders it on the north, south, and east, while the Atlantic Ocean borders it on the west [10]. With women of reproductive age (15–49 years) making up roughly 23% of the population, the demographic profile of the nation reveals a youthful population with high fertility rates. Maternal health care is under significant strain due to this demographic structure [11]. Developing countries like The Gambia can improve their Maternal Mortality Rate (MMR) by investing in supportive environments, enacting laws and policies that facilitate it, expanding the delivery of trained personnel in rural and neglected areas, and removing or reducing financial constraints [12]. The Gambia is ranked 13th with the highest maternal death rate, 597/100,000 as of 2017 [13]. According to estimates from the World Health Organisation (WHO), there were around 430 maternal fatalities for every 100,000 live births in 2017, which is a high rate in the past [14]. This figure highlights the pressing need for effective measures.

The Gambia has made great strides in improving maternal health through community-based interventions during the last ten years, as evidenced by its Demographic Health Surveys [15]. In the areas of nutrition, health, and population, the nationally representative Demographic and Health Surveys (DHS) are household surveys that provide data on a range of monitoring and evaluation indicators. Geographical differences, cultural beliefs, and funding limitations are potential obstacles to maternal healthcare [16]. With a GDP per capital of about \$772 USD, The Gambia is still among the least developed nations in the world [17]. The allocation of resources for maternal health services and healthcare infrastructure are greatly impacted by this financial limitation. Approximately 94% of the economically active population in the nation is employed, while the total age-dependency ratio is 0.85:1 and the percentage of economically engaged people

without a formal education is somewhat greater for men (51.1%) than for women (48.9%), with over half (56.1%) lacking any formal education [18]. In The Gambia, traditional beliefs also have a big impact on how mothers seek medical attention. Strong cultural customs around delivery are still practised in many communities, such as the desire for home births and traditional birth attendants [19]. Religious and cultural views that consider delivery to be a natural process requiring little medical intervention are frequently the basis of these practices. Aglobitse [20] discovered that male/female enrolment in Ghana's public health insurance is influenced by intra-household dynamics.

Many interventions have been implemented to improve maternal health outcomes in sub-Saharan Africa (SSA). Currently, however, systematic information on the effectiveness of these interventions remains scarce. This study aims to analyze the trends in key maternal health indicators in The Gambia, compare changes between the 2013 and 2019/2020 survey periods to assess the association between community-based intervention coverage metrics and maternal health outcomes in various Gambia regions, assess maternal health policies in Gambia, evaluate policy effectiveness and analyse the relationship between particular KPIs and rates of maternal health service use in The Gambia's various administrative regions.

The aim of this study is to assess policy recommendations from The Gambia on improving maternal health system in sub-Saharan Africa. The specific objectives of this study were to; (i) determine the socio-demographic information of the respondents in the study area; (ii) determine policy and government interventions on maternal health in the study area; (iii) determine donor programs and interventions targeting on maternal health in the study area; (iv) determine external donor programs and interventions on maternal health;

(v) determine representative of the community on maternal health in the study area.

Methods

Research Design and Site Description:

This study evaluated community-based health interventions for maternal health in The Gambia using a retrospective quasi-experimental design and secondary data analysis. Structured and detailed questionnaires and hospital interviews were used to give qualitative insights. The 7 administrative regions in The Gambia which include Brikama, Kerewan, Mansakonko, Banjul, Janjanbureh, Kuntaur and Basse, were used for this study.

Sample Size: The population size for this study was 217 participants.

Distribution Strategy: Stratifying the participants, approximately 31 participants per each region were considered for the study.

Data Collection: Data were extracted from well-structured questionnaires to provide quantitative insights into the effectiveness of community-based maternal healthcare interventions, using three KPIs based on the opinions of maternal healthcare service workers, and a comparison was drawn. The data was then categorised and manually recorded into a standardised Excel spreadsheet, with separate sheets for each administrative region.

Data Analysis: Data on the effectiveness of the community-based maternal healthcare interventions were analysed using descriptive statistics. Values obtained were then compared for the reports. Appropriate statistical tools such as SPSS and Excel were used to filter the data.

Inclusion and Exclusion Criteria

Inclusion: Only maternal healthcare workers who were present within this period of study were considered. All questionnaires submitted contained information on effectiveness of the community-based maternal

healthcare interventions using the three KPIs from the opinion of maternal healthcare service workers across all administrative regions of The Gambia.

Exclusion: Maternal healthcare workers who were not present within this period of study were not considered.

Results

Socio-Demographic Information of the Study Respondents

Socio-demographic information of the respondents in the study area is presented in Table 1. There were 206 responders in the survey, and the majority were men (57.8%) as opposed to women (42.2%). Ages 25–29 accounted for 38.6% of the total, followed by 30–34 (25.2%) and 20–24 (12.9%). Of the respondents, 87.9% had a tertiary education, 10.6% had a secondary education, and 1.4% had a vocational training. Of those who were married, 48.5% were single, 40.7% were monogamous, 8.3% were polygamous, 1.5% were split or divorced, and 1.0% were widowed. At 62.0%, nurses and midwives were the most common professional group. Public health officials came in second at 19.5%, followed by other categories at 9.3%, heads of facilities at 4.9%, and physicians at 4.4%. At 32.2%, the Western Coast Region (WCR) was the most geographically represented, followed by the Kanifing Municipal Council (KMC) at 18.3%, the Lower River Region (LRR) at 16.3%, Banjul at 11.1%, the North Bank Region (NBR) at 8.7%, and at 6.7% each, the Central River Region (CRR) and Upper River Region (URR). The Ministry of Health accounted for 92.1% of the total respondents, with 5.0% working for other organizations, 1.5% with CSOs, 1.0% with development partners, and 0.5% with the Ministry of Gender.

Table 1. Socio-Demographic Profile of Respondents

Demographic Information	Frequency (n)	Percent (%)
Sex		
Male	119	57.8
Female	87	42.2
Age		
15-19 years	1	0.5
20-24 years	27	12.9
25-29 years	81	38.6
30-34 years	53	25.2
35-39 years	23	11.0
40-44 years	7	3.3
45-49 years	9	4.3
50+	9	4.3
Highest level of education		
Secondary Education	22	10.6
Tertiary education (college/university)	182	87.9
Vocational Training	3	1.4
Marital Status		
Divorced/ Separated	3	1.5
Married (monogamous)	83	40.7
Married (polygamous)	17	8.3
Single	99	48.5
Widowed	2	1.0
Current level in the Health Facility		
Doctor	9	4.4
Head of the facility	10	4.9
Nurse/ Midwives	127	62.0
Other	19	9.3
Public Health Officer	40	19.5
Region of Assignment		
Banjul	23	11.1
CRR	14	6.7
KMC	38	18.3
LRR	34	16.3
NBR	18	8.7

URR	14	6.7
WCR	67	32.2
Institution of Assignment		
CSO	3	1.5
Development Partners	2	1.0
Ministry of Gender	1	0.5
Ministry of Health	186	92.1
Other	10	5.0

Policy and Government Interventions

Table 2 shows the government policies on improving maternal health service quality and 64.8% of respondents reported such policies, while 29.6% were unsure and 5.6% reported no such policies. Awareness of programs targeting midwives' deployment in rural health facilities was reported by 44.3%, while 29.5% were unsure and 26.1% were unaware. The most monitored KPI was family planning uptake at 64.3%, followed by ANC coverage at 62.5%, skilled birth attendance at 58.9%, and postnatal care coverage at 57.7%. Programs targeting

increased Human Resources for Health were known to 42.9% of respondents, while 40.0% were unsure and 17.1% reported no such programs. Government programs promoting facility-based delivery were reported by 62.0%, while 25.7% were unsure and 12.3% reported no such programs. On supply availability, 63.4% reported that supplies, commodities, and medicines were never available, 12.6% each reported always available or didn't know, 5.1% each reported usually available or rarely available, and 1.1% reported sometimes available.

Table 2. Policy and Government Interventions

Questions	Frequency (n)	Percent (%)
Is there any government policy on improving the quality of service for maternal health in your area?		
Yes	116	64.8
No	10	5.6
I don't know	53	29.6
Are you aware of any programs that target midwives' deployment to health facilities in rural communities?		
Yes	78	44.3
No	46	26.1
I don't know	52	29.5
Which KPI were monitored in your program?		
ANC Coverage	110	62.5
Skilled Birth Attendance	103	58.9
Postnatal Care Coverage	102	57.7
Family Planning uptake	118	64.3
Is there any program targeting the increase in Human Resources for Health in your region?		
Yes	75	42.9

No	30	17.1
I don't know	70	40.0
Is there any government program, policy, intervention or incentive promoting facility-based delivery in your community?		
Yes	106	62.0
No	21	12.3
I don't know	44	25.7
Is there consistent availability of supplies, commodities and medicines for maternal health services and delivery at your local health facility?		
Always available	22	12.6
Usually available	9	5.1
Sometimes available	2	1.1
Rarely available	9	5.1
Never available	111	63.4
I don't know	22	12.6

Donor Programs and CSOs Intervention

Table 3 reveals donor programs and CSOs' interventions. Awareness of donor programs targeting maternal health improvement was reported by 52.9% of respondents, with an equal proportion (52.9%) unsure and 16.7% reporting no such programs. Capacity building for midwives or health professionals was reported by 65.3%, while 21.8% were unsure and 12.9% reported no such programs. Benefits

from donor-funded maternal health projects between 2010 and 2020 were uncertain for 48.5% of respondents, while 29.9% reported benefits and 21.6% reported no benefits. On the effectiveness of donor and CSO interventions, 50.9% rated them as somewhat effective, 22.8% were unsure, 18.1% considered them very effective, 4.1% rated them as neither effective nor ineffective, 2.3% found them somewhat ineffective, and 1.8% considered them very ineffective.

Table 3. Donor Programs and CSOs Intervention

Questions	Frequency (n)	Percent (%)
Are there specific donor programs or interventions targeting improving maternal health outcomes in your community?		
Yes	92	52.9
No	29	16..7
I don't know	92	52.9
Is there any specific capacity building for midwives or health professionals in improving skilled-based attendance in your area?		
Yes	111	65.3
No	22	12.9
I don't know	37	21.8
Have you or anyone in your community benefited from any donor-funded maternal health projects between 2010-2020?		
Yes	81	29.9
No	36	21.6
I don't know	50	48.5

In your opinion, how effective have donor and CSO interventions been in improving maternal health services in your community between 2010-2020?		
Very Effective	31	18.1
Somewhat Effective	87	50.9
Neither Effective nor Ineffective	7	4.1
Somewhat ineffective	4	2.3
Very Ineffective	3	1.8
I don't know	39	22.8

External Donor Programs or CSO Interventions for Maternal Health

Figure 1 provided answers regarding external donor programs or CSO interventions for maternal health available in the respondents' community. As shown in the figure, awareness of external funding and civil society interventions varied significantly across organizations. UNICEF maternal and child health programs achieved the highest recognition at 58.8%, followed by WHO Safe

Motherhood Initiative at 56.5%. UNFPA maternal health programs showed moderate awareness at 47.1%, while World Bank-funded projects were recognized by 31.2% of respondents. Local NGO initiatives demonstrated limited community visibility at 18.2%, with international NGO projects even lower at 14.1%. The minimal "other" category (8.2%) suggests that major international organizations dominated the perceived landscape of external maternal health support.

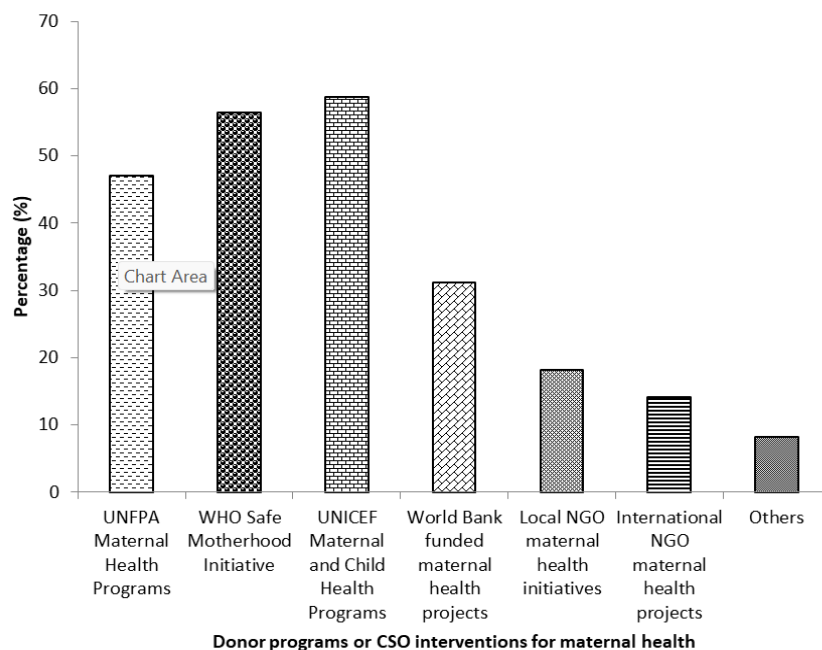


Figure 1. Which of the Following Donor Programs or CSO Interventions for Maternal Health are you Aware of in your community?

Representative of the Community

Respondents' opinions on representatives of the community are shown in Table 4. The largest group of community representatives

were categorized as "other" at 41.7%, followed by community mobilizers/facilitators at 39.3%, community leaders at 9.2%, beneficiaries (mothers) at 8.6%, and religious leaders at 1.2%. Distance from the nearest maternal

healthcare facility was 1-5 km for 43.5%, less than 1 km for 32.1%, 6-10 km for 16.1%, more than 20 km for 4.8%, and 11-20 km for 3.6%. Utilisation of maternal health services was reported by 81.7%, while 9.5% were unsure, and 8.9% reported no utilisation. The majority utilised services at hospitals (79.5%), followed by community-based services (15.2%), at home (1.2%), and 4.1% were not sure. Hospital-based

service utilization was primarily guided by availability of good services and supplies (61.0%), followed by community awareness programs on benefits (31.7%), complications from home delivery (28.7%), previous bad experience at home (21.3%), and non-availability of community-based services (14.0%).

Table 4. Representative of the Community

Questions	Frequency (n)	Percent (%)
What is your role in the Community?		
Beneficiaries (Mothers)	14	8.6
Community leaders	15	9.2
Community mobilizer/facilitator	64	39.3
Other	68	41.7
Religious Leaders	2	1.2
How far is your residence from the nearest health facility that provides maternal healthcare services?		
1 - 5 km	73	43.5
11 - 20 km	6	3.6
6 - 10 km	27	16.1
Less than 1 km	54	32.1
More than 20 km	8	4.8
Have you or someone in your community or household utilized maternal Health services before?		
Yes	138	81.7
No	15	8.9
I don't know	16	9.5
Where did you utilize Maternal Health services?		
At home	2	1.2
Hospital	136	79.5
In the Community	26	15.2
Not Sure	7	4.1
What guided the use of the Hospital Based services?		
Non-availability for community-based services	23	14.0
Availability of good services and supplies.	100	61.0
Previous bad experience at home	35	21.3
Complication from home delivery	47	28.7
Community awareness programme on benefit	52	31.7

Discussion

The respondent profile, which was primarily composed of highly educated males aged 25 to 34, is a good representation of the professional cohort in the Gambian health sector. Public health officers and nurses/midwives should be heavily represented, as they are leading the charge to put community-based maternal health programs into action. Their geographic distribution, which includes a substantial percentage of the Western Coast Region (WCR) and Kanifing Municipal Council (KMC), supports the idea that these are urbanized, heavily inhabited places with a concentration of health services and infrastructure. It is noteworthy that this data provides useful insight into how competent health cadres view systemic difficulties and achievements [21, 22].

Respondents demonstrated moderate awareness of government policies aimed at improving the quality of maternal health services and promoting facility-based delivery. Awareness of programs targeting Human Resources for Health (HRH) increases and midwife deployment in rural areas indicates ongoing efforts to strengthen the health workforce, a critical determinant of service access and quality [23]. The consistency in government-monitored KPIs (family planning uptake, ANC coverage, skilled birth attendance, postnatal care coverage) with those reported at the community level suggests a coherent national strategy for maternal health surveillance.

Also, the majority of respondents reported that supplies, commodities, and medicines were never available. These supply shortages represent a fundamental systemic failure that can negatively affect well-intentioned policies and trained personnel. According to Morrison [24], lack of essential supplies directly impacts service quality, reduces trust in the health system, and can force individuals to seek care elsewhere or delay it, directly affecting service utilization and outcomes.

One major piece of information from this study is the awareness of external funding and civil society interventions, which were dominated by major international organisations (such as UNICEF, WHO, and UNFPA, local NGO initiatives and international NGO projects, excluding the major UN agencies. This pattern suggests that while global partners are recognized for their contributions, there may be insufficient recognition or integration of smaller, perhaps more community-embedded, local organizations. Veress [25] documented that over-dependence on large, top-down initiatives without strong local ownership and visibility can limit sustainability and responsiveness to specific community needs.

Conclusion

In conclusion, The Gambia's policy recommendations provide a convincing framework for improving maternal health systems throughout Sub-Saharan Africa. These solutions tackle systemic gaps and cultural barriers by investing in experienced birth attendants, supporting health infrastructure, and prioritising community-based care. The focus on regional cooperation, fair resource distribution, and data-driven decision-making guarantees that interventions are scalable and long-lasting. Additionally, incorporating maternal health into more general public health and development agendas like education, nutrition, and gender equity can increase impact and promote long-term resilience. Given that high maternal mortality rates persist in Sub-Saharan Africa, The Gambia's approach highlights the significance of inclusive, creative, and context-specific solutions. With political will, sufficient funding, and cross-border collaboration, these recommendations can spark revolutionary change and guarantee that all women have access to safe, respectable, and high-quality maternal care. This comprehensive review of maternal health in The Gambia shows significant achievements alongside persistent challenges that

characterize maternal health systems across sub-Saharan Africa.

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Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

All authors contributed to the study conception and design.

Joy Michael is responsible for material preparation, data collection, analysis, and preparation of the first draft of the manuscript.

Dr Abiodun Olaiya Paul reviewed and commented on previous versions of the

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Ethical Approval

Ethical approval was not required for this study as it did not involve human participants or animals.

Data Availability

The data supporting the findings of this study are openly available in the Gambia Demographic and Health Survey 2010 and 2020. Also, a structured questionnaire was used to elicit information to corroborate the findings from the DHS. <chromeextension://efaidnbmninnibpcapjpcglclefndmkaj/https://dhsprogram.com/pubs/pdf/FR369/FR369.pdf>.

References

- [1]. Merdad, L., & Ali, M. M., 2018, Timing of maternal death: levels, trends, and ecological correlates using sibling data from 34 sub-Saharan African countries. *PloS one*, 13(1), e0189416.
- [2]. Konje, E., 2020, The Context of Maternal and Child Health Services in Northwest Tanzania: Missed Opportunities for Preventing Maternal and Perinatal Mortality in Rural Communities.
- [3]. Lincetto, O., & Banerjee, A., 2020, World Prematurity Day: improving survival and quality of life for millions of babies born preterm around the world. *American Journal of Physiology-Lung Cellular and Molecular Physiology*, 319(5), L871-L874.
- [4]. Lawn, J. E., Blencowe, H., Oza, S., You, D., Lee, A. C., Waiswa, P., & Cousens, S. N., 2014, Every Newborn: progress, priorities, and potential beyond survival. *The lancet*, 384(9938), 189-205.
- [5]. Onwuagbu, O. U., 2020, The Epidemiology of Stillbirths According to the Perinatal Problems Identification Program (PPIPP), at Rahima Moosa

Mother and Child Hospital, from August 2016 to July 2017 (Master's thesis, University of the Witwatersrand, Johannesburg (South Africa)).

- [6]. Stanislas, P., & Chongan, E., 2022, Communal Complexity Conflict and Security in Gambia. In *Understanding and Preventing Community Violence: Global Criminological and Sociological Perspectives* (pp. 205-217). Cham: Springer International Publishing.

- [7]. Cole-Cesay, R., Cherian, M., Sonko, A., Shivute, N., Cham, M., Davis, M., ... & Southall, D., 2010, Strengthening the emergency healthcare system for mothers and children in The Gambia. *Reproductive Health*, 7(1), 21.

- [8]. Johm, P. T., 2023, Understanding factors influencing maternal vaccination acceptance in The Gambia (Doctoral dissertation, London School of Hygiene & Tropical Medicine).

- [9]. Vieira, C., Portela, A., Miller, T., Coast, E., Leone, T., & Marston, C., 2012, Increasing the use of skilled health personnel where traditional birth

attendants were providers of childbirth care: a systematic review. *PLoS One*, 7(10), e47946.

[10]. Sundby, J., Ingstad, B., & Walraven, G., 2003, Maternal Mortality in the Gambia: Contributing factors and what can be done to reduce them (Doctoral dissertation, Department of General Practice and Community Medicine Faculty of Medicine, University of Oslo).

[11]. Kanteh, O., & Palamuleni, M. E., 2019, Women status and fertility in The Gambia. *Gender and Behaviour*, 17(3), 13627-13644.

[12]. Afferri, A., Dierickx, S., Bittaye, M., Marena, M., Pacey, A. A., & Balen, J., 2024, Policy action points and approaches to promote fertility care in The Gambia: Findings from a mixed-methods study. *Plos one*, 19(5), e0301700.

[13]. Kinteh, B., Barrow, A., Nget, M., Touray, E., Touray, J., Kinteh, S. L., ... & Jatta, S. P., 2022, Research Article Maternal and Child Health Services in Rural Settings of The Gambia: Contextual Determinants of Postnatal Care from Mothers' Perspectives—A Community-Based Analytical Cross-Sectional Study.

[14]. Babajide, O. O., 2021, Model-based sub-population estimates of maternal mortality rates and ratio from siblings' survivorship histories in Nigeria (2008-2018) (doctoral dissertation).

[15]. Sundby, J., 2014, A rollercoaster of policy shifts: global trends and reproductive health policy in The Gambia. *Global public health*, 9(8), 894-909.

[16]. Say, L., & Raine, R., 2007, A systematic review of inequalities in the use of maternal health care in developing countries: examining the scale of the problem and the importance of context. *Bulletin of the World Health Organization*, 85(10), 812-819.

[17]. Gautam, S., Suso, A., & Wood, E., 2024, Effect of antenatal care on birth outcomes in The Gambia: a propensity score matching analysis.

[18]. Kothari, M. T., Coile, A., Huestis, A., Pullum, T., Garrett, D., & Engmann, C., 2019, Exploring associations between water, sanitation, and anemia through 47 nationally representative demographic and health surveys. *Annals of the New York Academy of Sciences*, 1450(1), 249-267.

[19]. Lowe, M., Chen, D. R., & Huang, S. L., 2016, Social and cultural factors affecting maternal health in rural Gambia: an exploratory qualitative study. *PloS one*, 11(9), e0163653.

[20]. Aglobitse, D. M., 2012, Intra-Family Communication and Reproductive Health Decision Making in the Volta Region of Ghana (Doctoral dissertation, University of Ghana).

[21]. Gagnon, M. P., Desmartis, M., Labrecque, M., et al., 2012, Systematic Review of Factors Influencing the Adoption of Information and Communication Technologies by Healthcare Professionals. *J Med Syst*, 36, 241–277.

[22]. World Health Organization, 2022, WHO recommendations on maternal and newborn care for a positive postnatal experience. *World Health Organization*.

[23]. Lassi, Z. S., Musavi, N. B., Maliki, B., Mansoor, N., de Francisco, A., Toure, K., & Bhutta, Z. A., 2016, Systematic review on human resources for health interventions to improve maternal health outcomes: evidence from low-and middle-income countries. *Human resources for health*, 14(1), 10.

[24]. Morrison, B., 2015, The problem with workarounds is that they work: The persistence of resource shortages. *Journal of Operations Management*, 39, 79-91.

[25]. Veress, T. A., 2024, Community-Based Organizations and the Challenges of the Anthropocene (Doctoral dissertation, Budapesti Corvinus Egyetem).

Assessment of the Influence of Adolescent-Youth Friendly Health Services on HIV-related Quality of Life (AYLHIV) in Taraba State, Nigeria

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Abstract

Adolescents and youth living with HIV (AYLHIV) face unique challenges impacting their mental, emotional, and social well-being. In Nigeria, where youth-friendly healthcare services are evolving, the true influence of Adolescent and Youth-Friendly Health Services (AYFHS) on HIV-related quality of life (HRQoL) remains unclear. This study assessed the impact of AYFHS on the HRQoL of AYLHIV in Taraba State, Nigeria. Informed consent was obtained from all participants. A cross-sectional comparative study was conducted among 386 AYLHIV aged 10–24 years, comprising 193 AYFHS attendees and 193 non-attendees using a multistage sampling method. Data were collected via a structured, interviewer-administered questionnaire covering Anti-retro-viral therapy (ART) adherence, stigma, resilience, and overall quality of life. Analyses were performed using SPSS version 27, with *t*-tests and multiple regressions applied to determine group differences. Findings revealed that AYFHS attendees had significantly better ART adherence (78% vs. 62%), higher resilience (81% vs. 54%), and greater confidence in managing HIV in AYLHIV attendees. The AYLHIV attendees were also more hopeful about the future and less likely to feel ashamed of their status. Enhanced social support, peer-engagement, and provider friendliness were key contributing factors. Non-attendees reported greater emotional distress and lower treatment confidence. These results demonstrate that AYFHS attendees significantly improve HIV-related quality of life among adolescents. In conclusion, expanding youth-friendly models maybe essential for improving treatment outcomes and addressing psycho-social needs, contributing to Nigeria's progress toward achieving UNAIDS 95-95-95 goals.

Keywords: Adolescents, ART Adherence, HIV, Mental Health, Quality of Life, Youth-Friendly Health Services.

Introduction

Human Immunodeficiency Virus (HIV) infection remains a chronic communicable disease of significant global public health concern [1]. While early HIV responses emphasised adult treatment and prevention of vertical transmission, the specific needs of adolescents and young people living with HIV (AYLHIV) have received comparatively less attention [2]. This age group experiences heightened vulnerability, rapid disease progression, and poor clinical outcomes, including reduced ART adherence, increased stigma, and poor retention in care [3, 4]. Addressing this gap requires targeted approaches that consider their distinct social, emotional, and developmental needs.

One of the most promising involvements is the Adolescent and Youth-Friendly Health Services (AYFHS) mock-up, which many nations, including resource-constrained countries like Nigeria, have chosen to provide comprehensive, accessible, and non-judgmental HIV services. AYFHS focuses on building trust, offering psychosocial support, and tailoring health communication for youth populations [5]. Evidence from global and African contexts demonstrates that AYFHS significantly improves ART adherence, reduces emotional distress, and enhances quality of life among AYLHIV [6, 7]. Thus, AYFHS is considered one of the most effective strategies for improving care and outcomes among HIV-positive adolescents and youth.

In the face of the recognised benefits of AYFHS, several limitations hinder its full practice. Many young people still face stigma, poverty, low access to education, and health system weaknesses that prevent them from actualizing available services effectively [8]. The disparity in HIV treatment is glaringly 52% of HIV-infected children globally receive treatment, compared to 76% of infected adults [9]. These gradients persist across the entire care continuum, from diagnosis to retention,

and are particularly pronounced in underserved regions like North-East Nigeria.

Be that as it may, progress is evident. The Paediatric Breakthrough Partnership (PBP) project, funded by ViiV Healthcare Positive Action, brought partners together across their respective fields of expertise to implement paediatric and adolescent projects in Nigeria and four other African countries: Uganda, Mozambique, Tanzania, and Cameroon. The partners involved in this implementation are Aidsfonds, Elizabeth Glaser Paediatric AIDS Foundation (EGPAF), Paediatric-Adolescent Treatment Africa (PATA), and UNICEF, with Society for Family Health (SFH) as Aidsfonds' implementer in Nigeria. The project implementation is in Taraba and Rivers States in Nigeria, with one of its objectives to expand youth-friendly care access that will promote access to health care, which will improve health outcomes for adolescents living with HIV. These initiatives have contributed to increased ART adherence and engagement in care among AYLHIV, particularly among those enrolled in peer-led support models such as OTZ (Operation Triple Zero). These efforts reflect a growing commitment to improving the physical, mental, and social well-being of this liable group.

This study, therefore, aims to assess the influence of Adolescent and Youth-Friendly Health Services on the health-related quality of life of adolescents and young people living with HIV in Taraba State, Nigeria. Specifically, it evaluates and compares mental health and emotional well-being, healthy lifestyle choices, including physical activity and nutrition and social relationships between AYFHS users and non-users.

This study thoroughly focuses on health-related quality of life as an effect scrutinizing how structured AYFHS programs affect various dimensions of life quality among HIV positive adolescents and young adults. Additionally, focuses on low resource, high burden state like Taraba, Nigeria.

Materials and Methods

Description of the Study Area

Taraba State is an Island state in the Northeast Geopolitical Zone of Nigeria. The State lies on Latitude: 8.0° N - 10.0° N and longitude 9.0° E - 12.0° E. It covers an area of approximately 54,473 square kilometres, making it one of Nigeria's largest states. The state shares edge with Bauchi State to the north, Gombe State to the northeast, Adamawa State to the east, and Benue and Nasarawa states to the west. Taraba State is divided into three senatorial districts which covers 16 Local Government Areas, namely, Ardo Kola, Bali, Donga, Gashaka, Gassol, Ibi, Jalingo, Karim Lamido, Kurmi, Lau, Sardauna, Takum, Ussa, Wukari, Yorro and Zing. The study population were drawn from five LGAs; Wukari, Jalingo, Kurmi, Sardauna, Gashaka. According to the 2006 census in Nigeria, Taraba State had a population of 2,294,800 million people. The estimated population of the State was 3,609,800 [10]. The population comprised 51.1% male and 48.9% female. The people are largely farmers, traders and civil servants. Taraba State has the 4th largest population of people living with HIV in Nigeria, with a frequency rate of 2.7% [11].

Study Design

This study employed a comparative cross-sectional design to assess differences in health-related quality of life (HRQoL) among adolescents and young people living with HIV (AYLHIV) based on their use of Adolescent and Youth-Friendly Health Services (AYFHS). Data was collected at a single point to compare AYFHS attendees and non-attendees. A multistage sampling method was employed to select participants from AYFHS and non-AYFHS facilities across Taraba State. Quantitative data were gathered using a structured, interviewer-administered questionnaire AYLHIVQOLQ covering ART

adherence, mental and emotional well-being, lifestyle, and social relationships.

This study employed also used a qualitative approach, utilizing purposive sampling to select participants for in-depth interviews (IDIs) and focus group discussions (FGDs). A total of six participants were selected for the IDIs, while 14 participants were divided into two FGD groups, each consisting of seven participants. Semi-structured interview guides were used to facilitate both the IDIs and FGDs, allowing for in-depth exploration of the research topic.

The interviews were conducted in a private setting to ensure participant comfort and confidentiality. All interviews were audio-recorded and subsequently transcribed verbatim to ensure accuracy. Thematic coding was employed to identify themes and patterns in the data, enabling the researcher to draw meaningful conclusions.

To ensure the consistency and validity of the findings, data triangulation was conducted, combining insights from both the IDIs and FGDs. This approach allowed for a comprehensive understanding of the research topic, enhancing the reliability and credibility of the study's findings. In-depth interviews (IDI) were conducted to triangulate the quantitative analysis, providing qualitative data insights. The tool underwent expert validation and pilot testing.

Population of the Study

The study inhabitants consisted of all adolescents and young adults between the ages of 10 and 24 living with HIV in Taraba State. According to available data as at September 2024, by Data for Implementation (Data.FI) [12], a global initiative that support countries in strengthening their health information systems, stated that Taraba State, Nigeria has an estimated 2,598 adolescents living with HIV aged 10-24 who are aware of their status and on ART in Paediatrics Breakthrough Partnership supported facilities whether attending Adolescent and young people health friendly

services or not. Out of these numbers, 4 years of age, 157 females and 149 males, children aged 5 to 9 were (271 females and 321 males), 393 females and 424 males were between the ages of 10 and 14 years, and those aged 15 to 19 were (539 females and 344 males).

Inclusion Criteria

The inclusion criteria for this study prioritise adolescents and young people aged 10 to 24 years who had been diagnosed with HIV and were currently receiving antiretroviral therapy (ART). Participants were eligible if they were aware of their HIV-positive status and were receiving care either at Adolescent-Youth Friendly Health Services (AYFHS) facilities or non-AYFHS facilities within Taraba State, North-East Nigeria. Informed consent or assent was required from all participants or their caregivers, ensuring ethical compliance and voluntary involvement.

Exclusion Criteria

Subjects were excluded from the study if they did not fall within the specified age range of 10 to 24 years, had not been diagnosed with HIV, or were unaware of their HIV status. Those who were not on ART at the time of data collection or who declined to provide consent or assent were also excluded. These criteria were carefully designed to ensure the study population was representative of adolescents and young people living with HIV, thereby allowing for a precise assessment of the perceived quality of life among those attending AYFHS compared to their counterparts in non-AYFHS settings.

Sample Size Determination

The sample size was determined using the two-sample proportion comparison formula, which is applicable to comparing independent groups. Proportions were derived from Ulunta sampling formula [13], which showed that 92% of adolescents in OTZ Clubs achieved viral suppression, while we postulate that this proportion will be at least 10 percentage points

smaller for those not in such support groups. Using the same size for comparing proportions as follows.

$$N \text{ per group} = \frac{2 \times (Z_{\alpha} + Z_{\beta})^2 \times p(1 - p)}{(p_1 - p_2)^2}$$

Assuming a 95% confidence level and power of 80%, the sample size calculation per group is,

$$N \text{ per group} = \frac{2 \times (1.96 + 0.84)^2 \times 0.87(1.0.87)}{(0.92 - 0.82)^2}$$

This gives a sample size of per group of 174, 192 per group after adding 10% non-response, and a total sample size of 386 for the two groups.

Sampling Techniques

A multistage sampling technique was employed in this study. The population was categorized into two groups: AYPLHIV attending Adolescent and Youth-Friendly Health Services (AYFHS) in PBP-supported facilities, and those not attending AYFHS in non-PBP-supported facilities. Simple random sampling was used to select six facilities from each group. Within each facility, systematic random sampling was applied to select 193 participants per group. The first participant was chosen through balloting, and subsequent participants were selected at every *n*th interval. If a selected individual declined, the next available willing participant was included. Qualitative data were collected using semi structured interview and FGD guides. One-on-one interviews and FGDs explored participants' experiences and perceptions. FGDs were moderated by the researcher, with a research assistant as a note taker. Observation techniques were also used to assess the facility environment and staff-client interactions. All interviews and FGDs were audio recorded and transcribed verbatim. Data was analyzed using thematic analysis to identify recurring patterns and themes, providing deeper insight into the

quality of life and service experiences of AYPLHIV.

Data Collection

The data compilation techniques for quantitative data were the questionnaire titled “Adolescent-Youth Living with HIV Quality of Life Questionnaire” (AYLHIVQOLQ). The questionnaire contained both open and closed-ended questions in line with the objectives of the study. The questionnaire information was labelled A-F. Section “A”, termed socio-demographic characteristics, had 12 items, including AYA gender, age, education level, marital status, occupation, parental education, duration of HIV diagnosis, Household income, etc. Section “B, C D, E, and F” all had 10 items each bothering on specific research objectives and other meaningful issues relevant to the study.

Data Analysis

Quantitative data were predetermined during pilot testing for consistency and transformed into numeric codes for analysis. Descriptive statistics (frequencies and percentages) summarized demographic variables such as age, gender, and AYPHS attendance. Inferential statistics, including independent t-tests and regression analysis, examined relationships and group differences, using a 0.05 alpha level. All analyses were conducted using SPSS version 27, with results presented through tables and charts. Qualitative data from in-depth interviews and focus group discussions were transcribed verbatim. Thematic and content analyses were applied to identify recurring patterns and meaningful themes. Observational data were reviewed through field notes, focusing on physical settings and provider-client engagement.

Results

Table 1 provides a comprehensive outline of the characteristics of the study population. The gender distribution of the respondents indicates a slightly higher proportion of females (60%) compared to males (40%). This disparity reflects the general trend of females being more likely to access healthcare services, particularly in the context of HIV/AIDS. The age distribution of the respondents shows a relatively even spread across the adolescent and young adult age groups, with 25% in the 10-14 age range, 39% in the 15-19 age range, and 36% in the 20-24 age range. This distribution highlights the importance of tailoring healthcare services to meet the unique needs of different age groups within the adolescent and young adult population. The respondents' educational levels varied, with 23% having completed primary education, 41% having completed secondary education, and 18% having completed tertiary education. A small proportion (17%) of respondents had no formal education. This distribution highlights the need for healthcare services to be accessible and understandable to individuals with varying levels of education. The respondents' occupations were diverse, with 26% engaged in trading, 34% working as artisans, and 40% students. This distribution reflects the economic realities of many young people in the study population, with many engaged in informal sector activities or still in school. The living arrangements of the respondents showed that 41% lived with their biological parents, 29% lived with relatives, and 30% lived with others. This distribution highlights the importance of considering the social support networks of adolescents and young adults living with HIV.

Table 1. Socio-Demographic Information of Respondents

Items	Variables	Frequency	Percentage (%)
Gender	Male	155	40
	Female	231	60
Age	10-14 years	97	25
	15-19 years	152	39
	20-24	137	36
Educational Level	Primary	89	23
	Secondary	157	41
	Tertiary	76	18
	None	16	17
AYA Occupation	Trading	102	26
	Artisan	130	34
	Student	154	40
Who do you live with	Biological Parent	157	41
	Relatives	112	29
	Others	117	30
How long have you been on ART?	1-5 years	176	46
	6-10 years	167	43
	11 years & above	43	11

The interval of antiretroviral therapy (ART) among respondents varied, with 46% having been on treatment for 1-5 years, 43% for 6-10 years, and 11% for 11 years or more. This distribution highlights the need for ongoing support and care for individuals living with HIV, particularly as they transition from pediatric to adult care.

Table 2 presents a comparison of mental health and emotional well-being outcomes between adolescents and young adults (AYAs) attending Adolescent and Young Adults Health Friendly Services (AYFHS) and a comparison group. The findings suggest that AYAs attending AYFHS tend to have better mental health and emotional well-being outcomes compared to those not attending AYFHS.

In terms of internalised stigma, AYAs attending AYFHS reported lower levels of shame associated with their HIV status. Specifically, 57% of AYAs attending AYFHS strongly disagreed with feeling ashamed, compared to 8% in the comparison group. This suggests that AYFHS may play a role in

reducing internalised stigma among AYAs living with HIV.

The findings also indicate that AYA attending AYFHS demonstrated higher levels of resilience and coping. For instance, 75% of AYA attending AYFHS agreed or strongly agreed that they can handle emotional challenges, compared to 38% in the comparison group. This suggests that AYFHS may be effective in promoting resilience and coping skills among AYAs living with HIV.

Furthermore, AYAs attending AYFHS reported higher levels of hope for their future, with 95% agreeing or strongly agreeing that they are hopeful despite living with HIV, compared to 60% in the comparison group. This finding highlights the potential of AYFHS to promote a positive outlook and hope for the future among AYA living with HIV.

In addition, AYAs attending AYFHS demonstrated higher levels of confidence in managing their HIV treatment, with 98% agreeing or strongly agreeing that they are confident, compared to 57% in the comparison

group. This suggests that AYFHS may be effective in promoting self-efficacy and treatment adherence among AYA living with HIV.

Table 2. Frequency Table of Mental Health and Emotional Well-being Among Adolescents and Young Adults Attending AYFHS and the Comparison Group in Taraba

Items	Variables	Percentage (%) among AYAs attending AYFHS (N=193)	Percentage (%) among AYAs attending AYFHS (N=193)
Internalized stigma			
I have often felt ashamed of my HIV status	Strongly disagree	57	8
	Disagree	31	14
	Neutral	5	10
	Agree	5	23
	Strongly agree	2	45
Resilience and coping			
I am able to handle the emotional challenges of living with HIV	Strongly disagree	5	7
	Disagree	20	40
	Neutral	0	15
	Agree	45	22
	Strongly agree	30	16
Hope and optimism			
I am hopeful about my future despite living with HIV	Strongly disagree	0	26
	Disagree	5	8
	Neutral	0	6
	Agree	28	17
	Strongly agree	67	43
Self-Efficacy			
I am confident in my ability to manage my HIV treatment	Strongly disagree	0	5
	Disagree	0	25
	Neutral	2	13
	Agree	72	24
	Strongly agree	26	33

In one of the interviewees' opinions:

Managing one's HIV requires eating a balanced diet, adherence to ART, and maintaining physical, emotional and spiritual health. This is because HIV viral load is largely affected by one's state of mind, behavioural disposition and diet.

Another interviewee (Civil Servant), who happened to be a caregiver to one of the adolescents on treatment, said:

I encourage my child not to miss AYFHS and to always take her medication as prescribed. Attending AYHFS has made me have a better perspective of life.

Figure 1 highlights the importance of Adolescent and Young People Health Friendly Services (AYFHS) in promoting healthy lifestyles and habits among Adolescents and Youth Living with HIV (AYLHIV). The significantly higher adherence percentage (96%) among AYLHIV attending AYFHS

compared to the comparison group (74%) underscores the effectiveness of AYFHS in supporting treatment adherence. This finding is consistent with previous research highlighting the importance of comprehensive care models in improving treatment outcomes among people living with HIV [14]. The AYFHS model may be providing tailored support, education, and counseling that enables AYLHIV to better manage their condition and adhere to treatment regimens. The slightly higher adherence percentage to balanced diet habits among AYLHIV attending AYFHS (80%) compared to the comparison group (78%) suggests that AYFHS may be having a positive impact on nutrition-related behaviors. However, the

difference is not substantial and both groups still have room for improvement. Nutrition counseling and education are essential components of comprehensive care for people living with HIV and AYFHS may need to strengthen these aspects to have a more significant impact [15]. The similarity in physical exercise habits between the two groups (70%) suggests that AYFHS may not be having a significant impact on this aspect of healthy lifestyle. Physical activity is essential for overall health and well-being, particularly for people living with HIV [16]. AYFHS may need to prioritize physical activity promotion and provide accessible exercise programs tailored to the needs of AYLHIV.

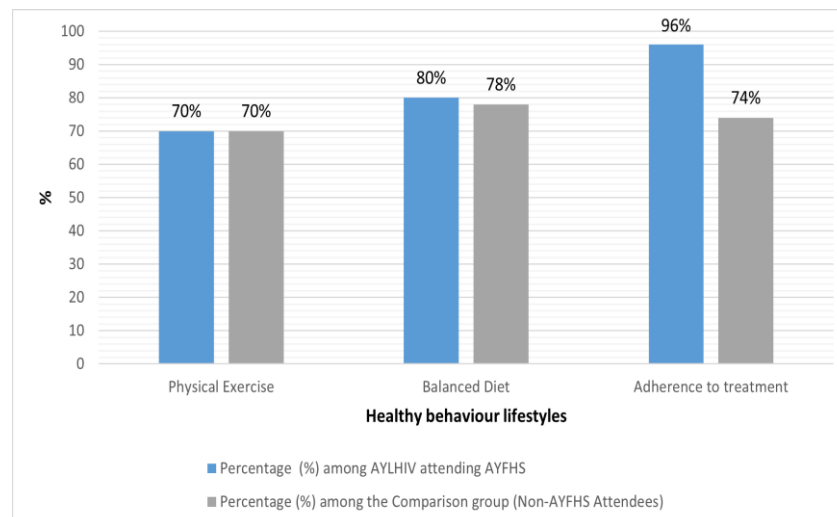


Figure 1. Adherence to Healthy Behavior and Lifestyle among Adolescent and Young Adult Attending AYFHS and the Comparison Group in Taraba State, Nigeria

Another respondent (male, 17years) narrated that:

We are 10 in the family, and we hardly ate balanced diet coupled with the current economy in Nigeria. This affected my ART adherence, and viral load. But through the AYFHS I have learnt how to make balanced meal from locally available recipe. This has helped improved my physical health.

According to another respondent (male), he said that:

I don't attend the AYFHS support group, but I learnt the importance of physical exercise to reduce stress and fatigue during

clinic appointment. I can say that I have seen massive improvement in my health ever since.

Table 3 The table presents findings on social support and adherence among adolescents and young adults living with HIV (AYALHIV) attending Adolescent and Young Adults Health Friendly Services (AYFHS) and a comparison group. The results highlight the importance of social support in medication adherence, with both groups relying heavily on family members to remember their medication. Specifically, 55% of AYFHS attendees and 56% of the

comparison group cited family support as a key factor.

In addition to family support, both groups also utilize mobile apps and reminders to aid adherence, with 33% of AYFHS attendees and 34% of the comparison group using these tools. Notably, all AYFHS attendees reported receiving counseling or support to help them adhere to their treatment, compared to 85% of the comparison group. Furthermore, AYFHS attendees reported higher satisfaction with the counseling and support they received, with 93% finding it "very helpful" compared to 89% of the comparison group.

The findings also suggest that AYFHS attendees may be less likely to experience adherence challenges, with 13% requiring enhanced adherence counseling compared to 19% of the comparison group. Overall, the results highlight the importance of comprehensive support services, including counseling and family involvement, in promoting treatment adherence and overall well-being among AYALHIV.

The implications of these findings are significant, suggesting that tailored interventions that address adherence challenges and promote social support can have a positive impact on outcomes among AYALHIV.

Table 3. Social Relationship Among AYALHIV Adolescent Who Attend AYFHS and the Comparison Group in Taraba

Items	Variables	Percentage (%) among AYA attending AYFHS (N=193)	Percentage (%) among AYA attending AYFHS (N=193)
Social support and adherence			
Who helps you remember to take your medication?	Family member	55	56
	Friend	2	0
	Healthcare provider	2	0
	Mobile app or reminder	33	34
	Other (please specify)	8	10
Counselling and support			
Have you ever received counseling or support to help you adhere to your treatment?	Yes	100	85
	No	0	15
Effectiveness of support			
If yes, how helpful was this support	Very helpful	93	89
	Not very helpful	3	11
	Not at all helpful	0	0
Adherence challenges			
Have you ever been placed on enhanced adherence counselling due to poor adherence to your treatment plan?	Yes	13	19
	No	87	81

A comparison of the findings between the two groups reveals that while family members are a crucial source of support for both groups, AYFHS attendees are more likely to use mobile apps and alarm clocks as reminders and find the support they receive to be more helpful. Non-attendees, on the other hand, are more likely to rely on prayer time & meals as reminders.

In an interview with a female interviewee receiving treatment at Zing General Hospital, she said:

I wasn't born with HIV but contracted it due to a careless lifestyle. At first, I was so depressed and felt like committing suicide but with the encouragement of my parent especially my father, I now have suppressed viral load adhering to my ART regimen. and I have been seeing improvement.

Hypothesis Testing: Inferential Statistics

Table 4 The table presents the results of a linear regression analysis examining the relationship between attendance at Adolescent and Young Adults Health Friendly Services (AYFHS) and mental health and emotional well-being among adolescents and young adults in Taraba State, Nigeria. The results indicate a

significant positive relationship between AYFHS attendance and mental health and emotional well-being ($B = 2.51$, $SE = 0.67$, $\beta = 0.35$, $t = 3.98$, $p < .001$). The 95% confidence interval (1.20, 3.82) suggests that the true effect size is likely to be between 1.20 and 3.82. In contrast, the results also indicate a significant positive relationship between non-AYFHS attendance and mental health and emotional well-being ($B = 1.82$, $SE = 0.41$, $\beta = 0.29$, $t = 3.56$, $p < .001$). However, the effect size is smaller compared to AYFHS attendance. The 95% confidence interval (1.02, 2.62) suggests that the true effect size is likely to be between 1.02 and 2.62. The coefficient of determination (R^2) values for AYFHS attendance and non-AYFHS attendance are 0.26 and 0.33, respectively. This indicates that approximately 26% and 33% of the variance in mental health and emotional well-being can be explained by the predictors in the model. The F-statistics (15.81 and 12.69) further support the significance of the models. Overall, the findings suggest that attending AYFHS is associated with better mental health and emotional well-being outcomes among adolescents and young adults.

Table 4. Linear Regression Analysis of Mental Health and Emotional Well-being Among Adolescent and Young Adult Attending AYFHS and the Comparison Group in Taraba State, Nigeria

Predictor	B	SE	β	t	P	R ²	F	CI
AYFHS Attendance	2.51	0.67	0.35	3.98	< .001	0.26	15.81	95%(1.20, 3.82)
Non-AYFHS Attendance	1.82	0.41	0.29	3.56	< .001	0.33	12.69	95%(1.02, 2.62)

$P < .001$, $df = 384$, $M = \text{mean}$, $SD = \text{Standard deviation}$, R^2 : coefficient of determination. $\beta = \text{standardized regression coefficient}$, AYFHS Attendance: 0 = non-attendees, 1 = attendees, $N = 386$, $an = 193$, $bn = 193$

Table 5 The table presents the mean difference in adherence to healthy behavior and lifestyle between adolescents and young adults attending Adolescent and Young Adults Health Friendly Services (AYFHS) and those not attending AYFHS in Taraba State, Nigeria. The findings revealed significant differences in adherence to healthy behavior and lifestyle between the two groups. Specifically, AYFHS

attendees reported a higher mean score for healthy behavior ($M = 5.05$, $SD = 5.65$) compared to non-attendees ($M = 4.65$, $SD = 5.43$), with a statistically significant mean difference ($t(384) = 2.03$, $p = 0.005$). The Cohen's d value of 0.20 suggests a small effect size. Similarly, AYFHS attendees reported a higher mean score for Health-Related Quality of Life (HRQoL) ($M = 3.89$, $SD = 2.96$)

compared to non-attendees ($M = 3.07$, $SD = 1.70$), with a statistically significant mean difference ($t(384) = 2.09$, $p = 0.006$). The Cohen's d value of 0.28 suggests a small to

medium effect size. These findings suggest that AYFHS may be effective in promoting positive health outcomes among adolescents and young adults.

Table 5. Mean Difference of Adherence to Healthy Behaviour and Lifestyle Among Adolescent and Young Adult Attending AYFHS and the Comparison Group in Taraba State, Nigeria

	On AYHFS		Not on AYHFS					
Variable	M	SD	M	SD	t(384)	P	R	Cohen's d
Healthy behaviour	5.05	5.65	4.65	5.43	2.03	.005	0.32	0.20
HRQoL	3.89	2.96	3.07	1.70	2.09	.006	0.36	0.28

* $P < 0.05$, $df = 384$, $M = \text{mean}$, $SD = \text{Standard deviation}$, $R = \text{Beta coefficient}$, $N = 386$, $an = 193$, $bn = 193$

Table 6: The table presents the mean difference in social relationship and Health-Related Quality of Life (HRQoL) among Adolescents and Young Adults Living with HIV (AYALHIV) attending Adolescent and Young Adults Health Friendly Services (AYFHS) and those not attending AYFHS in Taraba. The results indicate a significant difference in social relationship between AYFHS attendees ($M = 14.05$, $SD = 7.05$) and non-attendees ($M = 11.48$, $SD = 5.47$), with a t -value of 6.53 and a p -value of $< .000$. The Cohen's d value of 0.56 suggests a moderate effect size, indicating that AYFHS attendees tend to have better social relationships compared to non-attendees. The Beta coefficient ($R = 0.622$) indicates a strong positive relationship between AYFHS attendance and social relationships. In contrast, the results for HRQoL indicate a significant difference between AYFHS attendees ($M = 22.07$, $SD = 10.83$) and non-attendees ($M = 13.50$, $SD = 5.96$), with a t -value of 5.09 and a

p -value of $< .000$. The Beta coefficient ($R = 0.56$) indicates a strong positive relationship between AYFHS attendance and HRQoL, suggesting that AYFHS attendance is associated with higher HRQoL scores. The Cohen's d value of 0.80 suggests a large effect size. The positive Beta coefficient for HRQoL ($R = 0.56$) suggests that as AYFHS attendance increases, HRQoL scores also tend to increase. This indicates that AYFHS attendance positively impacts HRQoL among AYALHIV. The strong positive relationship between AYFHS attendance and both social relationships and HRQoL suggests that AYFHS is an effective intervention for promoting the well-being of AYALHIV. Overall, the findings suggest that AYFHS attendees tend to have better social relationships and higher HRQoL scores compared to non-attendees. These results highlight the potential benefits of AYFHS attendance for AYALHIV, particularly in terms of social relationships and overall well-being.

Table 6. Mean Difference of Social Relationship Among AYALHIV Adolescent Who Attend AYFHS and the Comparison Group in Taraba

	Not-On AYHFS		On AYHFS					
Variable	M	SD	M	SD	t (384)	P	R	Cohen's d
Social relationship	14.05	7.05	11.48	5.47	6.53	.000	0.622	0.56
HRQoL	13.50	5.96	22.07	10.83	5.09	.000	0.56	0.80

* $P < 0.001$, $df = 384$, $M = \text{mean}$, $SD = \text{Standard deviation}$, $R = \text{Beta coefficient}$, $N = 386$, $an = 193$, $bn = 193$

Discussion

This study assesses and compares the mental health and emotional well-being of Adolescents and Young People Living with HIV (AYLHIV) who attend Adolescent and Youth-Friendly Health Services (AYFHS) with those who do not, in Taraba State, Nigeria. It also evaluates the extent to which AYLHIV adopt healthy lifestyle choices particularly regular physical exercise and balanced nutrition. Furthermore, the study explores the level of social relationships and support among AYFHS attendees versus their counterparts in the comparison group.

The study found a significant positive relationship between AYFHS attendance and mental health and emotional well-being ($B = 2.51$, $SE = 0.67$, $\beta = 0.35$, $t = 3.98$, $p < .001$), with a 95% confidence interval of 1.20 to 3.82. In contrast, non-AYFHS attendance also had a significant positive relationship with mental health and emotional well-being ($B = 1.82$, $SE = 0.41$, $\beta = 0.29$, $t = 3.56$, $p < .001$), with a 95% confidence interval of 1.02 to 2.62. The R-squared values indicate that 26% ($R^2 = 0.26$) and 33% ($R^2 = 0.33$) of the variance in mental health and emotional well-being can be explained by AYFHS attendance and non-AYFHS attendance, respectively. The F-statistics (15.81 and 12.69) support the significance of the models. Overall, attending AYFHS is associated with better mental health and emotional well-being outcomes. This finding is consistent with previous studies that have shown the benefits of specialized youth-friendly settings in reducing stigma and improving mental health outcomes among AYLHIV [17].

The study also found significant differences in adherence to healthy behavior and lifestyle among adolescents and young adults attending Adolescent Youth-Friendly Health Services (AYFHS) compared to non-attendees. AYFHS attendees had higher mean scores for healthy behavior ($M = 5.05$, $SD = 5.65$) compared to non-attendees ($M = 4.65$, $SD = 5.43$), with a

statistically significant mean difference ($t(384) = 2.03$, $p = 0.005$) and a small effect size (Cohen's $d = 0.20$). Additionally, AYFHS attendees reported higher mean scores for Health-Related Quality of Life (HRQoL) ($M = 3.89$, $SD = 2.96$) compared to non-attendees ($M = 3.07$, $SD = 1.70$), with a statistically significant mean difference ($t(384) = 2.09$, $p = 0.006$) and a small to medium effect size (Cohen's $d = 0.28$). The finding is in accordance with that of [18], who demonstrated that youth-friendly environments are associated with significantly improved promote physical exercise and balance diet essential for boosting the immune system, the management of HIV and the overall well-being of the adolescent. Furthermore, [19], postulated that the integration of peer support, targeted counselling, and a non-judgmental service atmosphere can markedly enhance treatment compliance. Also, this result is in line with the findings of [20], they reported an overall viral suppression load of 92.4% in the OTZ group of AYALHIV and 84.3% in the regular ART group among AYALHIV in Addis Ababa, Ethiopia, indicating that OTZ had 8.1% times greater chance of suppressing HIV viral load.

In this study, the independent sample t -test for Hypothesis revealed that at 384 degree of freedom reveals that AYFHS attendees had better social relationships ($M = 14.05$, $SD = 7.05$) compared to non-attendees ($M = 11.48$, $SD = 5.47$), with a significant difference ($t = 6.53$, $p < .000$) and a moderate effect size (Cohen's $d = 0.56$). AYFHS attendance was strongly positively related to social relationships ($R = 0.622$). Additionally, attendees had higher HRQoL scores ($M = 22.07$, $SD = 10.83$) compared to non-attendees ($M = 13.50$, $SD = 5.96$), with a significant difference ($t = 5.09$, $p < .000$) and a large effect size (Cohen's $d = 0.80$). AYFHS attendance was also strongly positively related to HRQoL ($R = 0.56$). This suggests that as social relationships increase, quality of life also improves.

Our postulate is consistent with previous studies that have shown a positive relationship between HIV resilience and quality of life among people living with HIV. [21], argued that social relationships facilitate disclosure and lead to viral load suppression. A friendly, supportive and non-judgmental environment can enhance self-efficacy and promote coping strategies that are integral to resilience [22] asserted that the integration of peer support networks and psycho-social interventions within AYFHS reduces emotional burden of HIV, strengthen social connections by 70% thereby strengthening the individual's ability to manage their condition effectively.

Further research should be carried out in different location and geographical area to compare and contrast if Taraba State, Nigeria is not an exception to how adolescence and young people living with HIV respond to the challenges associated with it.

Ethical Considerations

This study was conducted with utmost regard for ethical principles. Informed consent was obtained from all participants prior to data collection. Participants were assured of confidentiality and anonymity, and their right to withdraw from the study at any point was respected. For participants under the age of 18, parental or guardian consent was obtained in addition to the adolescent's assent. All data collected was stored securely and only accessible to authorized personnel. The study protocol was approved by the relevant institutional review board or ethics committee.

Conclusion

This study features the health-related quality of life of adolescents living with HIV,

comparing the health outcomes of AYLHIV who participate in Adolescent and Young Friendly Health Services (AYFHS) in PBP facilities and non-attendees. The study demonstrated that AYFHS attendance is associated with improved mental health and emotional well-being, healthy lifestyle choices, and social relationships among AYLHIV. The findings highlight the importance of specialized youth-friendly services in promoting positive health outcomes and improving the overall well-being of AYLHIV. The study's results have implications for policy, policy makers and practice, emphasizing the need to scale up AYFHS to reach more AYLHIV and improve their access to specialized care, promote healthy lifestyle choices, including physical exercise and balanced nutrition, among AYLHIV and strengthen social relationships and support networks among AYLHIV to improve their overall quality of life.

Conflict of Interest

No competing interests were declared by the authors.

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References

[1]. U.S. Department of Health and Human Services, 2020, What is HIV? <https://www.hiv.gov/hiv-basics/overview/about-hiv-and-aids/what-is-hiv>

[2]. UNAIDS, 2020, Seizing the moment: Tackling entrenched inequalities to end epidemics – Global AIDS Update 2020. Joint United Nations Programme on HIV/AIDS (UNAIDS).

- https://www.unaids.org/sites/default/files/media_asset/2020_global-aids-report_en.pdf
- [3]. Bekker, L.-G., Johnson, L., Wallace, M., & Hosek, S., 2015, Building our youth for the future. *Journal of the International AIDS Society*, 18(2Suppl 1), 20027. <https://doi.org/10.7448/IAS.18.2.20027>
- [4]. Slogrove, A. L., Sohn, A. H., Belecourt, C., Violari, A., & McNairy, M. L., 2020, Adolescents and young people with HIV: Unmet needs in the global response. *Current Opinion in HIV and AIDS*, 15(1), 36-42. <https://doi.org/10.1097/COH.0000000000000590>
- [5]. UNFPA, 2021, Youth-friendly health services: An assessment of youth access to adolescent sexual and reproductive health services in Nigeria. United Nations Population Fund Nigeria. <https://nigeria.unfpa.org/en/publications/youth-friendly-health-services-assessment>
- [6]. Mark, D., Armstrong, A., Andrade, C., Penazzato, M., Hatane, L., Taing, L., & Bekker, L.-G., 2021, Adolescent HIV treatment in the era of Universal Health Coverage: Lessons from South Africa and beyond. *Journal of the International AIDS Society*, 24(Suppl 2), e25652. <https://doi.org/10.1002/jia2.25652>
- [7]. UNICEF, 2020, Improving Adolescent HIV Care and Treatment: A Peer Support Model for Africa. *United Nations Children's Fund*.
- [8]. Govender, K., Naicker, S. N., Meyer-Weitz, A., Fanner, J., Naidoo, A., & Penfold, L., 2020, Adolescent access to HIV prevention services in sub-Saharan Africa: A scoping review and narrative synthesis. *African Journal of AIDS Research*, 19(4), 267-275. <https://doi.org/10.2989/16085906.2020.1861320>
- [9]. UNAIDS, 2022, In Danger: UNAIDS Global AIDS Update 2022. Joint United Nations Programme on HIV/AIDS.
- [10]. National Bureau of Statistics (NBS), 2020, 2020 Statistical Report on Women and Men in Nigeria. *Federal Republic of Nigeria*. <https://www.nigerianstat.gov.ng>
- [11]. National Agency for the Control of AIDS (NACA), 2020, Revised National HIV and AIDS Strategic Framework 2019–2021. *Federal Republic of Nigeria*. <https://naca.gov.ng/revised-national-hiv-and-aids-strategic-framework-2019-2021/>
- [12]. PEPFAR Nigeria, 2023, Nigeria Country Operational Plan (COP/ROP) 2023 Strategic Direction Summary. U.S. President's Emergency Plan for AIDS Relief. Retrieved from https://www.state.gov/wp-content/uploads/2023/07/Nigeria_COP23_SDS_Final.pdf
- [13]. Busza, J., Besana, G. V. R., Mapunda, P., & Oliveras Rodriguez, M. L., 2020, Meeting the needs of adolescents living with HIV through differentiated care: Lessons from the Zvandiri programme in Zimbabwe. *Journal of the International AIDS Society*, 23(S5), e25552. <https://doi.org/10.1002/jia2.25552>
- [14]. UNAIDS & World Health Organization, 2021, Adolescent HIV prevention and treatment: A situational analysis of adolescent HIV programming in selected countries in sub-Saharan Africa. Retrieved from <https://www.unaids.org/en/resources/documents/2021/adolescent-hiv-prevention-and-treatment>
- [15]. O'Brien, K. K., Tynan, A. M., Nixon, S. A., & Glazier, R. H., 2020, Effectiveness of aerobic exercise for adults living with HIV: Systematic review and meta-analysis using the Cochrane Collaboration protocol. *BMC Infectious Diseases*, 20(1), 73. <https://doi.org/10.1186/s12879-020-4779-1>
- [16]. Denison, J. A., Banda, H., Dennis, A. C., Packer, C., Nyambe, N., Stalter, R. M., Mwansa, J. K., & McCarraher, D. R., 2020, "The sky is the limit": Adhering to antiretroviral therapy and HIV self-management from the perspectives of adolescents living with HIV and their caregivers. *Journal of the International AIDS Society*, 23(3), e25470. <https://doi.org/10.1002/jia2.25470>
- [17]. Pantelic, M., Boyes, M., Cluver, L., & Thabeng, M., 2020, 'They Say HIV is a Punishment from God or from Ancestors': Cross-Cultural Adaptation and Psychometric Assessment of an HIV Stigma Scale for South African Adolescents Living with HIV (ALHIV-SS). *Child Indicators Research*, 13(1), 149–170. <https://doi.org/10.1007/s12187-019-09660-0>

- [18]. Willis, N., Milanzi, A., Mawodzeke, M., Dziwa, C., Armstrong, A., Yekeye, I., Keatinge, J., & Cowan, F. M., 2020, Effectiveness of community adolescent treatment supporters (CATS) interventions in improving linkage and retention in care, adherence to ART and psychosocial well-being: A randomised trial among adolescents living with HIV in rural Zimbabwe. *BMC Public Health*, 20, 117. <https://doi.org/10.1186/s12889-019-7995-4>
- [19]. Mburu, G., Ram, M., Skovdal, M., Bitira, D., Hodgson, I., Mwai, G. W., & Seeley, J., 2020, Supportive social relationships and improved health-related quality of life among adolescents living with HIV in sub-Saharan Africa: A structural equation modelling analysis. *AIDS Care*, 32(1), 6-15. <https://doi.org/10.1080/09540121.2020.1739203>
- [20]. de Terte, I., Becker, L. A., & Marks, D. F., 2020, Resilience and quality of life among people living with HIV: A systematic review of quantitative studies. *Journal of Health Psychology*, 25(6), 709-723. <https://doi.org/10.1177/1359105317718053>
- [21]. Shah, S. K., Celum, C., Baeten, J. M., Bukusi, E., & Pintye, J., 2021, Resilience among adolescents living with HIV: A review of global literature. *AIDS Care*, 33(6), 713-720. <https://doi.org/10.1080/09540121.2020.1742864>
- [22]. Mark, D., Armstrong, A., Andrade, C., Penazzato, M., Hatane, L., Taing, L., & Bekker, L.-G., 2021, Adolescent HIV treatment in the era of Universal Health Coverage: Lessons from South Africa and beyond. *Journal of the International AIDS Society*, 24(2), e25652. <https://doi.org/10.1002/jia2.25652>

Evaluating the Prevalence of Non-Communicable Diseases Among HIV Positive Individuals in Chingola District, Zambia

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Abstract

The study was aimed at evaluating the prevalence of non-communicable diseases among HIV positive individuals in Chingola District, Zambia. The widespread success of antiretroviral therapy (ART) has caused HIV to change from an acute to a chronic illness. Although the life expectancy of people living with HIV (PLHIV) has increased dramatically as a result of this advancement, new health issues have also emerged, most notably the increased prevalence of non-communicable diseases (NCDs) in this population. HIV-positive people are increasingly being diagnosed with noncommunicable diseases (NCDs), including diabetes, hypertension, cardiovascular disease, and chronic respiratory conditions. The study was carried out in Zambia's Copperbelt Province's Chingola District. Purposively, five of the district's largest antiretroviral therapy (ART) clinics were chosen based on patient volume and accessibility. Between January and May of 2025, a descriptive cross-sectional study was carried out involving 500 participants. The results show that most prevalent non-communicable disease among the 500 HIV-positive people was hypertension, which affected 268 participants i.e. 53.58% of the sample. The analysis identified predictors of non-communicable diseases (NCDs) include age which had the odds of having an NCD increased by 5% for every year, indicating that age was a significant factor (OR = 1.05, 95% CI: 1.03–1.08, $p < 0.001$). The study concludes that there is a significant burden of non-communicable diseases (NCDs) among people living with HIV (PLHIV) in the district.

Keywords: *Antiretroviral Therapy (ART), HIV Positive Individuals, Non-Communicable Diseases, Prevalence.*

Introduction

Human Immunodeficiency Virus (HIV) and Acquired Immune Deficiency Syndrome (AIDS) remain a major public health concern that disproportionately affects sub-Saharan Africa (SSA). Of the 36.9 million people living with HIV worldwide, it is estimated that nearly 70% live in sub-Saharan Africa [1]. Eastern Africa is the second most affected region in Africa after southern Africa, which together are estimated to have over 17.7 million people living with HIV. In Zambia, the prevalence of HIV is estimated to be 11% [2].

In the early 80s and 90s, HIV/ AIDS was a mysterious, feared, untreatable, and often fatal condition. However, the advent of antiretroviral therapy (ART) has changed the course of the disease, giving patients and scientists new hope for fighting it and living longer [3].

Conversely, the ageing cohort of people living with HIV (PLHIV) raises concern about the coexistence of HIV with other chronic illnesses, notably the non-communicable diseases (NCDs). According to UNAIDS [4], it is estimated that NCDs are the cause of death of 38 million people each year, and three-quarters

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of these occur in low- and middle-income countries (LMICs), which are already burdened by HIV.

Furthermore, individuals living with HIV have been identified as having an increased risk of developing non-communicable diseases [5]. This outcome stems from the HIV infection, antiretroviral therapy, immunosuppression related to HIV, the advancing age of people living with HIV, HIV-related inflammation, along with conventional risk factors for non-communicable diseases, including tobacco smoking, alcohol consumption, lack of physical activity, poor dietary habits, and shifts in demographics and epidemiology [6].

The way medical professionals treat HIV patients has drastically changed since the introduction of antiretroviral treatment (ART) in the mid-1990s. Shah's study [7] examined the transformation of HIV from a fatal acute illness to a manageable chronic condition. Antiretroviral therapy's increased life expectancy created new challenges for HIV patients' long-term care. The healthcare difficulty that arises as a result of patients living longer due to higher survival rates among HIV-positive persons was detailed by Triant [8].

The application of recent epidemiological data provides consistent evidence showing NCDs are more prevalent among people living with HIV. The study of Mudenda, Mukosha, and Fwoloshi [9] shows that individuals with HIV disease have a 1.5 to 2 times greater probability of developing various NCDs compared to the normal population groups. The escalated NCD prevalence pattern is observed throughout all geographical areas and demographic segments, implying that biological elements precede conventional risk factors.

The widespread success of antiretroviral therapy (ART) has caused HIV to change from an acute to a chronic illness. Although the life expectancy of people living with HIV (PLHIV) has increased dramatically as a result of this advancement, new health issues have also

emerged, most notably the increased prevalence of non-communicable diseases (NCDs) in this population. HIV-positive people are increasingly being diagnosed with noncommunicable diseases (NCDs), including diabetes, hypertension, cardiovascular disease, and chronic respiratory conditions [5, 10]. Although ART coverage has increased in Zambia, there is still insufficient integration of NCD services into HIV care [12].

To enhance the management of chronic diseases among people living with HIV, some nations have started incorporating NCD screening into ART programs, implementing task-shifting techniques, and utilising mobile health technologies. Integration is possible and can lead to better patient outcomes, according to pilot projects in Kenya, South Africa, and Uganda [6]. Despite Zambia's efforts to promote integrated care through policy reforms, implementation remains uneven, particularly at the district level [9].

The most effective and patient-centered strategy is integrated service delivery, in which ART clinics incorporate NCD screening, diagnosis, and management [11]. This model enhances adherence and retention, lowers travel expenses, and lessens stigma.

Despite evidence from around the world that integrated care is beneficial, Zambia still faces obstacles such as a lack of funding, a shortage of skilled workers, fragmented medical records, and ineffective monitoring systems [13]. Furthermore, local adaptation and prioritisation are hampered by a lack of district-level data.

Zambia has made significant strides towards reaching the 95-95-95 goals for HIV, reaching 91-98-96 in 2021, and has achieved significant ART coverage, with 1.2 million people receiving antiretroviral therapy in 2021 [4]. To encourage NCD screening in HIV clinics, national guidelines have been updated. However, inadequate data collection and underreporting of comorbidities limit district-specific accomplishments [14].

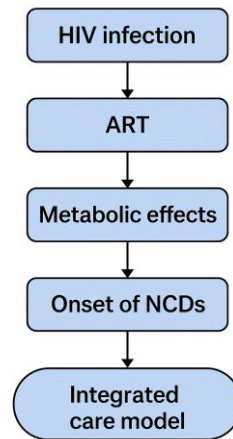


Figure 1. Schematic Diagram

As shown in Figure 1, the flow diagram shows the interaction between HIV infection, ART, metabolic effects, and the onset of NCDs, leading to an integrated care model. The graphic highlights the necessity of an integrated care model by showing the progression from HIV infection to the emergence of non-communicable diseases (NCDs). It starts with HIV infection, which is treated with antiretroviral therapy (ART). ART is frequently linked to metabolic side effects like insulin resistance, dyslipidaemia, and fat redistribution, even though it successfully suppresses the virus and extends life. Particularly as people age and continue long-term ART, these metabolic alterations may contribute to the development of noncommunicable diseases (NCDs), such as obesity, cardiovascular disease, type II diabetes, and hypertension. The diagram ends by promoting an integrated care model that incorporates HIV treatment with NCD prevention, screening, and management in order to address this dual burden [15].

The purpose of this study is to assess the pattern and prevalence of non-communicable diseases among people living with HIV in Zambia's Chingola District. Additionally, it identifies clinical and demographic factors that predict NCDs in this population and proposes methods for integrating NCD management into HIV care services. The specific objectives are:

1. To determine the prevalence of selected NCDs among HIV-positive individuals in Chingola District.
2. To identify demographic and clinical factors associated with NCD comorbidity.
3. To provide recommendations for integrated HIV/NCD healthcare services.

To the best of our knowledge, this is the first district-level study to measure the prevalence of NCDs among people living with HIV in Chingola District. In contrast to previous national evaluations, this study uses a descriptive cross-sectional survey.

Materials and Methods

Description of the Site

The study was carried out in Zambia's Copperbelt Province's Chingola District, which is known for its industrial mining activity and high HIV prevalence. Five of the district's largest antiretroviral therapy (ART) clinics were purposively selected based on patient volume and accessibility. Both urban and peri-urban populations are served by these clinics.

Description of the Experiments Done

Between January and May of 2025, a descriptive cross-sectional study was carried out. Five hundred (500) HIV-positive people who were at least eighteen years old were enrolled. To ensure representativeness, stratified random sampling was used to select participants, with strata defined by clinic size

and geographic location. Three primary methods were used to collect the data: structured interviews, physical examinations, and reviews of medical records. Demographic information, ART history, lifestyle choices (such as drinking and smoking), and self-reported health status were all recorded during the interviews. To determine BMI, physical examinations included measurements of height, weight, and blood pressure. Documented diagnoses of diabetes, hypertension, cardiovascular disorders, and chronic respiratory conditions were examined in medical records.

Description of the Laboratory Methods

Although the majority of the clinical diagnoses used in this study were already in place, standard laboratory procedures used in clinics helped to verify certain non-communicable diseases. In situations where recent lab data were unavailable, blood glucose levels were measured using glucometers to confirm diabetes. Calibrated sphygmomanometers were used to measure blood pressure. Based on diagnoses made by clinical officers and doctors using standardised diagnostic procedures, other chronic conditions like cardiovascular disease and chronic respiratory illness were found in patient files.

Description of Statistical Methods Used

SPSS version 26 was used to enter and analyse the data. To summarise participant characteristics and disease prevalence, descriptive statistics such as means, standard deviations, frequencies, and proportions were computed. To evaluate relationships between categorical variables, chi-square tests were employed. The predictors of having at least one NCD were identified using binary logistic regression models. A p-value of less than 0.05 was considered statistically significant. To make sure the multivariate analyses were robust, model fit and collinearity diagnostics were carried out.

Results

SPSS version 26 was used to analyse the data. Baseline characteristics were summarised using descriptive statistics, such as means, standard deviations, frequencies, and proportions. Factors linked to the prevalence of NCDs were found using logistic regression models and chi-square tests.

Participant Characteristics

The mean age of participants was 43.7 years (SD = 11.2). Females constituted 61.2% of the sample.

Table 1. Socio-Demographic Characteristics of Participants (n = 500)

Characteristic	Frequency (%)
Age (mean = 43.7)	
18–29	60 (12.0%)
30–44	220 (44.0%)
45–59	170 (34.0%)
60+	50 (10.0%)
Gender	
Male	194 (38.8%)
Female	306 (61.2%)
ART years	40 (8%)
< 1 year	100 (20%)
1-3 years	150 (30%)
4-6 years	110 (22%)

7-9 years	100 (20%)
≥ 10 years	40 (8%)

Table 1 shows the Socio-demographic Characteristics of the 500 Participants. Important information about the study population can be gleaned from the respondents' demographics. As indicated in Table 1, the group had an average age of 43.7 years and was primarily middle-aged. When participants were broken down by age, the largest percentage (44.0%) belonged to the 30–44 age group, followed by the 45–59 age group (34.0%). 12.0% of participants were younger (aged 18 to 29), and 10.0% were older (aged 60 and over). According to this distribution, the majority of respondents were middle-aged and economically active, which may affect the burden of disease and the need for health services, particularly for non-communicable diseases.

Regarding the distribution of respondents by gender, women made up the majority (61.2%), followed by men (38.8%). Given that women may be more likely than men to seek medical attention or take part in community-based research, this gender disparity may be a reflection of trends in healthcare-seeking

behaviour. Given the biological and social disparities in disease exposure and response between men and women, these disparities may also affect how results are interpreted, particularly those related to health outcomes.

The distribution of years on antiretroviral therapy (ART) among the 500 respondents reveals a range of treatment durations. A sizable portion of people were in the mid-phase of long-term HIV management, as the largest percentage (30.0%) had been on ART for four to six years. Next in line were 20.0% who had been on treatment for one to three years and 22.0% who had been on ART for seven to nine years. Furthermore, 20.0% of respondents said they had been on ART for ten years or longer, indicating a sizable population of long-term survivors. Only 8.0% had started treatment in the previous 12 months. According to this distribution, the majority of respondents had a significant amount of ART experience, which could have an impact on treatment results, adverse effects, and the development of non-communicable diseases as a result of extended drug exposure.

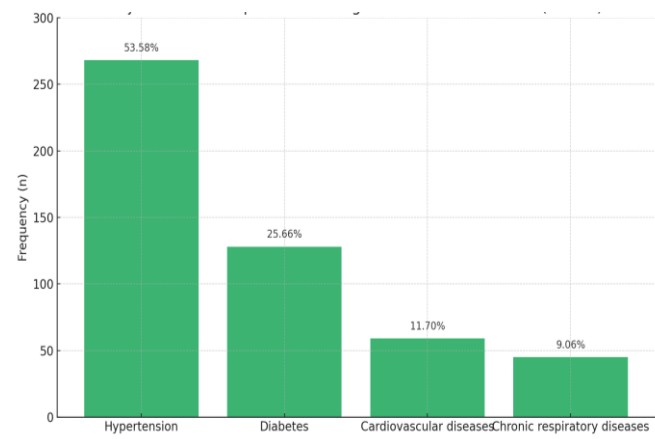


Figure 2. Prevalence of NCDs Among Participants

Source: Field data (2025)

The Prevalence of NCDs Among Participants are shown in Figure 2. The most prevalent non-communicable disease among the 500 HIV-positive people in Chingola

District was hypertension, which affected 268 participants, i.e., 53.58% of the sample. With 128 cases, or 25.66% of the total, diabetes was the second most common condition. Also, 59

respondents, or 11.70% of the total, had cardiovascular diseases, and 45, or 9.06%, had chronic respiratory diseases. With over half having hypertension and almost one in four having diabetes, these statistics demonstrate the significant burden of NCDs among HIV-

positive individuals. The results highlight how crucial it is to incorporate regular NCD screening and management into HIV care services to address this dual disease burden successfully.

Table 2. Logistic Regression Analysis of Factors Associated with NCDs

Variable	Odds Ratio	95% CI	p-value
Age (per year)	1.05	1.03 – 1.08	<0.001
BMI > 25	1.65	1.20 – 2.26	0.002
Smoking	2.10	1.40 – 3.15	<0.001

The Logistic Regression Analysis of Factors Associated with NCDs is illustrated in table 2. Among people with HIV, the analysis identified several important predictors of non-communicable diseases (NCDs). The odds of having an NCD increased by 5% for every year of age, indicating that age was a significant factor (OR = 1.05, 95% CI: 1.03–1.08, $p < 0.001$). Individuals with a BMI above 25 were 65% more likely to have an NCD than those with a normal BMI (OR = 1.65, 95% CI: 1.20–2.26, $p = 0.002$). The most significant risk factor was smoking; smokers had a greater than twofold increased risk of developing an NCD compared to non-smokers (OR = 2.10, 95% CI: 1.40–3.15, $p < 0.001$). These findings highlight how lifestyle choices and ageing all contribute to the development of chronic illnesses in HIV-positive populations.

Associated Factors

Older age, longer duration on ART, higher BMI, and smoking were significantly associated with higher odds of having at least one NCD ($p < 0.05$). No significant difference was found based on sex.

Discussion

The participants' demographic profile offers crucial background information for comprehending the prevalence of non-communicable diseases (NCDs) among Chingola District's HIV-positive population.

The respondents' average age was 43.7 years (SD = 11.2), indicating that middle-aged individuals comprised the majority of the study population. In low- and middle-income nations, where health systems are frequently ill-prepared to handle the combined burden of communicable and non-communicable diseases, this age group is generally more susceptible to chronic conditions like hypertension, diabetes, and cardiovascular disease [7, 9, 18].

The age distribution further emphasises that most participants were in their most economically productive years, with 44.0% in the 30-44 age group and 34.0% in the 45-59 age group. This has implications for household productivity, national economic development, and individual health outcomes.

With 61.2% of respondents being female, the sample was primarily female. Given that women are more likely to use healthcare services and participate in health-related research, this gender gap may reflect long-standing trends in healthcare-seeking behaviour [13, 18]. Moreover, the development and experience of HIV and NCDs may be influenced by the biological and social distinctions between men and women. For instance, antiretroviral therapy (ART)-related metabolic problems are more common in women with HIV, potentially making them more vulnerable to diseases like diabetes and hypertension [4, 17].

The 500 respondents' years on ART showed a broad range of treatment durations, suggesting that the cohort's treatment history was varied. With 30.0% of respondents having been on ART for four to six years and 22.0% for seven to nine years, the majority had significant ART experience. Furthermore, 20.0% had been on ART for more than ten years, indicating that the number of long-term survivors is increasing. Merely 8.0% had been on antiretroviral therapy for less than a year. These results are consistent with national trends in Zambia, where the life expectancy of individuals living with HIV has increased due to the scale-up of ART [12]. Long-term ART use, however, is known to raise the risk of NCDs over time by contributing to metabolic issues like insulin resistance and dyslipidaemia [16].

In this study, the prevalence of NCDs among people with HIV was noticeably high. With 268 cases, or 53.58% of the sample, hypertension was the most frequently reported condition. Cardiovascular diseases and chronic respiratory conditions were reported at 11.70% and 9.06%, respectively, with diabetes coming in second at 25.66%. These rates align with regional studies showing that ageing, lifestyle factors, and metabolic side effects linked to ART are contributing to an increasing burden of noncommunicable diseases (NCDs) among individuals living with HIV in sub-Saharan Africa [18, 19]. There is an urgent need for integrated HIV–NCD care models that offer routine screening, lifestyle counselling, and appropriate medication management, especially given the high prevalence of diabetes and hypertension.

Several important predictors of NCDs in the study population were identified by regression analysis of the data. The odds of having an NCD increased with age, increasing by 5% for every year of age (OR = 1.05, 95% CI: 1.03–1.08, $p < 0.001$). This confirms results from other studies that older HIV-positive people are more likely to develop chronic illnesses [20].

Body mass index (BMI) was another important predictor; those with a BMI over 25 had a 65% increased risk of getting an NCD (OR = 1.65, 95% CI: 1.20–2.26, $p = 0.002$), indicating the part that overweight and obesity play in the aetiology of conditions like diabetes and hypertension.

Smoking was the most powerful risk factor found; smokers had over twice the chance of getting an NCD as opposed to non-smokers (OR = 2.10, 95% CI: 1.40–3.15, $p < 0.001$). This is in line with research from around the world that shows tobacco use is linked to a variety of health problems, especially in people with weakened immune systems [21–23].

Conclusion

The study concludes that the district's people living with HIV (PLHIV) bear a hefty burden of non-communicable diseases (NCDs). The results show that the most common NCDs are diabetes and hypertension, which affect more than half and 25% of the respondents with HIV, respectively. This high prevalence emphasises how difficult it is becoming to manage HIV and co-occurring chronic conditions, particularly in settings with limited resources.

According to demographic data, most respondents were female, middle-aged, and had significant experience with long-term antiretroviral therapy (ART). These variables were found to be significant predictors of the occurrence of NCDs, especially when paired with lifestyle risks like smoking and having an elevated body mass index (BMI). The impact of ageing on HIV-positive populations was highlighted by the strong correlation found between age and an increased risk of developing an NCD.

The study also concludes that urgent health system reforms are necessary to support integrated care models given the co-occurrence of HIV and NCDs. HIV services should include routine NCD screening and management to promote early detection, lower complications, and enhance PLHIV's general health outcomes.

The growing prevalence of NCDs could undo Zambia's progress in HIV care and treatment if intentional policy changes are not made. As a result, this study backs the necessity of improved health infrastructure, community education, and the use of patient-centered, holistic approaches to managing chronic illnesses.

Conflict of Interest

None declared.

Acknowledgements

I would like to express my sincere gratitude to the Chingola District Health Office-HIV Team for providing access to the health facilities and data records, and analysis, which contributed to the success of this study.

Ethical Approval

Permission to carry out the study was obtained from Chingola District Health Office. Before the study, all respondents were clearly informed of the nature and purpose of the study.

References

- [1] Althoff, K. N., et al., 2019, "HIV and aging: State of knowledge and areas of critical need for research. A report to the NIH Office of AIDS Research by the HIV and Aging Working Group." *Journal of Acquired Immune Deficiency Syndromes*, 81(1), 1-12.
- [2] World Health Organization, Country Disease Outlook - Zambia. Date of access: 20/05/2025 <https://www.afro.who.int/sites/default/files/2023-08/Zambia.pdf>
- [3] Machalaba, C., et al., 2023, "Cardiovascular disease risk factors and outcomes in people living with HIV: A systematic review and meta-analysis." *The Lancet HIV*, 10(1), e32-e44.
- [4] UNAIDS, Global AIDS Update 2023. Date of access: 20/05/2025 <https://www.unaids.org/en/resources/documents/2023/global-aids-update>
- [5] Nduka, C. U., Stranges, S., Sarki, A. M., Kimani, P. K., & Uthman, O. A., 2020, Evidence of increased

In addition, participants were clearly informed about their roles, the data being collected, and the usage of this information. Further, the study stressed out voluntary participation, allowing individuals the freedom to join or withdraw from the research at any time.

Data Availability

The datasets that were produced and/or examined in the course of this study can be obtained from the corresponding author upon a reasonable request.

Author Contributions

The author made most of contribution to the development, conceptualization, analysis, and composition of this paper. A research assistant was engaged in data cleaning and proofreading.

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risk of non-communicable diseases in HIV-positive populations in sub-Saharan Africa: A systematic review and meta-analysis. *PLOS ONE*, 15(8), e0237420.

<https://doi.org/10.1371/journal.pone.0237420>

- [6] Rabkin, M., Nishtar, S., & Besada, D., 2018, Integrated care for chronic conditions: the global challenge to achieve health equity. *Health Affairs*, 37(3), 408-412.

<https://doi.org/10.1377/hlthaff.2017.1393>

- [7] Shah, A. S., 2020, "Non-communicable diseases and HIV care and treatment: Models of integrated service delivery." *Tropical Medicine & International Health*, 25(3), 298-305.
- [8] Triant, V. A., 2023. "Cardiovascular disease and HIV infection." *Nature Reviews Cardiology*, 20(1), 33 -45.
- [9] Mudenda, S., Mukosha, M., & Fwoloshi, S. 2019, Prevalence of hypertension and diabetes mellitus among people living with HIV/AIDS on

antiretroviral therapy. *Medical Journal of Zambia*, 46(2), 85–90.

[10] Mutagonda, R. F., Siril, H., Kaaya, S., 2022, Prevalence and determinants of non-communicable diseases including depression among HIV patients on antiretroviral therapy in Dar es Salaam, Tanzania. *Trop Med Int Health*, 27:742–51

[11] World Health Organization, 2021, Noncommunicable diseases: Key facts. Date of access: 2/06/2025 <https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases>

[12] Zambia Ministry of Health, 2021, Zambia Population-based HIV Impact Assessment (ZAMPHIA) Report.

[13] Chanda-Kapata, P., Klinkenberg, E., Maddox, N., & Kapata, N, 2016, Health seeking behaviour among individuals with presumptive tuberculosis in Zambia. *PLOS ONE*, 11(3), e0149336. <https://doi.org/10.1371/journal.pone.0149336>

[14] Hamoonga, B. M., Tsarkov, A., Petlovanyi, P., Marinda, P. A., Kumwenda, C., Oguta, T. J., Phiri, C., 2023, Prevalence and incidence of hypertension and diabetes mellitus among HIV-infected individuals receiving HAART in Chongwe District, Lusaka Province, Zambia. *European Journal of Clinical Medicine*, 1(2) 45- 64.

[15] Moyo-Chilufya, M., Maluleke, K., Kgarosi, K., Muyoyeta, M., Hongoro, C., & Musekiwa, A., 2023, The burden of non-communicable diseases among people living with HIV in Sub-Saharan Africa: A systematic review and meta-analysis. *eClinicalMedicine*, 65, 102255. <https://doi.org/10.1016/j.eclinm.2023.102255>

[16] Nduka, C. U., Stranges, S., Sarki, A. M., Kimani, P. K., & Uthman, O. A., 2017, Evidence of increased cardiometabolic risk in HIV-positive individuals receiving antiretroviral therapy: A systematic review and meta-analysis. *PLOS ONE*, 12(4), e0173936.

<https://doi.org/10.1371/journal.pone.0173936>

[17] Zambia Ministry of Health, 2021, *Zambia Consolidated Guidelines for Treatment and Prevention of HIV Infection*. Lusaka: MoH.

[18] Henderson, K. L., 2023, "Long-term effects of integrase inhibitors on bone health: A prospective cohort study." *Journal of Bone and Mineral Research*, 38(4), 725-736.

[19] Ibrahim, N., 2022, "Digital health interventions for integrated HIV-NCD care: A randomized controlled trial in South Africa." *The Lancet Digital Health*, 4(6), e429-e438.

[20] Johnson, P. R., & Smith, A. B., 2023, "Cost-effectiveness of integrated care models for HIV and NCDs in resource-limited settings." *Health Policy and Planning*, 38(5), 567-579.

[21] Kang, Y. J., 2023, "Novel biomarkers for early detection of cardiovascular disease in HIV-positive individuals." *Nature Medicine*, 29(3), 312-324.

[22] Liu, H., 2022, "Epigenetic alterations in chronic HIV infection: Implications for aging and disease." *Cell Host & Microbe*, 30(4), 534-547.

[23] Morrison, T. A., 2023, "Exercise interventions for HIV-associated metabolic syndrome: A metaanalysis." *Sports Medicine*, 53(2), 245-262.

Phenomenological and Clinical Insights into Near-Death Experiences: A Retrospective Analysis in Aseer Province Population, Saudi Arabia

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Abstract

Near death experience (NDE) reported as supernatural and emotional feelings with episodes involving a special state of consciousness, including several special elements and these experiences typically occur with often grouped contents commonly observed in life-threatening conditions. Participants were provided with an Arabic version of the Near-Death Experience (NDE) scale via mail and social media platforms, along with a contact number for inquiries. NDE scale scores, used to assess the depth of the near-death experience, were considered indicative of an NDE if they were 7 or greater. A total of 14 participants of both sex aged between 18 and 56 years, with a mean age of 37.1 years (SD = 12.4). with a gender dispersion of 57.1% (8 males) and 42.9% (6 females). The most commonly reported incidence of near-death experiences was “sudden understanding of everything” (93.0%), “time speeding up” (85.7%), and “feeling happy” (85.7%). Conversely, the incidence reported least frequently was “visions of the future” at 28.6% and “racing thoughts” at 21.4%. No statistically significant variation in the frequency of responses across the 12 of NDE elements. The elements most frequently reported exhibited narrow confidence intervals with elevated lower bounds: “sudden understanding of everything” (93.0%, 95% CI [77.9%, 100.0%]), “time speeding up” (85.7%, 95% CI [66.4%, 100.0%]), and “feeling happy” (85.7%, 95% CI [66.4%, 100.0]). This study shows that Near-Death Experiences (NDEs) involve sensory, emotional, cognitive, and spiritual elements, with altered consciousness and neural links, showing no gender differences.

Keywords: *Consciousness, End-of-life Experiences, Near-death Experience, Psychological Insights.*

Introduction

For living organisms, life and death are inseparable, representing two facets of existence in this world. In the transition between life and death, an unforeseen and profound subjective experience may occur. This vivid experience leads individuals to rely on personal, cultural, and religious perspectives to describe and understand these puzzling experiences, currently called near-death

experiences (NDE) [1]. Van Lommel et al. defined NDE as a reported memory of the deep illusions and hallucinations as well as robust supernatural and emotional feelings with episodes involving a special state of consciousness, including a number of special elements such as out-of-body experiences, pleasant feelings, seeing a tunnel, a light, deceased relatives, or a life review at the time they are approaching death or have temporarily begun the dying process, and these experiences

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typically occur with often grouped contents. These group contents NDE are commonly observed in life-threatening conditions such as sudden cardiac arrest (SCA), perioperative or postpartum complications, septicemia or anaphylaxis, electrical injuries, coma secondary to traumatic brain injury (TBI), intracerebral haemorrhage, (ICH), ischemic stroke (cerebral infarction), hypoglycemic episodes, near drowning, hypoxia-induced asphyxia, and apnea. Further circumstances like mild or non-life-threatening conditions, psychological states such as depression, minor injuries, falls, and various other situations that may not pose a risk to life are also associated with near-death experiences (NDEs) [2-5]. Recent modern resuscitation techniques increase the survival rates, which resulted in increase NDE incidence [6]. However, the content of NDE and its influence on patients' experiences are similar all the time across the continent with different cultural environments. Earlier studies have had a hard time finding clear differences in age, mental state, or life situations that set apart people who report near-death experiences (NDEs) from those who don't, or explaining why these experiences can vary so much. This gap in understanding led to the development of the "unitary concept" of NDEs, a theory proposed by author Ring, known as the invariance hypothesis. This concept suggests that NDEs share a core, universal structure, regardless of individual differences or cultural contexts [7]. According to Ring, this hypothesis underscores the idea that NDEs are fundamentally similar across populations, reflecting a common human experience rather than being shaped by external variables.

The perspective of a unitary concept of near-death experiences (NDEs) has been acknowledged by psychologists Ring and Frank, who highlighted the unvarying nature of these profound experiences, emphasizing shared characteristics that define their occurrence. They recognized that NDEs have a

core structure, comprising similar universal content elements experienced by NDE survivors irrespective of cultural or personal differences [8, 9]. However, this perspective has not received universal acceptance. Researchers Bates and Stanley found that a single explanatory hypothesis cannot fully account for the heterogeneity observed in NDEs. Rather, they proposed that NDEs can be classified into defined categories, each characterized by unique sequences of experiences. For example, some individuals may report vivid out-of-body sensations, while others might primarily experience a sense of transcendence, encounters with deceased loved ones, or a journey through a tunnel toward a bright light. These observations propose that, while commonality exists across NDEs, the phenomenon is far more complex and multifaceted than initially assumed and recommend more profound investigation into its variables and mechanisms [10]. Multiple hypotheses have been proposed to explain the origins of NDEs. However, physiological theories conclude changes in the brain, such as cerebral hypoxia leading to the death of brain cells, may play a significant role. Additionally, psychological explanations suggest that NDEs could be a coping mechanism or response to the imminent threat of near death, potentially acting as a form of psychological protection. Some researchers advocate for a combined physiological and psychological theory, while others propose that NDEs involve a transcendent state of consciousness. In this state, individuals experience altered perception, emotional intensity, cognitive shifts, and a sense of identity that is detached from normal, body-linked waking consciousness. Despite the varying explanations, research consistently shows that individuals who have had NDEs are generally psychologically healthy. While some exhibit non-pathological dissociative traits, these individuals do not differ significantly from controls in terms of demographic factors

such as age, sex, ethnicity, or religious belief [11].

One notable study conducted in Germany involved a large-scale retrospective investigation of more than 2,000 participants. It found that 4.3% of respondents had experienced an NDE, with a mean age of 22 years at the time of the event [12]. This study underscored the prevalence of NDEs and the challenges inherent in estimating their frequency due to inconsistent definitions and research methods. Additionally, it noted the profound life changes often associated with NDEs, including heightened intuition, reduced fear of death, and trans-formative insights, though the assimilation and acceptance of these experiences often take several years. In the United States, it is estimated that nine million people have undergone NDEs, highlighting the prevalence of this phenomenon. However, these experiences remain underreported, partly because many physicians are unfamiliar with the phenomenon and patients are hesitant to discuss them due to fears of being dismissed or misunderstood. This reluctance underscores the need for greater awareness and sensitivity among healthcare providers regarding NDEs. Recent retrospective studies, which often examine NDEs years after their occurrence, have revealed intriguing findings. Between 43% and 48% of adults who have experienced life-threatening illnesses report having had an NDE, with this figure rising to as high as 85% among children [13]. NDEs raise deep, thoughtful questions about human consciousness, the relationship between brain function and perception, and the trans-formative outcomes of these experiences for individuals. Why do NDEs occur? What determines their content? Is there a biological basis for consciousness, and how do these experiences influence a person's life and worldview? The subjective vividness and transformative nature of NDEs continue to intrigue researchers, necessitating further exploration of their causes, content, and

implications. Hence, we conducted a random retrospective study in the Aseer region of Saudi Arabia. Our monocentric study is the first to investigate the incidence and characteristics of NDEs among individuals in the Aseer region of Saudi Arabia. This study aims to describe the vivid subjective experiences of individuals who have undergone an NDE, recognize common themes and patterns, and discover the effect of these experiences on beliefs about death, spirituality, and personal well-being. Additionally, it examines the psychological and emotional outcomes of NDEs, including their positive and negative effects on mental health. The study also seeks to identify effective strategies and interventions, such as counseling, support groups, and spiritual practices, that could aid individuals in integrating and coping with their experiences. By employing robust methodologies and addressing gaps in existing research, this study not only sheds light on the prevalence of NDEs in the Aseer region of Saudi Arabia but also offers more profound insights into their unique characteristics and transformative potential. These findings contribute to an extensive understanding of NDEs, concretizing the way for future research and refining support for individuals who experience these vivid, profound phenomena.

Methods

Study Design

This was a retrospective cross-sectional study conducted from March 2024 to April 2024. The study was approved by the local Ethics Committee, and informed consent was obtained from study participants. Data collection was intended to target individuals residing in the Aseer Province and potential participants were recruited through various channels, including email invitations, direct contact via phone numbers, and social media posts. Participants from both genders of the general population in the Aseer region who were older than 18 were eligible for the study.

Participants will be excluded from the study if they have a history of major psychiatric disorders, including schizophrenia, bipolar disorder, or psychotic depression, as these conditions may affect the perception or interpretation of the near-death experience. People who are currently using or have recently used drugs, including hallucinogenic or dissociative drugs like Lysergic Acid Diethylamide (LSD) or ketamine when the event happened, will be left out to avoid mixing up drug-related experiences with the near-death experience. Individuals with significant cognitive impairments, such as dementia, traumatic brain injury, or other neurological disorders affecting memory or comprehension, will be excluded. Experiences of near-death that lack association with medically confirmed life-threatening conditions, including cardiac arrest, respiratory failure, or coma, will be excluded to maintain the event's validity. Other reasons for exclusion include difficulties with communication due to language barriers or insufficient fluency in the study language, serious vision or hearing problems that prevent participation in assessments, and unwillingness or inability to provide informed consent. Furthermore, individuals whose near-death experiences happened only during a medically induced coma, and who did not show clear recovery of consciousness or memory, will also be excluded.

Data Collection

This study employs the Greyson Near-Death Experience Scale (GNDE Scale) as its primary data-collection tool, a standardised and validated questionnaire designed to quantify and characterise near-death experiences. The questionnaire comprises 16 structured items, each scored on a scale from 0 to 2, yielding a total score ranging from 0 to 32. A score of 7 or higher is regarded as indicative of a classical near-death experience. The questionnaire evaluates four fundamental dimensions: cognitive, affective, paranormal, and

transcendental experiences. This survey is structured and employs close-ended questions, distinguishing it from an open-ended interview format. Each question presents specified response options, facilitating quantifiable and objective scoring. Examples of phenomena include sensations of detachment from the body, feelings of tranquility, a perception of timelessness, and encounters with beings or bright lights. The original version of the questionnaire was created in English and subsequently translated into Arabic using the standard forward-backwards translation method to maintain cultural and linguistic equivalence. The translation was conducted by expert bilingual translators, and content validity was assessed by a panel of professionals in psychology and clinical research. A pilot test was conducted with 5 participants to assess the clarity, comprehension, and relevance of the translated items.

Participants were provided with an Arabic version of the Near-Death Experience (NDE) scale via mail and social media platforms along with a contact number for inquiries. Completed questionnaires were submitted anonymously and identified only by a numerical code. NDE scale scores, used to assess the depth of the near-death experience, were considered indicative of an NDE if they were 7 or greater. The Greyson NDE Scale is a validated tool that has undergone psychometric evaluation. The tool shows strong internal consistency (Cronbach's $\alpha = 0.88$) and reliability over time, and it has been widely used in both clinical and academic settings for NDE research [14].

Statistical Analysis

The collected data were tabulated and analyzed using both descriptive and inferential statistics. All the parameters were assessed using the Statistical Package for the Social Sciences (SPSS) version 23, with a significance level of p-value less than 0.05 and a 95% confidence interval set for all analyses. This

study utilized a non-parametric statistical method due to the categorical nature of the data, which does not fall on normality distribution. Descriptive statistics, such as frequency analysis and percentage distributions, were calculated to summarize the prevalence of each reported near-death experience (NDE) element. Central tendency measures, including mean and standard deviation, were applied to continuous demographic variables (e.g., age). Cross-tabulations were conducted to examine variations in response patterns according to demographic characteristics. A chi-square goodness-of-fit test was performed to evaluate if the distribution of NDE elements significantly deviated from a uniform distribution. Furthermore, 95% confidence intervals (CIs) were calculated for each proportion to assess the precision of the observed frequencies.

Results

Based on the population of the Aseer region, a target sample size of 840 individuals was estimated. Participant enrollment was terminated after 900 responses were received. Of these, 500 participants were excluded for failing to meet the inclusion criteria. The remaining 400 responses were evaluated, and 14 participants met the criteria for a near-death experience (NDE).

The exclusion of 500 participants was due to failure to meet the primary eligibility criteria, which included the absence of a documented near-death experience, lack of a medically verified life-threatening event, or incomplete demographic and clinical data. These individuals either self-reported experiences that did not align with the standardized definition of an NDE or lacked sufficient clinical documentation to support the reported event. An additional 386 participants were excluded during the screening phase based on specific criteria. These included: a history of significant psychiatric disorders such as schizophrenia or bipolar disorder; presence of substance or drug

intoxication at the time of the reported experience; cognitive impairment or neurological conditions affecting memory recall; and inability to provide informed consent or complete the questionnaire due to language barriers. These exclusion decisions were essential to maintain the internal validity of the study and minimize potential confounding psychological or neurological influences on NDE interpretation. The final sample included 14 participants, consisting of both sexes, aged between 18 and 56 years, with a mean age of 37.1 years (SD = 12.4). The gender distribution was 57.1% male (n = 8) and 42.9% female (n = 6). Several key features of near-death experiences (NDEs) were reported with varying occurrences. The most commonly reported incidence of near-death experiences were “sudden understanding of everything” (93.0%), “time speeding up” (85.7%), and “feeling happy” (85.7%). Conversely, the incidence reported with the least frequency were “visions of the future” at 28.6% and “racing thoughts” at 21.4%. A chi-square goodness-of-fit test was performed to assess if the observed frequency distribution of NDE elements significantly deviated from a uniform distribution. The result was non-significant ($p = .145$), indicating no statistically significant variation in response frequency across the 12 elements. To evaluate the reliability of these proportions, 95% confidence intervals were computed. The elements most frequently reported exhibited narrow confidence intervals with elevated lower bounds: “sudden understanding of everything” (93.0%, 95% CI [77.9%, 100.0%]), “time speeding up” (85.7%, 95% CI [66.4%, 100.0%]), and “feeling happy” (85.7%, 95% CI [66.4%, 100.0%]). Conversely, factors such as “racing thoughts” (21.4%, 95% CI [3.0%, 39.9%]) and “visions of the future” (28.6%, 95% CI [7.4%, 49.7%]), which possess broader confidence intervals, suggest greater variability and less uniformity in reporting. Using chi-square, this study examined gender-based differences in

participants who reported near-death experiences (NDEs). The results indicated variations in experiences between males and females (figure 1); however, none of these variations were statistically significant

($p > 0.05$). The results show that although precise NDE elements are more prevalent and consistent among participants, the overall frequency distribution remains largely uniform.

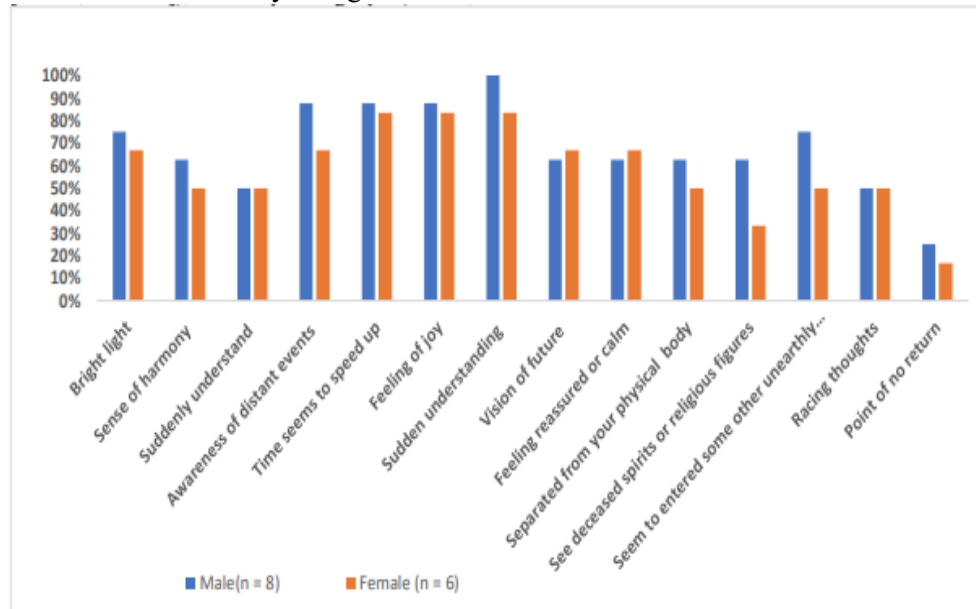


Figure 1. Gender-Based Distribution of Reported Near-Death Experiences (NDEs)

Discussion

The present study offers valuable insight into the multifaceted nature of Near-Death Experiences (NDEs), highlighting their sensory, emotional, cognitive, and spiritual dimensions. Among participants, the most frequently reported features included the sensation of time speeding up, a sudden and profound understanding of everything, and intense feelings of happiness experiences that align with commonly documented NDE characteristics in previous literature. These findings reinforce the notion that NDEs often involve altered states of consciousness characterized by vivid perceptions, emotional clarity, and a sense of transcendence.

A high proportion of participants also reported increased awareness of distant events (78.6%) and a perceived unity with the universe (57.1%). Such experiences suggest a temporary shift in sensory and existential boundaries, where individuals feel both connected to

something greater than themselves and detached from ordinary reality.

Reports of heightened sensory perception, feelings of calm or reassurance, visions of the future, and out-of-body experiences further underscore the rich and layered nature of NDEs. The incidence of NDEs observed in this study (3.5%) is consistent with prior findings among hospitalized patients, irrespective of illness severity. This aligns with reported incidences among cardiac arrest survivors (10–23%) but remains lower than the estimated prevalence in the general population (4–8%) [15]. This variation may be due to differences in study populations, cultural contexts, or the methods used to assess and classify NDEs. Importantly, this study identified several significant associations between specific NDE elements.

A statistically significant relationship between seeing a bright light and experiencing time acceleration ($p = 0.038$) reinforces the idea that visual and temporal distortions often co-occur during episodes of altered consciousness.

This is consistent with prior literature suggesting that neural activity during life-threatening events can impact both visual processing and temporal perception [16]. Similarly, a significant association between feelings of unity with the universe and experiencing happiness ($p = 0.049$) supports theories that NDEs evoke profound emotional states tied to transcendence and interconnectedness. This is in line with proposals that such experiences are mediated by brain structures like the limbic system, which are involved in emotional regulation and spiritual processing [17, 18]. Another key finding was the significant association between out-of-body experiences and the perception of spirits or religious figures ($p = 0.022$). This suggests that detachment from bodily awareness may facilitate or enhance the perception of supernatural or spiritual entities. Previous studies have implicated the temporoparietal junction in generating out-of-body experiences, possibly through disruptions in multisensory integration and self-processing [19]. Conversely, the lack of a significant association between visions of the future and racing thoughts ($p = 0.088$) suggests that prophetic or visionary elements of NDEs may occur independently of heightened cognitive activity. This supports the idea that not all NDE features are interrelated, and that some elements may arise from distinct neural or psychological mechanisms.

While the findings are informative, several limitations should be acknowledged. The small sample size ($n = 14$) restricts the generalizability of the results and limits the ability to detect more nuanced patterns. Additionally, factors such as age, cultural background, religious beliefs, and underlying medical conditions were not fully explored but may play a role in shaping the content and interpretation of NDEs. Further studies with larger and more diverse samples are needed to examine these variables in depth. Longitudinal research could also shed light on how

individuals integrate NDEs into their belief systems and life narratives over time.

This study contributes to the existing body of literature by emphasising that core elements of near-death experiences, such as temporal distortion, emotional elevation, cognitive insight, and spiritual perceptions, are commonly reported across individuals. While this study did not seek to draw conclusions about demographic variations, the consistency of reported experiences suggests that NDEs represent a universal human phenomenon. The significant associations between certain experiential elements further highlight the interconnections of perceptual, emotional, and cognitive alterations during NDEs. Overall, these findings support the theory that NDEs are deeply rooted in human consciousness rather than being solely shaped by cultural or demographic influences [20-23]. Future research incorporating larger, more diverse populations and neurophysiological approaches will be instrumental in advancing our understanding of the mechanisms underlying these profound experiences. Participants often recounted an awareness of distant events, sometimes referred to as a sixth sense. Additionally, the sensation of time distortion, particularly the feeling that time had sped up, was widely reported. Positive emotional states, such as intense happiness and feelings of calm or reassurance, were also prevalent.

In terms of cognitive experiences, many individuals described a sudden, profound understanding of everything, along with visions of the future. Some participants also reported out-of-body experiences in which they perceived themselves as separate from their physical bodies. Encounters with spiritual or religious figures and the perception of entering a strange or unfamiliar world were also noted. The gender-wise statistical analysis of near-death experience (NDE) phenomena revealed variations in reported experiences between males and females. However, none of these differences was statistically significant ($p >$

0.05), indicating that gender was not a strong determinant of experiencing specific NDE elements in this sample. Mental activity during the NDEs included racing thoughts, and some participants reported reaching a point of no return, a moment perceived as a decision point or boundary between life and death. While descriptive variations in experience were observed among participants, statistical analysis did not reveal any significant differences in the prevalence of these features by gender ($p > 0.05$). These findings suggest that, within this sample, the nature of near-death experiences was varied yet consistently reported across multiple domains: sensory, emotional, cognitive, and spiritual.

Overall, the results highlight a wide range of subjective experiences associated with NDEs, underscoring the complexity and richness of these phenomena. Although limited by a small sample size and a lack of demographic diversity, the findings contribute meaningful evidence to the growing body of NDE research and underscore the need for larger, more comprehensive studies to further explore the underlying mechanisms and long-term impact of these extraordinary events. These studies with larger and more diverse populations may offer deeper insights into the nuances and determinants of such experiences.

Conclusion

This study enhances our understanding of Near-Death Experiences (NDEs) by highlighting their complex, multidimensional nature, encompassing sensory, emotional, cognitive, and spiritual elements. The consistency of core features—such as time distortion, intense emotional states, out-of-body experiences, and feelings of unity—across participants supports the view that NDEs

reflect profound alterations in consciousness rather than being solely shaped by cultural or personal factors.

Significant associations between certain experiential elements suggest interconnected neural and psychological mechanisms, while the lack of gender differences reinforces the universality of these experiences.

Author Contributions

All authors contributed to the study conception and design. A.B was responsible for material preparation, data collection, and analysis. O.P prepared the first draft of the manuscript, and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Ethical Approval

The study involving human participants was reviewed and approved by the regional ethics committee and review board. Written informed consent was obtained from all participants prior to their inclusion in the study.

Data Availability

The datasets supporting this study are not publicly available due to ethical restrictions but are available from the corresponding author on reasonable request and with permission from the Ministry of Health, Saudi Arabia.

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Conflict of Interest

The authors declare no conflict of interest.

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Reference

[1]. Long, J., 2014, Near-death experience: Evidence for their reality. *Mo Med*, 111(5):372–380.

[2]. van Lommel, P., 2014, Getting comfortable with near-death experiences: Dutch prospective research on near-death experiences during cardiac arrest. *Mo Med*, 111(2):126–131.

- [3]. Parnia, S., Waller, D. G., Yeates, R., Fenwick, P., 2001, A qualitative and quantitative study of the incidence, features and aetiology of near-death experiences in cardiac arrest survivors. *Resuscitation*, 48(2):149–156.
- [4]. Greyson, B., 2003, Incidence and correlates of near-death experiences in a cardiac care unit. *Gen Hosp Psychiatry*, 25(4):269–276.
- [5]. Parnia, S., Spearpoint, K., de Vos, G., Fenwick, P., Goldberg, D., Yang, J., et al., 2014, AWARE-Awareness during resuscitation- A prospective study. *Resuscitation*, 85(12):1799–1805.
- [6]. Moody, R. A., 2013, Getting comfortable with death & near-death experiences: An essay in medicine & philosophy. *Mo Med*, 110(5):368–371.
- [7]. Horstmann, G., 2015, The surprise-attention link: A review. *Ann N Y Acad Sci*, 1339:106–115.
- [8]. Ring, K., 1982, Precognitive and prophetic visions in near-death experiences. *Anabiosis*, 2:47–74.
- [9]. Ring, K., 1988, Prophetic visions in 1988: A critical reappraisal. *J Near-Death Stud*, 7(1):4–18.
- [10]. Shaw, N. A., 2024, The role of cerebral hypercarbia in the induction of the near-death experience. *J Nerv Syst Physiol Phenom*, 1(1):1–32.
- [11]. Martial, C., Rousseau, A. F., Dams, L., Massart, Q., Choquer, L., Cassol, H., et al., 2024, Phenomenological memory characteristics and impact of near-death experience in critically ill survivors: Observations at discharge and after a 1-year follow-up. *Int J Clin Health Psychol*, 24(3):100478.
- [12]. Schmied, I., Knoblauch, H., Schnettler, B., 1999, Todesnäheerfahrungen in Ost- und Westdeutschland—eine empirische Untersuchung. In: Knoblauch, H., Soeffner, H. G., eds. *Todesnähe: Interdisziplinäre Zugänge zu einem außergewöhnlichen Phänomen*. Konstanz: Universitätsverlag Konstanz: 217–250.
- [13]. Morse, M., 1996, Parting visions: A new scientific paradigm. In: Bailey, L. W., Yates, J., eds. *The near-death experience: A reader*. New York and London: Routledge: 299–318.
- [14]. Greyson, B., 1983, The near-death experience scale: Construction, reliability, and validity. *J Nerv Ment Dis*, 171(6):369–375.
- [15]. Rousseau, A. F., Dams, L., Massart, Q., Choquer, L., Cassol, H., Laureys, S., et al., 2023, Incidence of near-death experiences in patients surviving a prolonged critical illness and their long-term impact: A prospective observational study. *Crit Care*, 27(1):76.
- [16]. King, R. A., 2021, The irrelevance of time in near-death experiences (NDEs). *Academia Letters*, Article 2427.
- [17]. Romand, R., Ehret, G., 2023, Neuro-functional modeling of near-death experiences in contexts of altered states of consciousness. *Front Psychol*, 13:846159.
- [18]. Kopel, J., 2019, Near-death experiences in medicine. *Proc (Bayl Univ Med Cent)*, 32(1):163–164.
- [19]. Blanke, O., 2004, Out of body experiences and their neural basis. *BMJ*, 329(7480):1414–1415.
- [20]. Greyson, B., 2003, Incidence and correlates of near-death experiences in a cardiac care unit. *Gen Hosp Psychiatry*, 25(4):269–276.
- [21]. Schwanninger, J., Eisenberg, P. R., Schechtman, K. B., Weiss, A. N., 2002, A prospective analysis of near-death experiences in cardiac arrest patients. *J Near-Death Stud*, 20:215–232.
- [22]. Hashemi, A., Oroojan, A. A., Rassouli, M., Ashrafizadeh, H., 2023, Explanation of near-death experiences: A systematic analysis of case reports and qualitative research. *Front Psychol*, 14:1048929.
- [23]. Athappilly, G., Greyson, B., Stevenson, I., 2006, Do prevailing societal models influence reports of near-death experiences? *J Nerv Ment Dis*, 194(3):218–222.

Safety Climate and Practices in University Laboratories: Evidence from a Ghanaian Case Study

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Abstract

Academic laboratories in developing countries face numerous occupational health and safety (OHS) challenges due to limited resources, diverse hazards, and often underdeveloped safety systems. This study was conducted to evaluate the safety climate, occupational health and safety (OHS) knowledge, attitudes, and practices of laboratory workers in academic laboratories at the University of Cape Coast, Ghana. This cross-sectional study used the Nordic Safety Climate Questionnaire (NOSACQ-50), a standard questionnaire, direct workplace observations, and a decision matrix risk assessment to identify and evaluate hazards. The study was conducted in academic laboratories across three colleges at the University of Cape Coast, Ghana. The study included 104 laboratory staff members with at least one year of work experience in laboratory settings. Participants demonstrated high knowledge of OHS (mean score: 12.94 ± 2.76) and awareness (12.42 ± 2.39), but poor safety practices (12.06 ± 4.48) and inconsistent use of personal protective equipment (PPE). The overall safety climate score was low (2.45 ± 0.71), with management's safety commitment and justice rated poorly. Observations revealed inadequate PPE availability, lack of ergonomic infrastructure, and absence of incident reporting systems. High-risk hazards, including chemical inhalation, musculoskeletal injuries, and chemical splashes, were identified with risk scores of 20 each. The findings reveal significant gaps between OHS knowledge and safety practices in academic laboratories. These gaps highlight the need for improved resource allocation, stronger management engagement, enhanced safety training, and the establishment of dedicated OHS units to foster safer working environments and promote a robust safety culture in academic institutions.

Keywords: Academic Institutions, Ghana, Laboratory Safety, Occupational Health and Safety, Personal Protective Equipment, Risk Assessment, Safety Climate.

Introduction

Occupational health and safety (OHS) plays a pivotal role in managing risks and ensuring the well-being of individuals in various workplace settings. Laboratories, particularly those in academic institutions, present a unique

combination of physical, chemical, biological, and ergonomic hazards due to their dynamic and high-risk nature. These risks are compounded by the presence of diverse activities involving hazardous chemicals, biological agents, and sophisticated equipment. The consequences of inadequate safety

measures in these environments can include severe injuries, health complications, and damage to critical infrastructure.

Although usually used interchangeably, safety climate is a quick assessment of workers' perceptions, attitudes, and beliefs regarding risk and safety, whilst safety culture is the culmination of all an organization stands for and does in the name of safety [1, 2]. Assessing safety climate in the workplace is essential for understanding employees' perceptions of safety and identifying areas for improvement. Various tools have been developed and utilized across different industries to measure safety climate. These include the Safety Climate Assessment Tool (S-CAT), Safety Climate Tool (SCT), and the Psychosocial Safety Climate (PSC) Scale [3-5]. In 2011, a group of Nordic Occupational Safety Experts created the Nordic Safety Climate Questionnaire (NOSACQ-50) by drawing on organizational and safety climate theory, psychological theory, prior empirical research, empirical findings from global studies, and an ongoing development process [6]. The NOSACQ-50 evaluates seven key dimensions of safety climate, such as management's safety commitment, safety communication, and group safety norms. This comprehensive approach enables a nuanced understanding of the factors influencing safety behaviors, which is critical for identifying areas for improvement in academic laboratories.

Academic laboratories are complex environments characterized by diverse and evolving hazards. Globally, several studies have highlighted the risks associated with these settings, particularly exposure to chemical, biological, and ergonomic hazards. For instance, incidents such as chemical explosions and exposure to infectious agents have been reported in the United States and Singapore, underscoring the critical need for robust safety measures [7, 8]. An exposure to West Nile Virus was reported in Singapore in 2003 when a postgraduate microbiology student contracted the infection from a virus culture he was

working on. That culture was also contaminated with the SARS Coronavirus [8].

Research on OHS knowledge, attitudes, and practices has primarily focused on healthcare laboratories, with limited attention to academic settings. Studies conducted in Yemen and Nigeria revealed varying levels of biosafety knowledge and practices among laboratory workers, often influenced by resource availability and training opportunities [9, 10]. Similarly, a Jamaican study highlighted significant gaps in personal protective equipment (PPE) availability, which impeded compliance with safety protocols [11].

In higher education settings, studies from Indonesia and South Africa have reported inadequate safety compliance, with an average compliance rate of 54% and significant gaps in hazard identification and risk management [12, 13]. However, these studies often rely heavily on self-reported data, raising concerns about social desirability bias and the reliability of findings.

In the African context, there is a notable paucity of research on the safety climate in academic laboratories. The limited studies available often focus on healthcare workers and lack methodological rigor, such as standardized tools or observational methods.

Despite global efforts to improve laboratory safety, the unique challenges of academic settings in low-resource environments, such as those in Ghana, remain underexplored.

The necessity of this study lies in its focus on Ghana, a developing country where limited resources and systemic challenges hinder the implementation of comprehensive OHS practices in academic institutions. Our search in available literature found no published studies that assessed the safety climate, knowledge, attitudes, and practices of laboratory workers in Ghanaian universities. This study seeks to bridge these gaps by applying the Nordic Safety Climate Questionnaire (NOSACQ-50), alongside direct observations and risk assessments, to evaluate OHS in teaching and

research laboratories at the University of Cape Coast.

Methods

Study Setting

The University of Cape Coast is a public university located in the historic town of Cape Coast in the central region of Ghana. The university is one of the rare sea-front universities in the world and sits on a hill above sea level overlooking the Gulf of Guinea to the south. Geographically, the area occupied by the university lies at latitude 5.1155° North of the Equator and longitude 1.2909° West of the Prime Meridian. The university has many teaching and research laboratories for students, lecturers, and other academic community members.

Study Design and Duration

This cross-sectional study employed a comprehensive array of approaches. The Nordic Safety Climate Questionnaire (NOSACQ-50) assessed the safety climate perceptions of teaching and research laboratory staff. Hazards were meticulously identified through a questionnaire and surprise workplace visits to monitor work procedures. The study was conducted from May 2023 to August 2023.

Study Population, Sample, and Data Source

The study sample included 104 University of Cape Coast staff who work in various academic laboratories. The university has 25 chemical and medical laboratories in three Colleges, namely, College of Agriculture and Natural Sciences; College of Health and Allied Sciences and College of Health and Allied Sciences. To be included in this study, a laboratory staff member must have worked at the University for at least one year and be 18 years old or above. Following the inclusion criteria, the census sampling technique was used on all 104 eligible staff members.

Potential Sources of Bias

After identifying potential sources of bias, we implemented some steps to guarantee the validity and reliability of our findings. The two sources found were the potential for participants to provide responses that would be accepted in society and the experts' arbitrary evaluation of the risks. A range of extra data sources, such as incident registers, were used to offset these. To prevent subjectivity-related bias, three experts independently assessed the risks, and an observation checklist was incorporated to confirm the comments made by the participants.

Reliability Test

The Cronbach's alpha test was used to assess the reliability of sets of latent variables in each dimension. The results showed that all sets of items had a close relationship, with an acceptable to good alpha score range of 0.781–0.916 across the seven dimensions examined. The NOSACQ-50 was found to have an excellent score of 0.838 (Table 4).

Statistical Methods

The means and standard deviations were used to summarize continuous variables. The categorical variables were summarized using percentages and frequencies. Using multiple linear regression analysis, predictors of participants' knowledge of occupational health and safety were calculated. Multivariable linear regression was used to carry out adjusted analysis. The independent variables with a bivariate correlation greater than 0.70 were excluded from the multiple regression analysis to address the multicollinearity issue. The resultant multiple linear regression model was diagnosed and assessed for robustness and fitness using a few tests and indicators. Backward regression analysis was used to quickly exclude collinear and non-significant predictors from the model and find the best-fitting model for the data. Computer programs SPSS v 22 and EViews 12 were used to process

the data. A 95% confidence interval and a 5% threshold for statistical significance were used.

Instruments

Questionnaires

This study used the NOSACQ-50 and a standard questionnaire, developed from validated tools used in similar studies [14]. Ten University of Cape Coast Hospital laboratory employees participated in a pilot study to confirm the questionnaires' validity. This allowed for the necessary modifications to be made to the questionnaire. There were six parts to the developed questionnaire. Information on the sociodemographic characteristics of the respondents was the focus of Section A. Information regarding respondents' awareness, knowledge, and practices regarding occupational health and safety was acquired in Section B. The participants' attitudes toward risks and the application of occupational health and safety were evaluated in Section C. The workers' self-reported exposure to working hazards was assessed in Section D. Section E was used to collect information on workplace safety measures available for hazard control. At the same time, Section F examined how occupational risks affected the workforce the previous year.

Cumulative scores for the knowledge, attitude, practices, and awareness variables were combined and categorized into good and poor (knowledge and practice), low and high (awareness), and positive and negative (attitude) [15]. The obtained median score for every variable served as the basis for categorization. A score lower than the median was classified as low/poor/negative, while scores equal to or higher than the median were classified as high/good/positive.

NOSACQ-50 Questionnaire

The NOSACQ-50 questionnaire was used to gather employee perceptions of safety climate elements related to management and supervisor support for workplace safety. The NOSACQ-50

consists of 50 items spanning seven safety climate dimensions; the first three items address the workgroup's and management's safety rules, while the final four items (training, communication, and competency) address employees' obligations to practice safety [6]. The findings were analysed and interpreted per the author's instructions as follows: scores <2.70 were categorized as very low, 2.70–2.99 as fairly low, 3.00–3.30 as fairly good, and ≥ 3.00 as good [16]. The internal consistency of the NOSACQ-50 was assessed using Cronbach's alpha.

Observational Checklist

An observational checklist was developed following a review of previous related studies [17]. The part had eight sections: First aid, general security, electrical safety, fire safety, general safety, PPE availability, OHS rules, and worker PPE use.

Risk Assessment Form

The study modified a validated risk assessment matrix [18] from an earlier investigation to account for the observed hazards. Three experts utilized the form to assess the risks of the main hazards discovered throughout the risk identification procedures.

Risk Calculation

The probability (P) and severity (S) of the incident were multiplied to determine the risk score (R). The risk scores are defined as follows: insignificant risk (1), tolerable/low risk (2, 3, 4, 5, and 6), moderate/medium risk (8, 9, 10, and 12), significant/high risk (15, 16, and 20), and intolerable risk [18, 19].

Results

There were 99 participants in this study, representing 94% of all eligible respondents. The majority of respondents were males, 81 (81.8%), with the majority in the 30- 39 age group (48.5%). Most participants, 84 (84.8%), had at least five years of working experience as Laboratory workers in an institution of higher

education. Table 1 shows the demographic characteristics of the participants.

Table 1. Socio-Demographic Characteristics of Participants

Characteristic	Frequency (%)
Age group (years)	
20-29	3 (3.0)
30-39	48 (48.5)
40-49	42 (42.4)
50-59	6 (6.1)
Sex	
Male	81 (81.8)
Female	18 (18.2)
Educational level	
Certificate	51 (51.5)
Diploma	9 (9.1)
Bachelor's degree	39 (39.4)
Years of working at the University	
<5	15 (15.2)
5-10	36 (36.4)
11-15	15 (15.2)
>15	33 (33.2)

Knowledge and Awareness of Occupational Health and Safety

Respondents' knowledge of occupational health was good, with an overall mean score of 12.94 ± 2.76 (maximum score of 15). A multiple regression was run to predict Knowledge scores. Level of awareness, practice of safety precautions, and use of PPEs significantly predicted participants' knowledge scores. $F(3,92)=37.66$ $p<0.0005$. The general form of the equation is predicted knowledge scores = $3.423 + (0.425 \times \text{Awareness score}) + (0.184 \times \text{practice of precautions}) + (0.191 \times \text{Use of PPEs})$. Age group ($p=0.644$), sex ($p=0.958$), and years of working experience ($p=0.181$) were not significantly associated with knowledge scores.

Awareness and Practice of Safety Precautions

Respondents showed a high level of awareness of safety precautions in the

laboratory. The overall score for awareness was 12.42 ± 2.39 (maximum score of 14). Participants' overall score for their practice of safety precautions was poor (12.06 ± 4.48 , maximum score of 28). There was a moderate positive correlation ($r=0.484$, $p<0.0005$) between awareness and practice of safety precautions. Awareness was also significantly associated with the practice of OHS ($t=4.024$, $p=0.001$), use of PPEs ($t=2.456$, $p=0.016$), and knowledge scores ($t=3.688$, $p=0.0001$). Overall practice of safety precautions was significantly associated with knowledge scores ($t=0.342$, $p=0.006$) and use of PPEs ($t=2.341$, $p=0.022$). However, the practice of safety precautions was not significantly associated with attitude towards OHS ($t=0.540$, $p=0.588$). In comparison, all participants knew the need to be fully immunized against hepatitis B, but only 84(84.8%) knew about being vaccinated against tetanus. On their immunization status, only 42(42.4%) and 12(12.1%) had been immunized

against hepatitis B and tetanus, respectively. The self-reported awareness and practices of

safety precautions of respondents are shown in Table 2.

Table 2. Participants' Awareness and Practice of Safety Precautions

	Safety Precaution	Awareness		Practice	
		Yes (%)	No (%)	Always (%)	Sometimes (%)
1	Hand washing with a bactericidal agent	99 (100)	0	33 (33.3)	57 (57.6)
2	Taking regular breaks during work	78 (78.8)	21 (21.2)	9 (9.1)	54 (54.5)
3	Disinfecting office desks every day	99 (100)	0	30 (30.3)	54 (54.5)
4	Avoiding prolonged use of the computer	75 (75.8)	24 (24.2)	9 (9.1)	48 (48.5)
5	Correct body posture during procedures	84 (84.8)	15 (15.2)	27 (27.3)	39 (39.4)
6	Handling hot glasses with gloves or beaker tongs	78 (78.8)	21 (21.2)	18 (18.2)	33 (33.3)
7	Wearing gowns (apron) when working on chemicals	99 (100)	0	51 (51.5)	33 (33.3)
8	Wearing masks (goggles) to avoid eye splashes	90 (90.9)	9 (9.1)	33 (33.3)	48 (48.5)
9	Not opening glass ampoules with bare hands	93 (93.9)	6 (6.1)	42 (42.4)	36 (36.4)
10	Safe disposal of sharps	72 (72.7)	27 (27.3)	9 (9.1)	24 (24.2)

Education on Occupational Hazards

Even though a majority of respondents, 87 (87.8%), reported that they had received training in occupational health at least once in the course of their work, 51 (51.5%) reported having received formal training on occupational health in the last 12 months before the survey, and only 3 (3.0%) indicated that they received pre-employment training in occupational health and safety. The majority of participants, 93 (93.9%), were unaware of any existing protocols in the worksite that dealt with occupational exposures.

Perception of Risk and Attitudes Towards Occupational Safety

All participants perceived their jobs as risky, classifying them as high-risk 60(60.6%), medium-risk 21(21.2%), and low-risk

18(18.2%). Attitudes toward occupational health and safety among participants were high. There was an overall score of 48.12 ± 3.79 (maximum score of 55).

Availability of and Use of PPEs

Table 3 gives participants' reports on the availability and use of protective equipment. The most available and highly used equipment is the laboratory coat. Fire-resistant coats and fire blankets were the least available equipment. The overall availability score of 12.97 ± 5.04 was low (maximum score of 28). There was, however, a poor overall score for the use of the available equipment, 10.59 ± 4.92 (maximum score 28). There was a strong positive correlation between availability and use of protective equipment ($r=0.85$, $p<0.0005$).

Table 3. Availability and Use of Protective Equipment

	Equipment	Available		Use	
		Always (%)	Sometimes (%)	Always (%)	Sometimes (%)
1.	Face mask/shield	42 (42.4)	21 (21.2)	36 (36.4)	33 (33.3)
2.	Gloves	60 (60.6)	39 (39.4)	60 (60.6)	39 (39.4)
3.	Hand sanitizer	72 (72.7)	24(24.2)	54 (54.5)	36 (36.4)
4.	Hand washing facilities	60 (60.6)	39 (39.4)	69 (69.7)	30 (30.3)
5.	Lab coats/aprons	81 (81.8)	18 (18.2)	57 (57.6)	24 (24.2)
6.	Safety boots/shoes	45 (45.5)	54 (54.5)	54 (54.5)	15 (15.2)
7.	Chemical splash-resistant coat.	9 (9.1)	18 (18.2)	2 (2.0)	10 (10.1)
8.	Fire resistant coat	6 (6.1)	12 (12.1)	0	0
9.	Eye wash kit	9 (9.1)	18 (18.2)	5 (5.1)	12 (12.1)
10.	Fire blanket	3 (3.0)	18 (18.2)	0	0
11.	Safety shower	21 (21.2)	72 (72.2)	12 (12.1)	6 (6.1)

Perceived Effects of Occupational Hazards on Health

Respondents disclosed any health issues they had experienced in the year before the survey that they believed were related to their line of work. Low back pain 30 (30.3%), eye issues 24 (24.2%), neck pain 18 (18.2%), and wrist joint pain 15 (15.2%) were the main health issues reported.

Exposure to Hazards

Survey participants self-reported the prevalence of exposure to occupational hazards in any form in the year preceding the study. The most common physical hazards reported were high noise levels 54 (54.5%), trips and falls 50 (50.5%), heat 36 (36.4%), and poor ventilation in the labs 30 (30.3%). The main chemical hazards were reported as the presence of unlabeled and unmarked chemicals in laboratories 33 (33.3%) and exposure to flammable liquids 28(28.3%) and corrosive chemicals 25(25.3%). The most reported psychosocial hazards were working for long hours 66 (66.7%) and skipping meals, toilet breaks, and medications 48 (48.5%). With regards to biological hazards, needle pricks

were reported by 27 (27.3%), and direct contact with body fluids by 15 (15.2%). Regarding ergonomic hazards, 80 (80.9%) respondents reported the absence of non-adjustable chairs.

Reporting of Occupational Injuries

Of those surveyed, 33 (33.3%) said they consistently report workplace injuries, 51 (51.5%) sometimes report, and 15(15.2%) never report. Almost all (50, 83.3%) who do not always report occupational injuries indicated that nothing significant would be done about their complaints, with 30, 16.7% indicating that they are usually blamed for the accident. All respondents stated that no units or officers were designated to manage occupational health issues in their laboratories.

Safety Climate Perception Scores

A poor safety climate score of 2.45 ± 0.71 overall suggests much room for improvement. The safety climate elements that respondents saw as being most positive were safety communication, learning, and trust in coworkers' safety competence (3.25 ± 0.40) and trust in the effectiveness of safety systems (3.37 ± 0.43). Management safety justice (1.73 ± 0.36) and management safety priority,

commitment, and competence (1.69 ± 0.21) were the least positively rated. Cronbach's alpha, a measure of reliability, was acceptable for each of the seven scales.

Table 4 presents the mean distribution and Cronbach's alpha reliability results for the NOSACQ-50 across the seven dimensions.

Table 4. Respondents' Safety Climate Perception Scores Distribution for the Seven Safety Climate Dimensions

No.	Dimension	Items	Mean $\pm$ SD	Interpretation	Cronbach's α
1	Management safety priority, commitment, and competence	9	1.69 ± 0.21	Very low	0.781
2	Management safety empowerment	7	2.10 ± 0.15	Very low	0.714
3	Management safety justice	6	1.73 ± 0.36	Very low	0.695
4	Workers' safety commitment	6	2.06 ± 0.38	Very low	0.916
5	Workers' safety priority and risk non-acceptance	7	2.96 ± 0.31	Fairly low	0.794
6	Safety communication, learning, and trust in co-workers' safety competence	8	3.25 ± 0.40	Fairly good	0.881
7	Trust in the efficacy of safety systems	7	3.37 ± 0.43	Good	0.871
	Overall/Total	50	2.45 ± 0.71	Very low	0.838

Findings of Experts' Visits to the Laboratories

Physical Safety: There was no observable damp flooring; however, some slippery floors were observed with no warning signs. All the lighting arrangements were operating as intended. Most of the labs had local exhaust ventilation that ensured that the labs were adequately ventilated. Some staff were observed eating and drinking in the lab.

Ergonomic safety: Some of the labs visited did not have adjustable stools. Some staff were observed standing for prolonged periods to view microscopes. Some repetitive activities, such as using thumb-operated pipettes, were observed.

Electrical Safety: Most of the outlets were in good functioning order, and there were no overloaded extension cords. A few outlets and switches were damaged.

Fire Safety: All the labs visited had fire extinguishers and smoke detectors installed. Still, there was not a single conspicuous fire exit sign, no fire-resistant blankets on hand, and some of the labs had only one door for entry and exist.

Availability of PPEs: Every facility visited had face masks, goggles, safety boots, plastic aprons, and utility gloves available for inspection. There were eye-wash fountains and emergency showers in 80% of the labs visited. Some staff at work were not wearing lab coats or proper footwear. None was observed in the face mask, even though they were working on volatile chemicals and were generating aerosols from biological specimens. Those observed working on corrosive chemicals were not in goggles, even though these chemicals could splash into the face. The only PPE used by all staff observed at work was the gloves. Even though equipment such as the centrifuge made noise, no hearing protection device was

available at any of the labs visited, and thus, no staff was observed using them.

Policies: Several protocols and guidelines were observed in the various labs. However, none of the labs had a designated office or officer responsible for the occupational health and safety of staff.

Incident Register

There was no incident register in any of the labs visited to document the instances of occupational exposure.

Risk Assessment

Table 5 shows the results of the decision matrix risk assessment, which was obtained from all of the University of Cape Coast's (UCC) chemical and medical laboratories. This process discovered and evaluated common workplace dangers.

Staff were found to be most at risk of musculoskeletal injuries (Risk Score 20), chemical inhalation (Risk Score 20), cuts and traumatic injuries (Risk Score 20), and dermatitis (Risk Score 12).

Table 5. Risk Assessment Matrix Evaluating Common Hazards Identified at Academic Laboratories at the University of Cape Coast

Risk / Activity	Hazards	Probability of Occurrence (P)	Severity (S)	Risk Score (P x S)	Outcome	Proposed Control Measures
Chemical inhalation and inhalation of aerosols	Presence of a volatile chemicals, aerosols generated while working on a biological specimen, poor usage of face masks	5	4	20	HIGH RISK	The use of face masks at all times, the use of a local exhaust ventilation system
Slips and falls	Lack of safety signs for slippery surfaces	3	2	6	LOW RISK	Provision of safety signs for slippery surfaces and the use of appropriate footwear
Musculoskeletal injuries	Prolonged standing while viewing microscopes, non-adjustable stools, the use of thump pipetting	5	4	20	HIGH RISK	There is an urgent need for adjustable stools, provision of microscopes with affixed video cameras, the use of magnetic assist or programmable pipettes.
Needle stick injuries	Possible exposure to pathogens in biological specimens such as blood	2	5	10	MEDIUM RISK	Enforcing the use of gloves at all times, practice of proper sharp disposal techniques
Chemical splash to skin and eyes	Presence of un-labelled chemicals, not wearing lab coats	4	4	16	HIGH RISK	Enforcing rules on the wearing of lab coats at all times,

	and plastic aprons, poor use of goggles					using goggles and plastic aprons when appropriate
Hearing impairment	Non-availability of hearing protective devices	3	3	9	MEDIUM RISK	Provision and usage of earplugs/muffs

Discussion

This study assessed the safety climate in teaching and research laboratories at a higher education institution using the validated NOSACQ-50 tool, along with a questionnaire and a risk assessment. The overall safety climate score was very low (2.45 ± 0.71), pointing to systemic gaps in organizational support for occupational health and safety (OHS). These findings align with a Nigerian study conducted during the COVID-19 pandemic [20] but contrast with a Pakistani study, where participants rated the safety climate as good [14].

Participants' self-rated scores for safety communication, trust in co-workers' safety competence (3.25), and their trust in the efficacy of safety systems (3.37) were good, similar to what was found in the Pakistani study among the reference laboratory staff [14]. The low safety climate scores, particularly in areas related to management's safety commitment, justice, and empowerment, point to a systemic lack of organizational support for OHS. When workers perceive that management does not prioritize safety, they may be less likely to adhere to safety practices, even when they are knowledgeable about them.

Knowledge and Training

Participants exhibited high knowledge of OHS (97%), consistent with findings from studies in Malaysia [21] and Saudi Arabia [21, 22], where most laboratory workers demonstrated a strong grasp of OHS principles. This could be attributed to in-service training, as 87.8% of participants in this study reported receiving training post-employment.

Contrarily, studies in Yemen [9] and Iran [23] found lower OHS knowledge, highlighting variations due to differences in study populations, tools, and settings.

Safety Attitudes and Awareness

Participants demonstrated positive attitudes toward OHS, consistent with findings from Canadian [24] and Malaysian [21] studies, in which laboratory workers prioritised safety. However, no significant association was found between attitudes and sociodemographic variables such as age, sex, and occupation. Awareness of OHS practices was high, as seen in the Malaysian study, [21] but gaps in communication and policy dissemination limited the practical application of this awareness.

Safety Practices

Safety practices were poor, with only 36.4% consistently using PPEs like face masks or shields. This finding aligns with a previous study [24], which found that only 40% of academic researchers reported wearing PPE while working. It also aligns with an earlier study indicating that academic researchers are less likely to wear protective gear than their industry counterparts [25], suggesting that PPE use among academic laboratory staff warrants greater global attention. The gap between positive attitudes and low safety practices suggests a need for more robust enforcement and behavioral reinforcement.

Hazard Perception and Risk Management

All participants perceived their work environment as dangerous, with 60.6% rating it

as high-risk. This perception contrasts with studies in high-resource settings where laboratories are generally perceived as safe. Interestingly, even though all participants perceived their work environment as high-risk, yet there was a noticeable lack of proactive safety measures. This paradox may stem from a normalisation of risk, where workers become desensitised to hazardous conditions over time, as postulated by Wilde in the risk homeostasis theory [26]. Additionally, time pressures, workload demands, and the absence of clear incentives for safety compliance can lead workers to prioritize productivity over safety practices.

Risk Evaluation

The risk assessment matrix revealed significant hazards within the academic laboratories at the University of Cape Coast, with multiple high-risk activities identified. The most critical risks included musculoskeletal injuries, chemical inhalation, and traumatic injuries, each receiving a high-risk score of 20. These hazards were primarily attributed to poor ergonomic practices, such as prolonged standing and the use of non-adjustable stools, and exposure to volatile chemicals due to insufficient use of local exhaust ventilation and improper handling of chemicals. Additionally, the inconsistent use of personal protective equipment (PPE), such as face masks, aprons, and goggles, compounded these risks, leaving workers vulnerable to chemical splashes and aerosolized biological specimens.

Medium-risk activities included needle-stick injuries, which pose a significant threat of exposure to bloodborne pathogens, and chemical splashes to the skin and eyes due to unlabeled chemicals and inadequate safety protocols. Low-risk activities, such as slips and falls, were also noted but could be mitigated through basic interventions, such as installing proper safety signs and ensuring clean, dry floors.

The findings highlight the urgent need for comprehensive control measures to mitigate these risks. These include improving the availability and consistent use of PPE, implementing ergonomic solutions such as adjustable stools and programmable pipettes, and enhancing the ventilation infrastructure. Furthermore, regular training on chemical handling and strict adherence to labeling protocols are essential to minimize exposure to hazardous substances. Addressing these issues is vital to creating a safer working environment and reducing the incidence of occupational injuries in academic laboratories.

Incident Reporting

The study revealed low rates of injury reporting, with only 33.3% consistently reporting workplace injuries. Similar trends were observed in Pakistan and other settings, where fear of blame and perceived inaction discouraged reporting. This highlights the need for institutional support and the establishment of dedicated OHS offices. Furthermore, the high underreporting of injuries due to fear of blame or lack of action from management reinforces a culture where safety concerns are marginalized. This aligns with prior research suggesting that a lack of safety justice can erode trust and discourage workers from engaging with safety initiatives [2, 27]. Management should invest in employee safety empowerment by encouraging workers to participate in decisions that affect their safety and setting up designated offices to address all issues related to occupational health.

Recommendations

1. Establish OHS Units: Create designated offices with trained officers to oversee safety protocols and manage incident reporting.
2. Enhance Management Engagement: Prioritize safety through leadership commitment, accountability, and clear communication.

3. Improve Resource Allocation: Ensure the availability of essential PPE, ergonomic tools, and emergency response systems.
4. Integrate Training Programs: Provide pre-employment and ongoing safety training for laboratory staff.
5. Develop Clear Policies: Standardize safety procedures for hazard identification, mitigation, and emergency response.

Conclusion

This study provides critical insights into the occupational health and safety (OHS) climate of teaching and research laboratories at the University of Cape Coast, a prominent academic institution in Ghana. By employing the Nordic Safety Climate Questionnaire (NOSACQ-50) alongside direct observations and a decision matrix risk assessment, this research presents a comprehensive evaluation of safety practices, hazards, and perceptions among laboratory staff. This study underscores the critical need for improved OHS practices in Ghanaian academic laboratories. While knowledge and awareness were high, systemic gaps in management commitment, resource allocation, and incident reporting hinder safety practice adherence. Addressing these issues through targeted interventions can foster a safer working environment and a stronger safety culture in academic institutions.

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Conflict of Interest

All authors declare no conflict of interest.

Author Contributions

All authors contributed to the study conception and design. *James Kojo Prah* was responsible for material preparation, data collection, analysis, and draft preparation. *Ebenezer Aggrey, Andreas Kudom, and Benedict Addo-Yeboah* prepared the first draft of the manuscript, and all authors commented on previous versions. All authors read and approved the final manuscript.

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Ethical Approval

The study involving human participants was reviewed and approved by the University of Cape Coast Ethical Review Board (Approval No: UCC/IRB/EXT/2023/13). Written informed consent was obtained from all participants prior to their inclusion in the study. The collected data was anonymized to maintain confidentiality. It was kept on a computer that required a password to ensure data protection.

Data Availability

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

References

[1]. Kalteh, H. O., Mortazavi, S. B., Mohammadi, E., & Salesi, M., 2021, The relationship between safety culture and safety climate and safety performance: a systematic review. *Int J Occup Saf Ergon*, 27(1): 206–216, <https://doi.org/10.1080/10803548.2018.1556976>

[2]. Mearns, K. J., & Flin, R., 1999, Assessing the state of organizational safety—culture or climate? *Curr. Psychol*, 18(1), 5–17, <https://doi.org/10.1007/s12144-999-1013-3>

[3]. Probst, T. M., Goldenhar, L. M., Byrd, J. L., & Betit, E., 2019, The Safety Climate Assessment Tool (S-CAT): A rubric-based approach to measuring construction safety climate. *J. Saf. Res*, 69, 43–51,

ISSN 0022-4375,
<https://doi.org/10.1016/j.jsr.2019.02.004>

[4]. Health and Safety Executive (HSE), 2011, Measuring the safety climate in organizations. Available from chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://books.hse.gov.uk/gempdf/Measuring_the_Safety_Climate_in_Organisations.pdf

[5]. Loh, M. Y., Dollard, M. F., McLinton, S. S., & Brough, P., 2024, Translating psychosocial safety climate (PSC) into real-world practice: two PSC intervention case studies. *JOH*, 66 (1): uiae051, <https://doi.org/10.1093/jocculh/uiae051>

[6]. Kines, P., Lappalainen, J., Mikkelsen, K. L., Olsen, E., Pousette, A., Tharaldsen, J., Tómasson, K., & Törner, M., 2011, Nordic Safety Climate Questionnaire (NOSACQ-50): A new tool for diagnosing occupational safety climate. *Int. J. Ind. Ergon*, 41(6): 634–646, <https://doi.org/10.1016/j.ergon.2011.08.004>

[7]. Minister, A., 2015, Unsafe science. *NFPA J*, Available at <http://www.nfpa.org/newsandpublications/nfpa-journal/2015/september-october2015/features/unsafe-science>

[8]. Singh, K., 2009, Laboratory-Acquired Infections. *Clin. Infect. Dis*, 49(1) : 142–147, <https://doi.org/10.1086/599104>

[9]. Al-Abhar, N., Al-Gunaid, E., Moghram, G., Al-Hababi, A. A., Al Serouri, A., & Khader, Y. S., 2017, Knowledge and Practice of Biosafety Among Laboratory Staff Working in Clinical Laboratories in Yemen. *Appl Biosaf*, 22(4): 168–171, <https://doi.org/10.1177/1535676017733451>

[10]. Fadeyi, A., Fowotade, A., Abiodun, M. O., Jimoh, A. K., Nwabuisi, C., & Desalu, O. O., 2011, Awareness and practice of safety precautions among healthcare workers in the laboratories of two public health facilities in Nigeria. *Niger. Postgrad. Med. J*, 18(2): 141–146.

[11]. Vaz, K., McGrowder, D., Alexander-Lindo, R., Gordon, L., Brown, P., & Irving, R., 2010, Knowledge, awareness and compliance with universal precautions among health care workers at the University Hospital of the West Indies, Jamaica. *Int J Occup Environ Med*, 1(4):171–181.

[12]. Lestari, F., Bowolaksono, A., Yuniautami, S., Wulandari, T. R., & Andani, S., 2019, Evaluation of the implementation of occupational health, safety, and environment management systems in higher education laboratories. *J. Chem. Health Saf*, 26(4–5): 14–19, <https://doi.org/10.1016/j.jchas.2018.12.006>

[13]. Mugivhisa, L. L., Baloyi, K., & Oluwole Olowoyo, J., 2021, Adherence to safety practices and risks associated with toxic chemicals in the research and postgraduate laboratories at Sefako Makgatho Health Sciences University, Pretoria, South Africa. *Afr J Sci Technol Innov Dev*, 13(6): 747–756, <https://doi.org/10.1080/20421338.2020.1797269>

[14]. Roghani, M., Haroon, Z. H., Munir, M. U., Kirmani, S. I., Anwar, M., & Younas, M., 2023, Laboratory Safety Climate Assessment and its Correlation with Safety Procedures Amongst Staff of a Reference Clinical Laboratory. *J Coll Physicians Surg Pak*, 33(11): 1259–1263, <https://doi.org/10.29271/jcpsp.2023.11.1259>

[15]. Aluko, O. O., Adebayo, A. E., Adebisi, T. F., Ewegbemi, M. K., Abidoye, A. T., & Popoola, B. F., 2016, Knowledge, attitudes and perceptions of occupational hazards and safety practices in Nigerian healthcare workers. *BMC Res Notes*, 9(1), <https://doi.org/10.1186/s13104-016-1880-2>

[16]. Det Nationale Forskningscenter for Arbejdsmiljø, 2024, Interpreting the Nordic Occupational Safety Climate Questionnaire NOSACQ-50 results. Available at <https://Nfa.Dk/Vaerktoejer/Spoergeskemaer>.

[17]. Alshalani, A. J., & Salama, K. F., 2019, Assessment of Occupational Safety Practices Among Medical Laboratory Staff in Governmental Hospitals in Riyadh, Saudi Arabia. *J. Saf. Stud*, 5(1): 1–23, <https://doi.org/10.5296/jss.v5i1.14992>

[18]. Uca, M., & Alizadehebadi, L., 2021, Risk Analysis and Assessment Using Decision Matrix Risk Assessment Technique in Sports: The Case of Boxing. *PJMHS*, 15(10): 2971–2976, <https://doi.org/10.53350/pjmhs2115102971>

[19]. Prah, J. K., Aggrey, E., Kudom, A., & Addo-Yeboah, B., 2025, Assessment of occupational risks among academic staff in a Ghanaian public

university. *Texila Int J Public Health*, 13(2),
Doi:10.21522/TIJPH.2013.13.02.Art001.

[20]. Moda, H. M., Dama, F. M., Nwadike, C.,
Alatni, B. S., Adewoye, S. O., Sawyerr, H., Doka, P.
J. S., & Danjin, M., 2021, Assessment of Workplace
Safety Climate among Healthcare Workers during
the COVID-19 Pandemic in Low and Middle
Income Countries: A Case Study of Nigeria.
Healthcare, 9(6): 661,
<https://doi.org/10.3390/healthcare9060661>

[21]. Paul, E., Abidin, E. Z., Mahmud, N. A., &
Ismail, N. H., 2022, Assessment of Knowledge,
Attitude and Practice on Occupational Safety and
Health among Laboratory Workers in OSHMS
Certified and Non-Certified Public Universities in
Malaysia. *MJMHS*, 18(5): 3–12,
<https://doi.org/10.47836/mjmhs18.5.2>

[22]. Alquraini, R. A., Allehyani, M. M., Wasl, M.,
Almogati, S., Alsulami, A. A., Alsulami, B. O.,
Alotaibi, Y. M. S., Alotaibi, F. F. M., & Almalki, M.
Y., 2022, Assessment of Knowledge, Attitude, and
Practice on Laboratory Occupational Safety and
Health among Healthcare Workers. *JPPW*, 6(2):
2735–2743, <http://journalppw.com>

[23]. Nasab, H. S., Ghofranipour, F., Kazemnejad,
A., Khavanin, A., & Tavakoli, R., 2009, Evaluation
of Knowledge, Attitude and Behavior of Workers
towards Occupational Health and Safety. *Iran J
Public Health*, 38(2):125-129.

[24]. Ayi, H. R., & Hon, C. Y., 2018, Safety culture
and safety compliance in academic laboratories: A
Canadian perspective. *J. Chem. Health Saf*, 25(6): 6–
12, <https://doi.org/10.1016/j.jchas.2018.05.002>

[25]. Schröder, I., Huang, D. Y. Q., Ellis, O., Gibson,
J. H., & Wayne, N. L., 2016, Laboratory safety
attitudes and practices: A comparison of academic,
government, and industry researchers. *J.
Chem. Health Saf*, 23(1):12–23,
<https://doi.org/10.1016/j.jchas.2015.03.001>

[26]. Wilde, G. J. S., 1998, Risk homeostasis theory:
an overview: Figure 1. *Inj. Prev*, 4(2): 89–91,
<https://doi.org/10.1136/ip.4.2.89>

[27]. Enwere, O. O., & Diwe, K. C., 2014,
Knowledge, perception and practice of injection
safety and healthcare waste management among
teaching hospital staff in southeast Nigeria: an
intervention study. *Pan Afr. med. J*, 17:218,
<https://doi.org/10.11604/pamj.2014.17.218.3084>

Clinical Study of Dickkopf-Related Protein 1 and its Relation with Biomarkers of Bone Resorption in Patients with Metabolic Syndrome

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Abstract

Metabolic syndrome (MetS) is a global health concern, with potential complications affecting bone health. Dickkopf-1 (DKK1) may serve as a marker for MetS progression, particularly when analyzed alongside other bone metabolism markers such as Bone Gamma Osteocalcin (BGP-OST), calcitonin, and intact parathyroid hormone (I-PTH). To evaluate the correlations between DKK1 levels and bone metabolism markers (BGP-OST, calcitonin, and I-PTH) in patients with MetS, this case-control study included 88 participants (60 MetS patients and 28 healthy controls). Based on data distribution, biomarker levels were analyzed using one-way ANOVA or Kruskal-Wallis H tests. Correlations were assessed using Spearman's test, with $p < 0.05$ considered statistically significant. The diagnostic utility of DKK1 was evaluated using ROC curve analysis. No significant differences were observed between MetS patients and controls for DKK1, I-PTH, or calcitonin levels, whereas BGP-OST levels were significantly higher in MetS patients ($p < 0.05$). In MetS patients, DKK1 showed a significant negative correlation with calcitonin, while BGP-OST had a significant positive correlation with calcitonin. DKK1 demonstrated diagnostic potential with an AUC of 0.758 and a 4.11 ng/mL cut-off value. DKK1 is significantly correlated with calcitonin and shows diagnostic utility for MetS. Elevated BG-OST levels in MetS patients further suggest its potential role in bone metabolism alterations associated with MetS progression.

Keywords: Bone Metabolism, Calcitonin, DKK1, Intact Parathyroid Hormone (I-PTH), Metabolic Syndrome, Osteocalcin.

Introduction

A cluster of abdominal obesity, hyperglycemia, hypertension, and dyslipidemia characterizes metabolic syndrome (MetS). The global prevalence of MetS is approximately 31%, associated with a two-fold increase in the risk of coronary heart disease and cerebrovascular disorders, as well as a 1.5-fold increase in all-cause mortality [1-2]. Central to MetS is insulin resistance, which is linked to the accumulation of body fat, dyslipidemia, diabetes, and hypertension. Conversely, peripheral fat distribution is metabolically less impactful.

MetS negatively influences bone mineral density (BMD), which correlates positively with physical activity. Individuals with MetS often exhibit reduced physical activity, leading to early signs of decreased BMD at the hip and a higher incidence of osteoporosis [3]. Bone is a metabolically active tissue undergoing continuous remodeling, driven by circulating cytokines and hormones. Abnormalities in this process can weaken bone structure, impair mechanical strength, and manifest as clinical symptoms, including deformities and disrupted homeostasis [4].

Studies suggest MetS contributes to inflammation and osteoarthritis, with obesity,

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dyslipidemia, insulin resistance, and hypertension recognized as primary metabolic risk factors. This "deadly quartet" disrupts physiological processes, causing detrimental bone and cartilage changes and perpetuating a pro-inflammatory joint microenvironment [5].

Dickkopf-related protein 1 (DKK1) is a key regulator of embryogenesis and bone remodeling. It is a potent natural inhibitor of the Wntless (Wnt) signaling pathway, crucial for osteoblastogenesis and bone formation. Overexpression of DKK1, particularly in osteoblasts, is implicated in metabolic bone diseases and arthritis [6]. The Wnt pathway governs the differentiation of mesenchymal stem cells into osteoblasts or fibroblasts. DKK1 activation inhibits Wnt signaling, reduces β -catenin translocation to the nucleus, and ultimately downregulates osteoblast activity [7-8]. Bone-related proteins, such as osteocalcin, parathyroid hormone (PTH), and calcitonin, also play pivotal roles in bone and energy metabolism. Osteocalcin, secreted by osteoblasts, extends its influence beyond bone mineralization to regulate reproduction, metabolism, and cognition [9]. PTH, traditionally known for calcium homeostasis, is now recognized as a multifunctional hormone affecting adipocyte browning and lipolysis [10]. Calcitonin, produced by thyroid parafollicular cells, suppresses bone resorption by inhibiting osteoclast activity and is a clinical marker for medullary thyroid carcinoma [11].

The bone-specific isoform of osteocalcin, Bone gamma osteocalcin (BGP-OST), has been identified as a critical factor in regulating bone metabolism and systemic glucose homeostasis. BGP-OST enhances insulin production and reduces insulin resistance, further establishing its role in metabolic regulation. In a cross-sectional study of patients 18 years and older who met the NCEP-ATP III criteria for metabolic syndrome, serum osteocalcin levels, including BGP-OST, were positively associated with lower fasting blood glucose and higher serum HDL cholesterol levels.

Additionally, individuals with fewer components of metabolic syndrome exhibited higher serum osteocalcin levels, including BGP-OST, compared to those with more components [12].

Patients with metabolic syndrome tend to have lower serum osteocalcin and BG-OST levels, highlighting their significant association with glucose metabolism and adipose tissue regulation. Furthermore, BG-OST plays a regulatory role in systemic inflammation, contributing to its broader impact on metabolic health [13].

The aim of this study is to investigate the relationship between metabolic syndrome (MetS) and bone disorders, especially focusing on the role of Dickkopf-related protein 1 (DKK1) as a key representative in future diagnostic and therapeutic strategies. To analyze the correlation between DKK1 levels and bone resorption markers (such as Bone gamma osteocalcin (BGP-OST), calcitonin, and parathyroid hormone) in patients with MetS, aiming to determine its role in bone metabolism disruption related to MetS.

Materials and Methods

Participants and Study Design

This case-control study included 88 participants (60 with Metabolic Syndrome [MetS] and 28 healthy controls) recruited from Kirkuk and Azadi Teaching Hospitals, Kirkuk City, Iraq, between June and September 2024. Participants were selected through a systematic random sampling method to minimize selection bias. MetS was diagnosed based on the NCEP ATP III criteria, requiring the presence of at least three of the following components [14]:

1. Abdominal obesity: Waist circumference >102 cm (male), >88 cm (female).
2. Reduced HDL cholesterol: <40 mg/dL (male), <50 mg/dL (female).
3. Elevated fasting triglycerides: >150 mg/dL.
4. Elevated fasting glucose: >100 mg/dL.
5. High blood pressure: $\geq 130/85$ mmHg.

Exclusion Criteria

Participants were excluded if they had:

1. Endocrine disorders, rheumatoid arthritis, liver disease, chronic kidney disease ($\text{eGFR} < 60 \text{ mL} \cdot \text{min}^{-1} \cdot 1.73 \text{ m}^2$), malignancy, or cerebrovascular diseases.
2. Use of medications affecting bone metabolism, such as vitamin D, alfacalcidol, calcitonin, calcium, bisphosphonates, estrogen, thiazolidinediones, glucocorticoids, or SGLT-2 inhibitors.

Data Collection and Anthropometric Measurements

Participants were interviewed using a structured and pretested questionnaire to gather demographic and clinical data, including age, weight, height, and waist circumference. Waist circumference was measured at the midpoint between the lower rib margin and the iliac crest using a flexible, non-stretchable tape, ensuring snug but non-compressive placement. Body mass index (BMI) was calculated as weight (kg) divided by height (m^2).

Laboratory Analysis

Fasting blood samples (6 mL) were collected via venipuncture, allowed to clot at room temperature, and processed as follows:

1. 3 mL in plain gel tubes for serum separation to measure fasting blood glucose, HDL cholesterol, and triglycerides using the colorimetric method (BIOLABO Kit, France).
2. 3 mL in plain gel tubes stored at -80°C and thawed only once before analysis for biomarkers:
 - DKK1 (Cat. No. ELK2097, Lot No. 27426701) and I-PTH (Cat. No. ELK2427, Lot No. 27427413) via ELISA kits from ELK Biotechnology.
 - BGP-OST (Cat. No. QS1308Hu, Lot No. 20240826) and Calcitonin (CT)

(Cat. No. QS0391Hu, Lot No. 20240826) via ELISA kits from SunLong Biotech.

Statistical Analysis

Data were analyzed using SPSS software (version 25, IBM, USA). Descriptive statistics were presented as mean $\pm$ standard deviation (SD) for continuous variables. The Kolmogorov-Smirnov/Shapiro-Wilk tests assessed normality. Statistical methods included:

1. One-way ANOVA for normally distributed data.
2. Kruskal-Wallis H tests with post hoc Dunn test for non-normally distributed data.
3. Pearson's or Spearman's correlation analyses based on data distribution.
4. ROC analysis will evaluate the predictive power of DKK1 and BGP-OST, with cut-off values determined using the Youden index.
5. Statistical significance was set at $P < 0.05$.

Ethical Approval

The ethical committees of Azadi Teaching Hospital, Kirkuk Teaching Hospital, and the Kirkuk Health Directorate approved the study. In compliance with the Declaration of Helsinki, written and verbal informed consent was obtained from all participants.

Results

Demographics and Baseline Characteristics

The study included 88 participants (60 with MetS and 28 healthy controls). The mean age of participants was comparable between groups, with a higher prevalence of overweight and obesity among MetS patients (Table 1). It was observed that 30.7 % and 1.1% of the controls were normal and overweight, respectively (Table 2).

Table 1. Age Distribution by Group and Sex

Group	N (Total)	Sex	N	% within total	Mean Age $\pm$ SD	Range
MetS Patients	60	Male	28	31.8%	50.93 $\pm$ 9.53	29–60
MetS Patients	60	Female	32	36.3%	48.09 $\pm$ 10.95	18–60
Control Group	28	Male	18	20.5%	45.61 $\pm$ 8.76	26–59
Control Group	28	Female	10	11.4%	43.20 $\pm$ 6.30	35–54
Overall Total	88	–	–	–	48.85 $\pm$ 9.50	18–60

Table 2. BMI Distribution in Metabolic Syndrome Patients

BMI Category	Male (n)	Female (n)	Total (n)	% of Total (n=60)
Normal (18.5–24.9)	4	3	7	8.0%
Overweight (25–29.9)	11	10	21	23.9%
Obese Class I (30–34.9)	9	7	16	18.2%
Obese Class II (35–39.9)	3	5	8	9.1%
Obese Class III (>40)	1	7	8	9.1%
Total	28	32	60	100%

Metabolic Parameters

Patients with MetS exhibited significantly elevated fasting glucose and triglyceride levels,

alongside reduced HDL-C levels, compared to controls (Figure 1). These findings align with the diagnostic criteria for MetS.

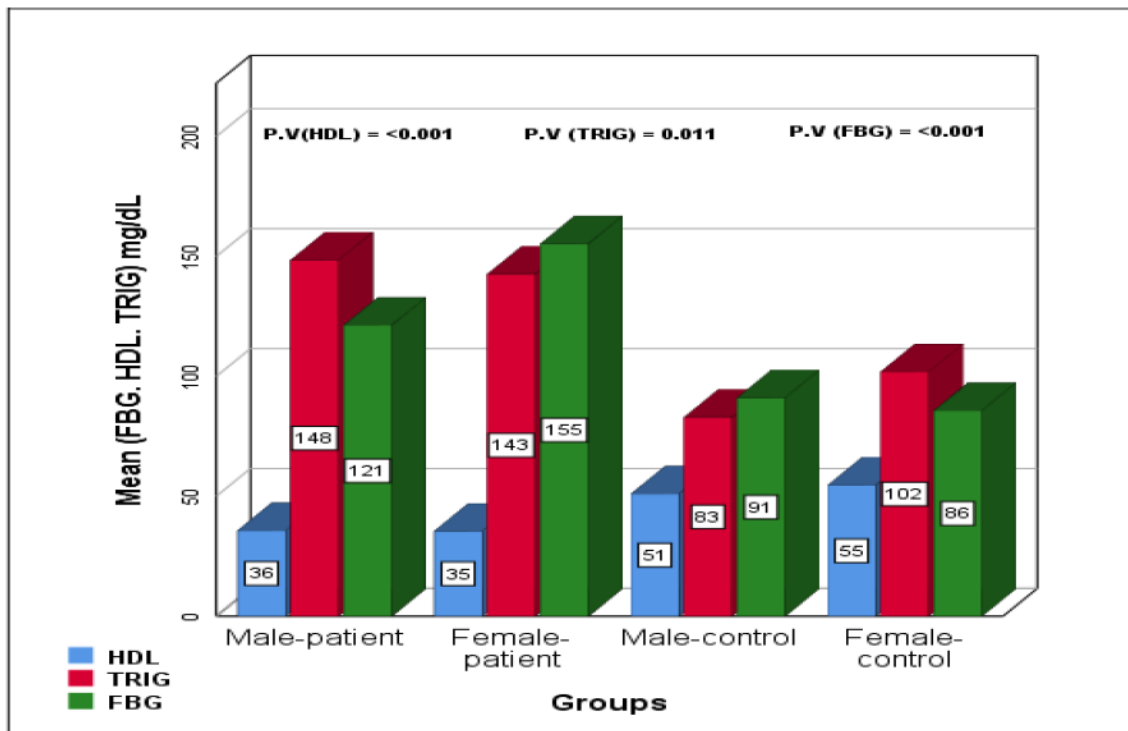


Figure 1. Comparison Between Patients with MetS and Control Groups with Both Genders Regarding Mean $\pm$ Standard Deviation (SD) of Serum Fasting Blood Glucose (FBG), Triglyceride (TRIG), and HDL

Biomarker Analysis: DKK1 Levels: No significant difference between groups, though a trend of higher levels in MetS patients was observed ($P = 0.361$). Also, Calcitonin and I-PTH have shown no significant difference

between groups ($P > 0.05$; See Table 3). BGP-OST Levels: Significantly lower in MetS patients than controls ($P < 0.001$; Table 4), indicating potential disruptions in bone metabolism.

Table 3. Comparison Between Patients with Metabolic Syndrome and Control Groups with Both Sexes Regarding the Mean $\pm$ Standard Deviation (SD) of DKK1, CT, and I-PTH

Studied groups	N	Markers	Total (Mean ± SD)	Male (Mean ± SD)	Female (Mean ± SD)
Patients with MetS	60	DKK1(ng/mL)	4.96 ± 1.24	4.73 ± 1.19	5.17 ± 1.26
Patients with MetS		CT(pg/mL)	10.37±14.73	10.65±11.27	10.13±17.38
Patients with MetS		I-PTH(pg/mL)	41.30 ± 18.70	41.49 ± 18.14	41.15 ± 19.48
Control group	28	DKK1(ng/mL)	4.65 ± 1.46	4.53 ± 1.57	4.88 ± 1.27
Control group		CT(pg/mL)	10.37 ± 7.80	10.52 ± 8.61	10.11 ± 6.51
Control group		I-PTH(pg/mL)	40.39 ± 17.67	46.13 ± 14.70	30.07 ± 18.55
P-Value within subgroups			DKK1= 0.361	CT=0.805	I-PTH=0.256
DKK1 (One- way ANOVA), CT, and I-PTH ((Kruskalls- wallis H)					

Table 4. Comparison Between Patients with Metabolic Syndrome and Control Groups with Both Sexes Regarding the Mean $\pm$ Standard Deviation (SD) of BGP-OST

Studied groups	N	BGP-OST Mean ± SD		
		Total	Male	Female
Patients with MetS	60	P 1.44 ± 1.47	M-P 1.52 ± 1.11	F-P 1.38 ± 0.73
Control group	28	C 2.54 ± 1.03	M-C 2.64 ± 1.03	F-C 2.39 ± 1.07
P-value between the two groups	P * C	< 0.001	0.001	0.001
	M-P * F-C	0.017		
	M-C * F-P	< 0.001		
	M-P * F-P	0.230		
	M-C * F-C	0.579		
P-Value (Kruskalls- wallis H)	88	< 0.001		
Male-Patient (M-P), Male-Control (M-C), Female-Patient (F-P), Female-Control (F-C)				

Correlation and Predictive Value: In the MetS group, DKK1 negatively correlated with CT ($r = -0.332$, $P = 0.009$), while BGP-OST

positively correlated with CT ($r = 0.432$, $P = 0.001$). See Figures 2 and 3.

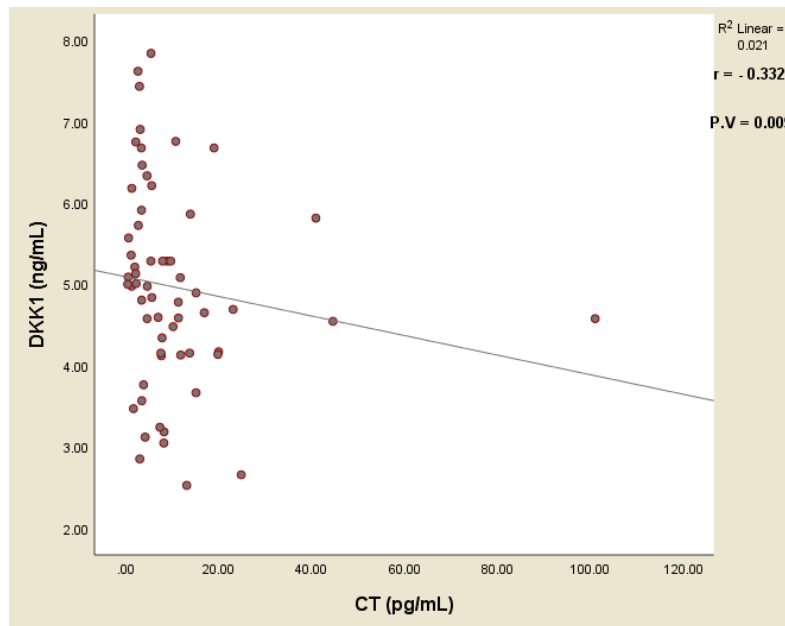


Figure 2. Correlation between Serum BGP-OST Levels and Serum CT Levels in Patients with Metabolic Syndrome

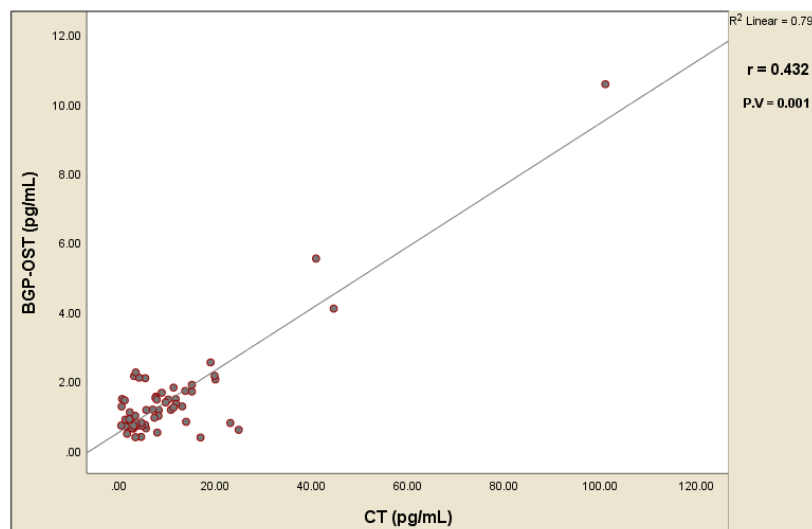


Figure 3. Correlation between Serum DKK1 Levels and Serum I-PTH Levels in Patients with Metabolic Syndrome

The ROC analysis (Table 5) demonstrated moderate diagnostic utility for DKK1 (AUC = 0.758, P = 0.014; Figure 4), while BGP-OST showed limited predictive value (AUC = 0.612, P = 0.140; Figure 5).

Table 5. The Data of the ROC Curve for the Following Biomarker (Patient Group)

Biomarker (patient group)	AUC	S.E	Confidence Intervals (CI)	Sen %	Spe %	Acc%	PPV%	NPV%
DKK1	0.758	0.102	0.558-0.958	76.56	54.17	70.45	81.67	46.43
BGP-OST	0.612	0.074	0.467-0.757	91.30	57.14	75	70	85.71

Sen = Sensitivity, Spe = Specificity, Acc = Accuracy

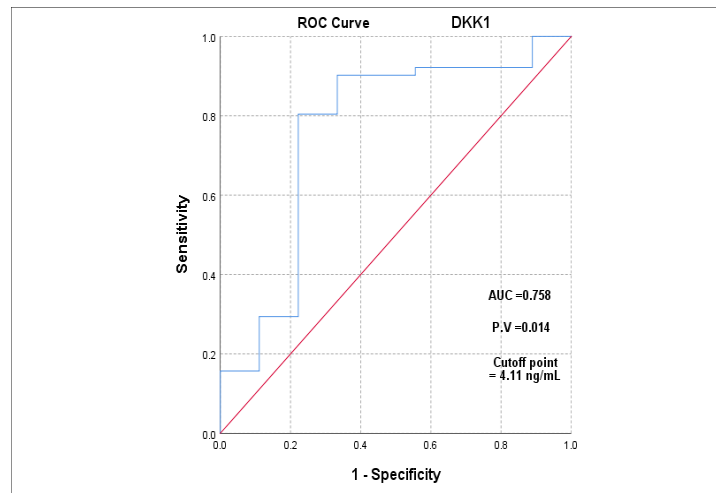


Figure 4. The ROC Curve of DKK1

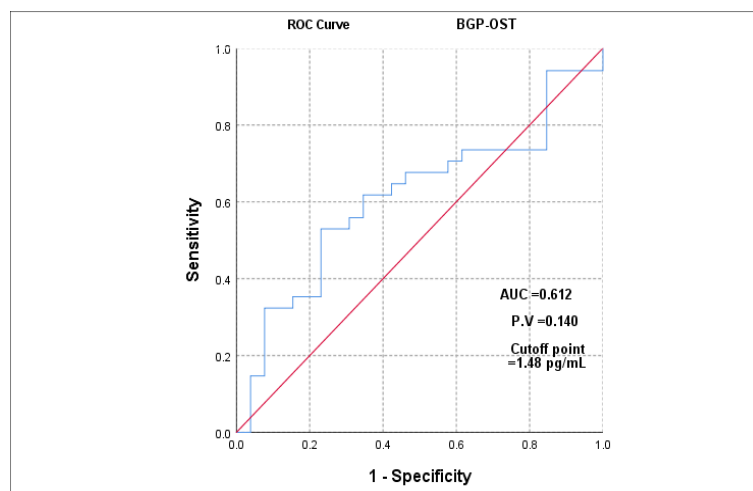


Figure 5. The ROC Curve of BG-OST

Discussion

It is important to estimate the incidence of MetS in our country because of the global increase in MetS prevalence, especially MetS risk factors, abdominal obesity, hyperglycemia, and hypertension, which have increased among the population, leading to an increased incidence of untreated MetS among Mediterranean countries. This study concluded that a higher incidence of MetS was in females (36.3%) than males (31.8%). This distribution agrees with a study in Iraq and another that suggested a higher incidence of MetS among females than males [15-16] (Table 1).

This study showed that the percentage proportion of BMI among most study participants was overweight and obese 1. It has been observed that obesity and abdominal

obesity increased in the Middle East and North Africa (MENA) region involving (18) countries at different economic levels, classified (Jordan, and Iraq) as upper-middle-income level, and about one-fifth of the adults considered as obese, increasing, with age increase, gender, income, nutrition patterns, education, and urbanization. [17]. The relation of BMI with insulin resistance and Type 2 diabetes mellitus, a complication of MetS, was confirmed by Ilyas et al in Iraqi overweight and obese adults [18] (Table 2).

Dickkopf 1 (DKK1) is a protein linked with metabolic diseases, including insulin resistance (IR). In this study, we found that there is no statistical difference in the mean of the patient group with MetS and control subgroups by one-way ANOVA (P.Value = 0.361) Table 3, even

studies found that had a relation with insulin resistance but more of these studies found DKK1 had a relation with complications of MetS as diabetes mellitus (DM) and congenital heart disease (CHD), maybe as the MetS become more complicated and progress to diseases with years to DM and CHD, the DKK1 become more obvious. The studies about DKK1 in MetS were not found; rather, they were related to MetS complications. The following studies explain the complications of MetS, such as DM and CHD. A study found that serum DKK1 levels were elevated in patients with Insulin resistance than in controls and positively correlated with BMI, systolic blood pressure, Triglycerides, blood glucose, and glycosylated hemoglobin HbA1c [19]. Also, a study in Egypt found that serum DKK1 was elevated in type 2 DM patients with prolonged duration and inadequate glycemic control compared to controls [20].

The study found that patients with MetS had significantly lower serum BGP-OST levels than controls (Table 4). A study done by Liu X et al. demonstrated that both forms of osteocalcin (carboxylated **cOST** and uncarboxylated **ucOST**) at lower levels were related to metabolic health (e.g., higher glucose, triglycerides, and lower HDL) [21]. Osteocalcin has been linked to reducing insulin resistance. A study by Viswanath et al. indicated that higher total osteocalcin levels are associated with lowering blood glucose and elevated HDL cholesterol, suggesting its protective effect [22].

Calcitonin levels in this study were not significantly different between patients and control subgroups (Table 3). Because the research about calcitonin in MetS was limited, other studies showed significant differences between patients and control groups compared to this study; a study found that serum calcitonin levels in Type 2 DM patients were lower than those in the control group [23].

I-PTH levels in this study were not significantly different between patient and

control subgroups (Table 3). Given the limited research on calcitonin and PTH in MetS, measuring these levels was crucial to confirm that participants did not have bone metabolic diseases. The lack of significant differences supported the accuracy of our findings. A study reported higher serum I-PTH -Vitamin D3 ratio levels in individuals with MetS than those without it. It suggested that it could predict chronic inflammation and dyslipidemia, which aligns with our observations [24]. Similarly, a study found elevated serum I-PTH levels in patients with diabetic mellitus and chronic kidney disease [25]. In contrast, another study indicated that reduced I-PTH levels were associated with decreases in BMI and diastolic blood pressure [26].

Results on Novel Correlations Between DKK1, BGP-OST, and calcitonin in Bone Metabolism

The roles of DKK1, BGP-OST, and calcitonin in bone metabolism are well-recognized, yet their interrelationships remain underexplored. This study investigates the correlations between serum DKK1 and calcitonin levels ($r = -0.332$, $p = 0.009$) and between BGP-OST and calcitonin levels ($r = 0.432$, $p = 0.001$). The findings supply new insights into the potential interplay of these biomarkers in regulating bone homeostasis and may inspire future research directions in bone disease diagnostics and therapeutics. Bone metabolism is a dynamic process regulated by several factors, involving hormones, signaling molecules, and bone-specific proteins. DKK1, a key modulator of the Wnt/ β -catenin signaling pathway, has been implicated in bone density regulation and osteoporosis. Calcitonin, a hormone secreted by parafollicular cells of the thyroid gland, inhibits osteoclast activity, thus reducing bone resorption. BGP-OST, a marker of bone formation, reflects osteoblastic activity and overall bone turnover. Despite their roles in an individual's bone health, limited data exist on the direct correlations between these

biomarkers. This study fills this gap by investigating the relationships between DKK1, BGP-OST, and calcitonin levels.

1. Correlation between DKK1 and Calcitonin: A statistically significant negative correlation ($r = -0.332$, $p = 0.009$) was identified, suggesting an inverse relationship between DKK1 and calcitonin levels (Figure 2).
2. Correlation between BGP-OST and Calcitonin: A statistically significant positive correlation ($r = 0.432$, $p = 0.001$) was observed, indicating a potential link between osteoblastic activity and calcitonin (Figure 3).

The inverse correlation between DKK1 and calcitonin supports the hypothesis that these biomarkers may have opposing roles in bone metabolism. While DKK1 is recognized to prevent bone formation through Wnt signaling, calcitonin's inhibitory effect on osteoclasts could counteract DKK1's impact on bone resorption.

The positive correlation between BGP-OST and calcitonin emphasizes a potential feedback mechanism in which calcitonin may support bone formation by promoting osteoblastic activity. These findings relate to understanding the complex interplay of molecular and hormonal factors in bone homeostasis. The ROC curve analysis highlights the diagnostic potential of DKK1 and BGP-OST in metabolic syndrome. DKK1 showed a moderate diagnostic performance with an AUC of 0.758, suggesting its utility as a biomarker for characterizing metabolic syndrome (Figure 4). Conversely, BGP-OST showed lower diagnostic differentiation (AUC = 0.612) but displayed high sensitivity (91.30%), suggesting

its potential role in early detection (Table 5, Figure 5). This study provides novel evidence of significant correlations between DKK1, BGP-OST, and calcitonin levels, and insights into their possible roles in bone metabolism. Additionally, the ROC analysis suggests that DKK1 and BGP-OST may be useful biomarkers for metabolic syndrome, with distinct diagnostic characteristics [27-30]. Further research, including mechanistic and longitudinal studies, is needed to support these findings and search for their clinical implications in bone diseases.

Conclusion

Although serum DKK1 levels were not significantly different between patients and control subgroups, DKK1 demonstrated a significant relationship with calcitonin. It displayed diagnostic potential (significant ROC) for identifying patients with metabolic syndrome (MetS). This suggests a possible role of DKK1 in the progression of MetS into more complex diseases involving bone health. Furthermore, the significant difference in serum BGP-OST levels between patients with MetS and controls suggests the potential impact of MetS on bone metabolism. These findings emphasize the importance of further research into the reciprocal action between metabolic syndrome and bone health to better understand and alleviate disease progression.

Funding

This research did not receive funds.

Conflict of Interest

The authors declare no conflict of interest.

References

[1]. Azrak, H. I., & Sarhat, E. R. (2026). Serum Klotho as a feasible diagnostic biomarker for metabolic syndrome in Iraqi adults aged over 50 years. *Journal of Associated Medical Sciences*,

59(2), 178–186. retrieved from <https://he01.tci-thaijo.org/index.php/bulletinAMS/article/view/283498>

[2]. Al Ghadeer HA, AlRamadan MS, Al Amer MM, Alshawaf MJ, Alali FJ, Bubshait AA, Alramadhan MA, Almurayhil Z, Aldandan NS,

- AlKhamis MA, AlHaddad HA, AlOmair A. Vitamin D Serum Levels in Type 2 Diabetic Patients: A Cross-Sectional Study. *Cureus*. 2022 Feb 24;14(2):e22558.
- [3]. Toaama, H.R., Sarhat, E.R., Mohammed, H.S. Metformin modulated adipokines biochemical markers in type 2 diabetes patients. *Georgian Medical News*, 2024, 350(5), pp. 95–97
- [4]. Salim J.Khalaf, Gadeer Hatem Aljader, Thuraia Rifaat Sarhat. (2021). Anti-diabetic effect of Aqueous Extract of Medicago Sativa with Enhanced Histopathology of Pancreas in Alloxan Induced Diabetic Rats. *P J M H S* .2021; 15(2): 492- 496.
- [5]. Sarhat RS, Siham A.W, Ayhan R. M. Effect of Ethanolic Extraction of Moringa oleifera on Paraoxonase and Arylesterase enzyme activity in High Fat Diet-induced Obesity in Rats. *Research J. Pharm. and Tech*.2018; 11(10): 4601-4. 8.
- [6]. Sarhat, E., Wadi, S. A., Sedeeq, B., Sarhat, T. R., Jasim, N. Study of histopathological and biochemical effect of Punica granatum L. extract on streptozotocin -induced diabetes in rabbits. *Iraqi Journal of Veterinary Sciences*, 2019; 33(2): 189-194. doi: 10.33899/ijvs.2019.125523.1045 .
- [7]. Zbaar, S.,khalaf, S. Association of C-Reactive Protein with Risk of Complications of diabetic nephropathy. *Egyptian Journal of Chemistry*, 2022; 65(8): 181-186. doi: 10.21608/ejchem.2021.99957.4868.
- [8]. Sarhat ER, Rmaid ZJ, Jabir TH (2020) Changes of salivary interleukine17, Apelin, Omentin and Vaspin levels in normal subjects and diabetic patients with chronic periodontitis, *Ann Trop Med & Pub Health*; 23:S404.
- [9]. Zoch, M. L., Clemens, T. L., Riddle, R. C., 2016, New insights into the biology of osteocalcin. *Bone*,82:42–49.
- [10]. Tay Donovan, Y. K., Bilezikian, J. P., 2024, Interactions between PTH and adiposity: appetizing possibilities. *Journal of Bone and Mineral Research*, zjae056. <https://doi.org/10.1093/jbmr/zjae056>
- [11]. Kiriakopoulos, A., Giannakis, P., Menenakos, E., 2022, Calcitonin: current concepts and differential diagnosis. *Therapeutic Advances in Endocrinology and Metabolism*, 13:20420188221099344.
- [12]. Viswanath, A., Vidyasagar, S., Amrutha Sukumar, C., 2023, Osteocalcin and Metabolic Syndrome. *Clinical Medicine Insights: Endocrinology and Diabetes*, 16:11795514231206728. <https://doi.org/10.1177/11795514231206729>
- [13]. Ugurlu, I., Akalin, A., Yorulmaz, G., 2022, The Association of Serum Osteocalcin Levels with Metabolic Parameters and Inflammation in Postmenopausal Women with Metabolic Syndrome. *Metabolic Syndrome and Related Disorders*, 20(4):219–223. <https://doi.org/10.1089/met.2021.0074>
- [14]. Expert Panel on Detection, 2001, Executive summary of the third report of the National Cholesterol Education Program (NCEP) expert panel on detection, evaluation, and treatment of high blood cholesterol in adults (adult treatment panel III). *JAMA*, 285(19):2486–2497. <https://doi.org/10.1001/jama.285.19.2486>
- [15]. Farmanfarma, K., et al., 2021, Incidence of and factors associated with metabolic syndrome, south-east Islamic Republic of Iran. *Eastern Mediterranean Health Journal*, 27(11):1084–1091.
- [16]. Zamil, A. H., Amin, S. S., 2022, The prevalence of metabolic syndrome among university students in Wasit, Iraq. *Saudi Medical Journal*, 43(11):1240–1247. <https://doi.org/10.15537/smj.2022.43.11.20220558>
- [17]. Nikoloski, Z., 2023, Obesity in Middle East, in *Metabolic Syndrome: A Comprehensive Textbook*, Ahima, R. S. (Ed.), Springer International Publishing, Cham, pp. 65–80. https://doi.org/10.1007/978-3-031-40116-9_6
- [18]. Ilyas, K. H., Tratsiakova, V. M., 2021, The Relationship Between Body Mass Index and Biochemical Parameters in Type 2 Diabetes Mellitus in Nineveh City in Iraq. *NVEO – Natural Volatiles & Essential Oils Journal*, 2021:8112–8127.
- [19]. Li, S., et al., 2023, Dickkopf1 (DKK1) as a Potential Biomarker in Polycystic Ovary Syndrome and Insulin Resistance: A Cross-Sectional Study. *International Journal of Molecular Sciences*, 25(12):6330. <https://doi.org/10.21203/rs.3.rs-2988034/v1>

- [20]. Kamel, A. A., et al., 2022, The Role of Vitamin D, DKK1, Hecpidin and Oxidative Stress Biomarkers in Type 2 Diabetes Mellitus Patients with and Without Diabetic Nephropathy. *The Egyptian Journal of Hospital Medicine*, 89(2):7137–7146. <https://doi.org/10.21608/ejhm.2022.273057>
- [21]. Liu, X., et al., 2021, Associations of Osteocalcin Forms with Metabolic Syndrome and Its Individual Components in Older Men: The Health in Men Study. *The Journal of Clinical Endocrinology & Metabolism*, 106(9):e3506–e3518. <https://doi.org/10.1210/clinem/dgab358>
- [22]. Kumar, V., et al., 2023, Association of serum osteocalcin with beta cell function, insulin resistance, and glycemic parameters in south Indian type 2 diabetic subjects. *International Journal of Diabetes in Developing Countries*, 43(3):469–475. <https://doi.org/10.1007/s13410-022-01087-y>
- [23]. Taher, Z. M., Ahmed, S. N., 2023, Estimation of serum calcitonin, phosphate, and calcium in type 2 diabetes mellitus. *Zanco Journal of Medical Sciences*, 27(2):205–212.
- [24]. Alemzadeh, R., Kichler, J., 2012, Parathyroid Hormone Is Associated with Biomarkers of Insulin Resistance and Inflammation, Independent of Vitamin D Status, in Obese Adolescents. *Metabolic Syndrome and Related Disorders*, 10(6):422–429. <https://doi.org/10.1089/met.2012.0056>.
- [25]. Elsurur, R., Afsar, B., Guner, E., Yildiz, I., 2011, Targeting Parathyroid Hormone Level in Diabetic Patients with Stage 3 to 5 Chronic Kidney Disease: Does Metabolic Syndrome Matter? *Journal of Renal Nutrition*, 21(3):219–225. <https://doi.org/10.1053/j.jrn.2010.04.006>
- [26]. Ministrini, S., et al., 2020, Determinants of High Parathyroid Hormone Levels in Patients with Severe Obesity and Their Relationship with the Cardiometabolic Risk Factors, Before and After a Laparoscopic Sleeve Gastrectomy Intervention. *Obesity Surgery*, 30(6):2225–2232. <https://doi.org/10.1007/s11695-020-04453-z>
- [27]. Baron, R., Kneissel, M., 2013, WNT signaling in bone homeostasis and disease: from human mutations to treatments. *Nature Medicine*, 19(2):179–192. <https://doi.org/10.1038/nm.3074>
- [28]. Karsenty, G., Ferron, M., 2012, The contribution of bone to whole-organism physiology. *Nature*, 481(7381):314–320. <https://doi.org/10.1038/nature10763>
- [29]. Khosla, S., Hofbauer, L. C., 2017, Osteoporosis treatment: recent developments and ongoing challenges. *The Lancet Diabetes & Endocrinology*, 5(11):898–907. [https://doi.org/10.1016/S2213-8587\(17\)30188-2](https://doi.org/10.1016/S2213-8587(17)30188-2)
- [30]. Seibel, B. A., 2016, Cephalopod Susceptibility to Asphyxiation via Ocean Incalescence, Deoxygenation, and Acidification. *Physiology*, 31(6):418–429. <https://doi.org/10.1152/physiol.00061.2015>

Dietary Diversity Practices of Pregnant Women and Associated Factors among Women Attending Public Hospitals in Gambella Town, Southwest Ethiopia

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Abstract

Inadequate dietary diversity among pregnant women in Ethiopia remains a major public health concern, with approximately half of the women affected. Understanding context-specific dietary practices and associated factors is essential for effective intervention. This study assessed dietary diversity practices of pregnant women and their determinants among women attending public hospitals in Gambella Town, Southwest Ethiopia. An institution-based prospective cohort design was employed from July 25, 2024, to September 10, 2024, using a single-stage cluster sampling approach. Data were collected using an interviewer-administered questionnaire with KoboCollect software and analyzed in SPSS version 25. Dietary diversity was assessed twice using a 24-hour dietary recall. A modified Poisson regression model was applied, and statistical significance was declared at $p < 0.05$. All 254 participants completed the first follow-up, yielding a 100% response rate. The prevalence of inadequate dietary diversity practice was 76.4%. Factors significantly associated with being exposed included having at least one child under five years (ARR = 1.27; 95% CI: 1.03–1.57), lack of television in household (ARR = 1.19; 95% CI: 1.02–1.40), lack of antenatal care (ARR = 1.25; 95% CI: 1.02–1.53), gastritis (ARR = 1.29; 95% CI: 1.13–1.47), and meals or snacks frequency of only 1–4 times per day (ARR = 1.41; 95% CI: 1.17–1.69). The prevalence of inadequate dietary diversity practice was high. Strengthening nutrition education through mass media, improving antenatal nutrition counseling on meal frequency and diversity, and enhancing the screening and management of gastritis with smaller, more frequent meals were recommended.

Keywords: Dietary Diversity, Gambella, Pregnant Women, Southwest Ethiopia.

Introduction

Malnutrition among pregnant women remains a public health concern, largely driven by inadequate and poor-quality dietary practices during pregnancy [1-3]. Dietary diversity can be categorized as inadequate or adequate based on the number of food groups consumed [4]. The Minimum Dietary Diversity for Women (MDD-W) is a standardized Dietary Diversity (DD) indicator for women based on

ten food groups [5]. It is used to assess dietary diversification and micronutrient adequacy at the population level among women aged 15-49 years [5]. It also reflects the quality of diets, based on micronutrient intake, for individual women who consume at least five of the ten defined food groups in a 24-hour recall period [5]. Accordingly, the MDD-W guide categorizes maternal DD as adequate DD and inadequate DD based on the Minimum Dietary Diversity Score (MDDS), which is obtained by

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summing up points scored for intake of foods in the ten food groups of MDD-W [5]. The MDDS ≥ 5 indicates adequate Minimum Dietary Diversity (MDD), whereas MDDS < 5 indicates inadequate MDD [5]. Consuming at least five of the ten food groups has been associated with higher micronutrient adequacy in women aged 15 to 49 compared to those consuming fewer than five [5]. Evidence showed that low maternal consumption of nutrient-dense foods such as nuts, poultry, and eggs, combined with high intake of refined grains and sugar-sweetened beverages, was associated with a lower prevalence (46.2%) of adequate MDDS ≥ 5 and a higher prevalence (53.8%) of inadequate MDDS < 5 [6]. Diets heavily reliant on maize-based foods (100 grams), which provide limited lipids and essential micronutrients, such as vitamins A, C, and E, calcium, iodine, and selenium, further contribute to poor nutritional status due to low dietary diversity, reduced nutrient bioavailability, and nutrient losses during processing [7]. Although plant-based foods, whole grains, and dietary fibers are indicators of carbohydrate quality, excessive consumption of refined carbohydrates and added sugars is associated with adverse health effects [8]. Although plant-based foods can improve health, they are not usually considered as a complex combination of nutrients and food elements [8]. In contrast, fortified and enriched staple foods, including dairy products and grains, provide essential micronutrients, such as calcium, vitamin D, potassium, and dietary fiber [8].

Inadequate dietary practices during pregnancy are more common than during other periods due to eating habits and dietary patterns associated with various factors [9, 10]. The prevailing habits in Ethiopia are predominantly characterized by the consumption of starchy foods and minimal intake of organ meats, which are believed to contribute to the persistence of nutritional deficiencies and the high prevalence of inadequate MDD [4]. The practice of

inadequate MDD during pregnancy in Ethiopia ranged from 49.0% to 73.6% [2, 11-13]. The prevalence of low DD was 53.2%, and low food consumption was 19.7% in the East Gojjam Zone of the Amhara Region [14]. Inadequate MDD ranged from 39.8% to 72.6% among pregnant women with acute undernutrition and from 27.4% to 60.2% among those without acute undernutrition in Chinaksen District, Eastern Ethiopia [15]. Additionally, inadequate MDD was reported among 49.0% of pregnant women in Southwest Ethiopia [12] and 51.6% in Addis Ababa [11]. Overall, the combined prevalence of inadequate MDD practices among pregnant women in Ethiopia ranged from 53.0% to 56.6% [4, 16].

Dietary patterns and diversity during pregnancy have both positive and negative effects on the risk of unfavorable pregnancy outcomes and complications for both mothers and fetuses [17, 18]. Poor dietary quality, diversity, and malnutrition during pregnancy are associated with numerous complications and adverse outcomes, such as Hypertensive Disorders of Pregnancy (HDP), Preterm Delivery (PTD), Low Birth Weight (LBW), and maternal anaemia [17-21]. Undernutrition, low-quality diets, or suboptimal diets with low energy and micronutrients during pregnancy have been linked to unfavourable or adverse pregnancy outcomes, poor fetal growth, PTD, poor infant survival, and an increased risk of chronic diseases later in life [6, 22]. These unfavorable pregnancy outcomes for mothers and their newborns are referred to as Adverse Pregnancy Outcomes (APOs). These include PTD, LBW, Diabetes Mellitus (DM), Small-for-Gestational-Age (SGA), HDP, placental abruption, and pregnancy loss [17, 18]. Maternal anaemia with adverse effects, defined as a haemoglobin (Hb) concentration below 10.0 g/dl at any stage of pregnancy, is strongly associated with adverse maternal and fetal outcomes, including intrauterine growth retardation and preterm birth [23]. As such,

maternal anemia is considered one of the key diet-related APOs [23].

Appropriate nutritional interventions and adequate dietary intake during the preconception period and pregnancy can enhance the quality of a diet, resulting in optimal gestational weight gain (GWG) and favorable birth outcomes [6]. Diet-related problems during pregnancy can lead to complications such as anemia and other adverse pregnancy outcomes, affecting both mothers and their newborns [24, 25]. These nutrition-linked complications, including maternal mortality, perinatal mortality, PTD, LBW, and hypertension, continue to pose serious public health challenges in Ethiopia [26]. The persistently high burden of inadequate dietary diversity, the increasing prevalence of diet-associated Non-Communicable Diseases (NCDs) such as HDP, anemia, LBW, and PTD, highlight significant regional and local disparities in Ethiopia [4, 26].

These findings underscore the urgent need to understand and address the complex relationships between dietary practices, associated factors, and pregnancy-associated outcomes. Despite this need, evidence on dietary diversity practices during pregnancy, associated factors, and risks of adverse pregnancy outcomes remains limited in the study area. There has been no previous study conducted in the Gambella Regional State and Gambella Town on dietary diversity practices during pregnancy and their associated factors. Therefore, this study aimed to assess the burden of dietary diversity practices during pregnancy and associated factors among pregnant women attending public hospitals in Gambella Town, Southwest Ethiopia.

Methods and Materials

Study Setting and Design

This institution-based prospective cohort study was conducted to determine exposure status based on the average MDDS among pregnant women attending public hospitals in

Gambella Town, the capital city of Gambella Regional State. Gambella Town or Gambella City Administration is situated 766 km west of Ethiopia's capital, Addis Ababa. It is located in the Western Lowlands of Ethiopia, at an elevation of 526 meters above sea level along the banks of the Baro River. It is administratively organized into five kebeles (the smallest administrative unit or sub-district level), namely Kebele 01, 02, 03, 04, and 05. Based on projections from the 2007 Ethiopian Population and Housing Census, the town has an estimated total population of 69,784, with 34,194 males and 35,590 females [27]. During the 2016 Ethiopian Fiscal Year (corresponding to 2023-2024 Gregorian Calendar (G.C.)), approximately 2,094 pregnant women were estimated to reside in the town. This study was conducted from July 25, 2024, to September 10, 2024, at Gambella Town Primary Hospital (GTPH) and Gambella General Hospital (GGH), the only public hospitals providing comprehensive antenatal and delivery services in the town.

Study Population

Pregnant women who were permanent residents of Gambella Town (those who had lived there for at least 6 months) were considered the source population. The target population included all pregnant women aged 15 to 49 who were permanent residents. The study population consisted of all pregnant women of reproductive age who attended Antenatal Care (ANC) services at GTPH and GGH during the study period. The sample was pregnant women selected from the study population based on predefined inclusion and exclusion criteria. The sampled participants were followed prospectively and assessed twice, yielding two groups: the exposed and unexposed groups. The exposed group comprised pregnant women who consumed inadequately diverse diets of less than five of the ten food groups twice or an average intake of less than five food groups over the two 24-

hour dietary recall periods, while the unexposed group included pregnant women who consumed adequately diverse diets of five or more food groups twice or an average intake of five or more food groups over two 24-hour recall periods, as per the MDD-W guide [5].

Inclusion and Exclusion Criteria

Pregnant women aged 15-49 who were permanent residents of Gambella Town and had a Gestational Age (GA) between 12 and 27 completed weeks at enrollment were eligible for inclusion. Additional inclusion criteria included having no known hypertension [Blood Pressure (BP) < 140/90 mm Hg without taking any antihypertensive medication], a baseline maternal Hb level ≥ 10.0 g/dl, willingness to attend routine ANC visits until delivery at the study hospitals, and provision of written informed consent. Pregnant women with BP < 140/90 mm Hg while on any antihypertensive medication or known chronic hypertension under treatment, or those whose delivery was decided or planned outside the study hospitals (e.g., at home or in other facilities) were excluded from the study.

Sample Size Determination and Sampling Procedures

The sample size was determined using the G*Power 3.1.9.7 computer program written by Franz Faul to detect a true Relative Risk (RR) or a difference in outcome proportions (P_1-P_2) between the exposed and unexposed groups using Fisher's exact test for two independent groups. The calculation assumed a 2-sided test with 85% power ($Z_{1-\beta} = 1.04$); a 95% confidence level [$Z_{\alpha/2} = 1.96$], and a type I error rate (α) of 5%. The proportion of inadequate DD practice among in the exposed

group (P_1) was assumed to be 60.2%, while the proportion of adequate DD practice among the exposed group (P_2) was of 39.8% yielding an absolute difference of 20.4% and an estimated relative risk of 1.51. An allocation ratio (N_2/N_1) of 0.66 was applied based on prior evidence among postpartum women in Gambella Town [28]. The DD findings from postpartum women were considered a good approximation proxy for DD during pregnancy, as this study represented the only available evidence using the ten food groups recommended by the MDD-W guide. After accounting for a 10% non-response rate to compensate for potential loss to follow-up, a final sample size of 254 pregnant women was determined.

Gambella Town has two hospitals, the GTPH and the GGH, which served as the study sites. According to District Health Information Software 2 (DHIS2) data records, 528 (71.6%) and 210 (28.4%) pregnant women were registered for their first ANC at GTPH and GGH, respectively, during the 2015 Ethiopian Fiscal Year (2022-2023). This indicated average monthly enrollment of 44 and 18 pregnant women at first ANC visits in GTPH and GGH, respectively. Consequently, proportional sample allocation, based on the size of pregnant women attended at ANC, was 182 and 72 for GTPH and GGH, respectively. A single-stage cluster sampling technique was employed, with each hospital considered a primary sampling unit. All eligible pregnant women attending ANC services at the respective hospitals were consecutively enrolled with inclusion criteria and informed written consent, until the required sample size for each hospital was reached. This cohort study's sampling procedures and participants' flow were illustrated schematically (Figure 1).

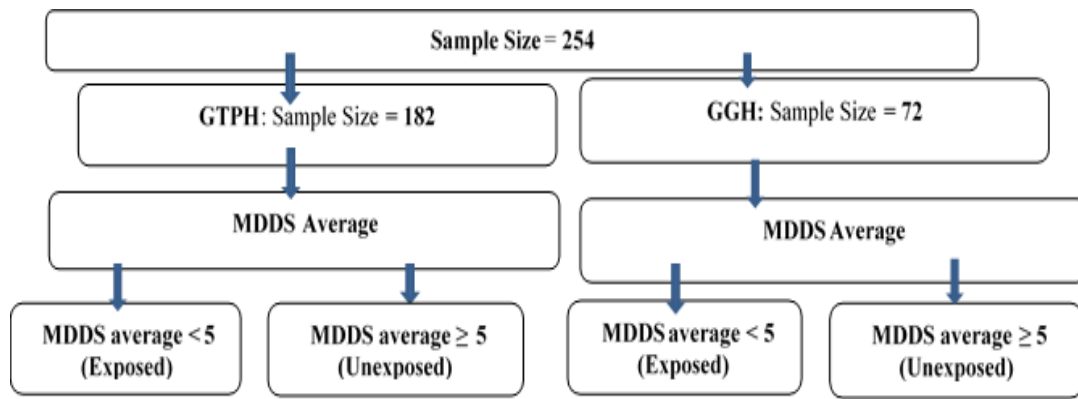


Figure 1. The Cohort of Pregnant Women Enrolled and Followed up for Exposure in Public Hospitals in Gambella Town, Southwest Ethiopia, 2024.

Study Variables

Dependent Variable

The dependent variable was DD practices during pregnancy, categorized as inadequate DD practice (exposed group) and adequate DD practice (unexposed group) based on the MDDS.

Independent Variables

Socio-demographic characteristics assessed included location of residence in Gambella Town; ethnicity; religion; marital relationship; age of the pregnant woman and her partner; education level of the pregnant woman and her partner; occupation types for a woman and her partner; family size or family members, such as pregnant woman, her partner, other wives of the husband, and their children).

Sociocultural characteristics included food taboos; cultural beliefs against weight gain during pregnancy; meal-sharing practices with a pregnant woman; family members and close relatives support for meal-sharing practices; age at the time of her marriage; practices of polygamous marriage by partner; partner's support of the household with food in kind or cash; number of children under five years in the household; number of relatives or visitors (non-family members who lived or stayed as a household within a month of dietary data collection); household size or number of household members (family members, relatives, guests, or visitors who lived or stayed

as a household within a month of dietary data collection).

Household socio-economic characteristics included household income; per capita or average income; household food insecurity status based on the Household Food Insecurity and Access Scale (HFIAS); household economic status based on wealth index quintiles; ownership of seven durable assets [television (TV), fridge, phone, car, bicycle, cheap utensils, such as a chair, table, clock, watch, water cooker, radio, fan, or mixers with price $\leq$ 50 United States Dollar (USD) or $\leq$ 2,750 Ethiopian Birr (ETB), and expensive utensils, such as a washer, dryer, computer, motorbike, motorboat, air conditioner, or generator with price $\geq$ 300 USD or $\geq$ 16,500 ETB [29].

Individual characteristics assessed included gravidity; parity; ANC services in the past; Postnatal Care (PNC) services in the past; delivery in the health facilities in the past; nutrition counseling or education provided by health care providers in the past; acute infectious diseases during pregnancy (e.g., malaria, Urinary Tract Infection (UTI), Sexually Transmitted Infections (STIs), intestinal worms, intestinal parasites); acute non-infectious illnesses (e.g., dyspepsia or gastritis, excessive nausea or vomiting or hyperemesis gravidarum); physical activity or exercise or household chores for at least 30 minutes daily; habits of taking coffee or tea

immediately after meals, alcohol intake, smoking, and charcoal/soil intake during pregnancy; frequencies of meals and snacks daily during pregnancy; dietary knowledge and attitudes/behaviours. Anthropometric indicators assessed included maternal weight before and during pregnancy, height, Body Mass Index (BMI), and Mid-Upper Arm Circumference (MUAC).

Data Collection Instruments and Procedures

Data were collected using an interviewer-administered structured questionnaire with five sections. These included: (I) Baseline characteristics, comprising socio-demographics, socio-cultural, household socio-economic, and individual characteristics; (II) MDD-W; (III) HFIAS; (IV) Anthropometry, laboratory, and clinical measurements; and (V) Follow-up and outcome assessments.

Gestational Age and Enrollment into the Study

Firstly, GA was determined using either the date of the Last Normal Menstrual Period (LNMP) or an obstetric ultrasound confirming a viable pregnancy. In accordance with WHO recommendations, GA estimation was based on LNMP and urine Human Chorionic Gonadotropin (HCG) levels, or on an ultrasound examination, conducted before the 24th week of gestation [30]. Eligible participants were enrolled during their first and second ANC visits, corresponding to gestational ages between 12 completed weeks and 27 weeks plus six days. Pregnant women outside this gestational age window were not eligible for enrollment.

Baseline Characteristics Assessment

Baseline data included comprehensive information on sociodemographics, sociocultural, and individual characteristics. The household wealth index was adopted from the International Wealth Index (IWI) scale using 12 assets with 20 indicators. These

indicators included ownership of consumer durable assets (seven indicators), housing quality characteristics (nine indicators, including floor quality, quality of toilet facilities, and number of rooms for sleeping), and households' access to two basic public utilities or services (four indicators), such as access to quality potable water supply and electricity [29].

Minimum Dietary Diversity Score Assessment

The MDDS assessment among women of reproductive age was conducted using two 24-hour (day and night) recall periods of at least one month apart for foods consumed or dietary intake of all foods eaten by pregnant women. Pregnant women were asked to complete a list of foods they consumed as meals (breakfast, lunch, dinner), and snacks (mid-morning snacks, mid-afternoon snacks, and bedtime snacks) 24 hours before the dietary recall assessment. The quantities of all food items and drinks consumed were estimated and recorded using the adapted DD checklist provided to data collectors during dietary recall assessments. A threshold of ≥ 15 g (one tablespoonful of food items) of food consumed was counted as 1, and extremely small amounts (< 15 g) of each food item eaten were ignored (recorded as 0), according to the MDD-W guide [5]. The data collectors or the Principal Investigator (PI) determined which food groups the food items eaten or drunk belonged to according to the MDD-W guide [5]. Eating at least 15 g of each food item from the food groups recommended by the MDD-W guide earned 1 point; otherwise, 0 points were given. Therefore, points ranged from 0 to 10 for each of the 10 food groups. The 10 food groups assessed from each woman included (1) Grains (cereals), white roots and tubers, and plantains; (2) pulses (beans, peas, and lentils); (3) nuts and seeds; (4) dairy (milk and milk products); (5) meat, poultry, and fish; (6) eggs; (7) dark green leafy vegetables; (8) vitamin A-rich fruits, and

vegetables, roots and tubers; (9) other vegetables; and (10) other fruits [5]. Some common foods, such as chili peppers, garlic, ginger root, bean paste, fermented bean paste, tomato paste, and other small food items added for flavor, were not included in the MDDS as per the MDD-W guide [5]. However, these food groups were assessed to understand their relationships with the risks of adverse pregnancy outcomes in this study. The MDDS assessment was conducted twice during enrollment and subsequent visits at least one month apart. The final MDDS for each participant was calculated as the average of the two MDD scores, providing more reliable data on the usual dietary practices than a single dietary recall assessment.

Household Food Insecurity Status Assessment

The food insecurity status of the households was determined using nine standard questions from the HFIAS, developed in 2006 by the Food and Nutrition Technical Assistance (FANTA) for developing countries [31].

Anthropometry, Clinical Assessments, and Laboratory Tests

Maternal Hb concentration was measured in grams per deciliter (g/dl) using a HemoCue (Hb analyzer) to determine anemia status. Anthropometric data, including maternal height and weight, were collected using anthropometric tools. A stadiometer was used to measure height in the Frankfort (standing) position, recorded to the nearest 1 mm or 0.1 cm. Maternal weight was measured using a scale and recorded to the nearest 0.1 kilogram. This was done after calibration of the weight scale with an object of known weight. The newborn's weight was measured using an electronic weight measuring scale and recorded to the nearest 100 grams or 0.1 kilogram. A newborn's weight was measured as follows: First, the weight of dry and warm linen was measured before measuring the newborn's

weight. Then the reading of the dry warm linen weight was recorded. Then the measurer pressed the zero (0) button on the scale once to neutralize the reading to zero. Then the newborn, without clothes, was placed on top of the linen, and the combined newborn and linen weight readings were obtained. Finally, the weight of the linen was subtracted from the weight of the linen plus that of the newborn for the weight of the newborn and recorded to the nearest 100 g (0.1kg).

Mid-upper arm circumference was measured using MUAC tape or armband, and the reading was to the nearest 0.1 cm or 1 mm. Blood pressure was measured using a digital BP measuring device (automatic sphygmomanometer) with a cuff wrapped around the upper arm (left or right) at heart level after resting for 5 minutes or more. Blood pressure was measured in millimeters of Mercury (mmHg) twice in a seated position at an interval of one to two minutes, and the average value of Systolic Blood Pressure (SBP) in mmHg or Diastolic Blood Pressure (DBP) in mmHg was recorded as per the procedure of Takagi and colleagues [32]. When high BP was detected, the urine protein level was checked for the presence of significant protein using urine protein measuring kits or urine dipstick kits with color change readings to compare against the standard. This was a qualitative measurement of color changes compared with a standardized level of protein and recorded level readings, plus (+) or minus (-). Proteinuria (protein in urine) was confirmed from spot urine or urine collected at the time of visit with dipstick test results of a positive (1+) or more detected at least twice at six hours apart [33].

Follow-up Assessments

The first ANC contact is recommended at the 12th gestational week [33]. Subsequent contacts are also recommended at gestational weeks 20, 26, 30, 34, 36, 38, and 40 to reduce perinatal mortality and improve women's experience of ANC, as outlined in the Ethiopian Federal

Ministry of Health (FMOH) ANC 2020 protocol [33]. Each participant underwent at least three follow-up visits before the expected date of normal delivery was reached at term (37 completed weeks to 41 completed weeks plus six days). The baseline characteristics, MUAC, weight, and height were assessed once during enrollment. The Hb, BP, and urine protein were checked at every ANC visit. BP and urine protein were also checked during delivery and within the first 24 hours after delivery. The newborn's weight was checked during delivery and within the first 24 hours after delivery. The assessments for MDDS were conducted twice during enrollment and at the first subsequent visit. Based on the average MDDS, the DD practices of pregnant women were classified as inadequate DD practice (exposed) when the average MDDS was less than five and adequate DD practice (unexposed) when the average MDDS was greater than or equal to five. Then, pregnant women were grouped into two groups: the exposed and the unexposed. The exposed group had inadequate DD practice (MDDS average < 5), and the unexposed group had adequate DD practice (MDDS average $\geq$ 5).

Data Quality Control

The questionnaire was prepared in English and then translated into two languages, Amharic and Nuer, spoken by most residents of Gambella Town. Finally, it was translated back into English by two other translators, who were blinded to the original English version, to check the questionnaire's consistency and clarity. Discrepancies were reviewed and resolved through consensus. Six data collectors (midwives and nurses) with a minimum qualification of a Bachelor of Science (BSc) degree were recruited, along with two supervisors with a Master of Science (MSc) degree.

All data collectors and supervisors received comprehensive training over three consecutive days. The training covered study objectives, eligibility and enrollment criteria, questionnaire

administration, skip patterns, dietary recall assessment, follow-up procedures, and ethical considerations. Particular emphasis was placed on standardized measurement techniques, calibration procedures, and the correct use of data collection instruments. Data collectors were trained and mentored in the proper use of anthropometric and clinical instruments, including digital weight scales, stadiometers, MUAC tapes, HemoCue Hb analyzers, urine dipstick kits, and automatic digital BP devices. They were also trained to use KoboCollect (Android software) for data collection. To ensure accurate dietary assessment, data collectors were trained in operational definitions of food groups, portion-size estimation using common household utensils (e.g., tablespoons, teaspoons, cups), and conversion of portions to approximate gram equivalents, following the MDD-W guide. The Ethiopian food-based dietary guideline (FBDGs) was used to enhance understanding of dietary assessment terminology and food group classification. Detailed discussions were held to standardize the classification of food groups and portion-size estimation for MDDS calculations.

To maintain measurement accuracy, data collectors were instructed to calibrate weight scales daily using objects of known weights before commencing measurements. Blood pressure was measured twice with automated devices, and the average of the two readings was recorded. Laboratory quality assurance was maintained through routine checks conducted by laboratory professionals. Urine protein testing was performed using dipstick kits, and Complete Blood Count (CBC) analyses were randomly cross-checked daily at each laboratory unit. Hemoglobin measurements obtained using the HemoCue analyzer were periodically validated through random hematocrit or Hb assessments using CBC machines to ensure consistency and accuracy.

Questionnaire sections, such as I and II, were pre-tested among 10 pregnant women who were

admitted or attended healthcare services in other units, rather than the ANC unit, Gynecology, and Obstetric wards of the two hospitals. The pre-test aimed to assess clarity, sequence of questions, and competence of data collectors. Feedback from the pre-test was reviewed, and necessary modifications were made before the actual data collection. To minimize information bias, data collectors were blinded to participants' exposure status (exposed and unexposed and followed all participants uniformly until delivery for outcome assessment).

Supervisors closely monitored data collection activities at each hospital to ensure adherence to standardized procedures. The PI conducted daily reviews of submitted data through the Kobo Toolbox server to verify completeness and consistency. Food item classifications into appropriate food groups were routinely cross-checked. The PI conducted weekly supervisory visits to both hospitals. Data quality was further ensured through cross-verification of ANC and laboratory records using participants' unique medical record numbers.

Data Processing and Analysis

Data were collected electronically using KoboCollect 2024.1.3 and exported to the Statistical Package for the Social Sciences (SPSS) 25 from International Business Machines (IBM) Corporation, Armonk, NY, USA, for data transformation and analysis. Descriptive analyses were performed to summarize the study population and key variables using frequency distributions, percentages, means, and standard deviations. Categorical variables were presented using tables and graphical displays, while continuous variables were summarized using means with standard deviations (SD).

Dietary diversity was classified using the average MDDS from two dietary assessments. Participants with an average MDDS < 5 were categorized as having inadequate dietary

diversity (exposed group), whereas those with an average MDDS ≥ 5 (adequate dietary diversity) or the unexposed group. A chi-square test or Fisher's exact test was used to check for the differences in proportions of pregnant women between exposed and unexposed groups at $p\text{-value} < 0.05$. The chi-square test of independence or Fisher's exact test was also used to assess the independence relationship between categorical independent variables and dependent variables (exposed and unexposed groups) at a $p\text{-value} < 0.05$.

For associations between independent variables and dietary diversity practices, bivariate analyses using log-binomial regression were used to identify significant factors (predictors) of the dietary diversity practices. Risk Ratios (RR), along with corresponding 95% Confidence Interval (CI), were estimated in bivariable analyses using log-binomial regression. In the bivariable analyses, all predictors with $p\text{-values} < 0.25$, potential confounders, and clinically/epidemiologically relevant variables were selected for the final model. A multivariable Poisson regression model with a log link and robust standard error was employed to identify independent predictors (factors associated with dietary diversity practices), while adjusting for other predictors and potential confounders. An Adjusted Risk Ratio (ARR) or an Adjusted Relative Risks (ARR), along with 95% CI, was calculated to quantify the strength of associations. Statistical significance was defined as $p\text{-value} < 0.05$ and a 95% CI excluding unity (1). Model adequacy was assessed using deviance statistics or Pearson's chi-square goodness-of-fit test. The final model was considered a good fit to the data when the deviance or Pearson chi-square statistic to the model's Degrees of Freedom (DF) ratio approximated 1, as assessed using a Poisson regression model with robust standard errors. Multicollinearity among independent variables was evaluated using the Variance Inflation

Factor (VIF) ≤ 5 , indicating no serious multicollinearity.

Operational Definitions

Food group consumption: A food group was consumed when a pregnant woman ate at least one food item twice from that individual food group in an adequate quantity of at least 15 grams or 1 tablespoon for the ten food groups of MDDS as per the MDD-W of reproductive age group (15-49 years) guide, or any amount twice for other food groups, on 24 hours before enrollment into study and 24 hours before the second dietary recall assessments; otherwise, it was considered as not consumed food group even if food items were eaten once during the study period.

Dietary diversity practices: Referred to the consumption of at least twice for food items from at least five or fewer food groups in the 24-hour recall period out of ten food groups as per the MDDS for women of reproductive age group (15-49 years) guide.

Inadequate dietary diversity practice (exposed): Referred to inadequate dietary diversity practice based on MDDS average less than five out of ten or consumption of less than five of the ten food groups at least twice, as per the MDD-W guide.

Adequate dietary diversity practice (unexposed): Referred to adequate dietary diversity practice based on the MDDS average of at least five out of ten or consumption of at least five of the ten food groups at least twice, as per the MDD-W guide.

Results

Dietary Diversity Practices

A total of 254 pregnant women were enrolled and followed up for DD practices, resulting in a 100% response rate. The mean of the MDDS average plus or minus SD was 4.11 ± 0.90 . The mean of the average MDDS < 5 was 3.72 ± 0.61 , while the mean of the average MDDS ≥ 5 was 5.38 ± 0.51 . An independent samples t-test was performed to compare the mean difference in MDDS between pregnant women with inadequate DD practices (exposed) and those with adequate DD practices (unexposed). The average MDDS ≥ 5 was 5.38 with SD of 0.51, and the average MDDS < 5 was 3.72 with SD of 0.61; $t(115.696)$ was -20.906 with p -value < 0.001 . The mean difference in MDDS between the two groups was -1.65 with a 95% CI from -1.81 to -1.49.

A Z-test for column proportions of the chi-squared test of independence was used to compare the difference in proportions between pregnant women who were exposed and unexposed. A total of 194 (76.4%) pregnant women had inadequate DD practices (exposed), while 60 (23.6%) pregnant women had adequate DD practices (unexposed). The difference in proportions of pregnant women between those with inadequate DD practices (average MDDS < 5) and those with adequate DD practices (average MDDS ≥ 5) was statistically significant at p -value < 0.001 (Table 1).

Table 1. A Z-Test for Column Proportion of Pregnant Women between Exposed and Unexposed among Women Attending Public Hospitals in Gambella Town, Southwest Ethiopia, 2024

Variable	Dietary diversity practices (n = 254)		Total
	Inadequate (exposed)	Adequate (unexposed)	
Minimum dietary diversity scores average			
MDDS average ≥ 5	0a (0.0%)	60b (100%)	60 (23.6%)
MDDS average < 5	194a (100%)	0b (0.0%)	194 (76.4%)
Total	194 (100%)	60 (100%)	254 (100%)

Notes: a, b, each subscript letter denotes a subset of categories of dietary diversity practices during pregnancy whose column proportions do not differ significantly from each other at the p -value 0.05 level.

Abbreviation: MDDS minimum dietary diversity scores.

Pregnant women with average MDDS < 5 had inadequate DD practices (exposed group), while those with average MDDS $\geq$ 5 had adequate DD practices (unexposed group). Among the ten food groups consumed by pregnant women, food items from the grains and cereals group were consumed by 191 (98.5%) and 60 (100%) exposed and unexposed women, respectively. While 54 (27.8%) of exposed pregnant women consumed pulses (mature beans, lentils, and peas), 29 (48.3%) of unexposed pregnant women consumed pulses. Among pregnant women, 79 (40.7%) of exposed women consumed meat, poultry, and fish, while 38 (63.3%) of unexposed women consumed meat, poultry, and fish. A total of 110 (56.7%) of exposed pregnant women consumed other vegetables, while 45 (75.0%) of those who were unexposed consumed other

vegetables. A total of 39 (20.1%) of exposed women consumed dark green leafy vegetables, while 23 (38.3%) of unexposed women consumed them. While 23 (11.9%) of exposed women consumed milk and milk products, 13 (21.7%) of unexposed women did so as well. About 20 (10.3%) of exposed women consumed vitamin A-rich vegetables, fruits, roots, and tubers, while 17 (28.3%) of unexposed women consumed foods from the group. While 15 (7.7%) of exposed women consumed other fruits, 21 (35.0%) of unexposed women consumed food items from this group. The least consumed food items were from food groups such as nuts and seeds and eggs, which were consumed by 5 (2.6%) and 9 (4.6%) exposed women, respectively (Figure 2).

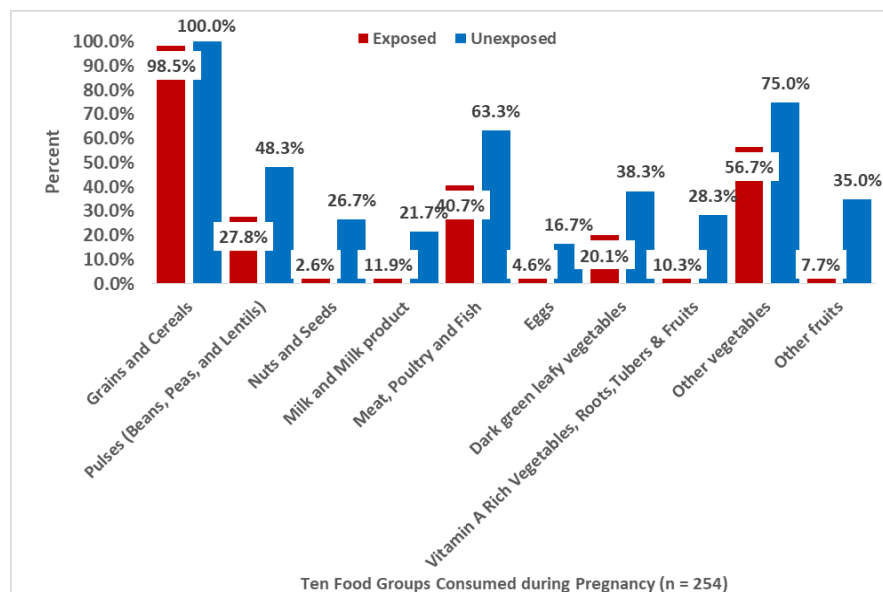


Figure 2. The Ten Food Groups Consumed in the Last 24 hours Recall Periods among Exposed and Unexposed Pregnant Women Attending Public Hospitals in Gambella Town, Southwest Ethiopia, 2024

Food Group Consumption

Among 254 pregnant women who consumed different food items from each of the food groups at least twice in the last 24 hours of dietary recall assessments (during enrollment and follow-up), 253 (99.6%) women consumed other oils including animals, seeds and fruits sources, 251 (98.8%) women consumed grains and cereals, 245 (96.5%) women consumed

condiments and seasonings, 155 (61.0%) women consumed other vegetables, 117 (46.1%) women consumed meat, poultry and fish. The Sugar-Sweetened Beverages (SSB) were consumed by 113 (44.5%) women, 83 (32.7%) women consumed pulses (mature beans, lentils, and peas), and 62 (24.4%) women consumed dark green leafy vegetables. The least consumed food groups among

pregnant women during pregnancy included eggs consumed by 19 (7.5%), nuts and seeds consumed by 21 (8.3%), milk and milk products consumed by 36 (14.2%) vitamin A

rich vegetables, fruits, roots, and tubers consumed by 37 (14.2%), and other fruits consumed by 36 (14.2%) women (Figure 3).

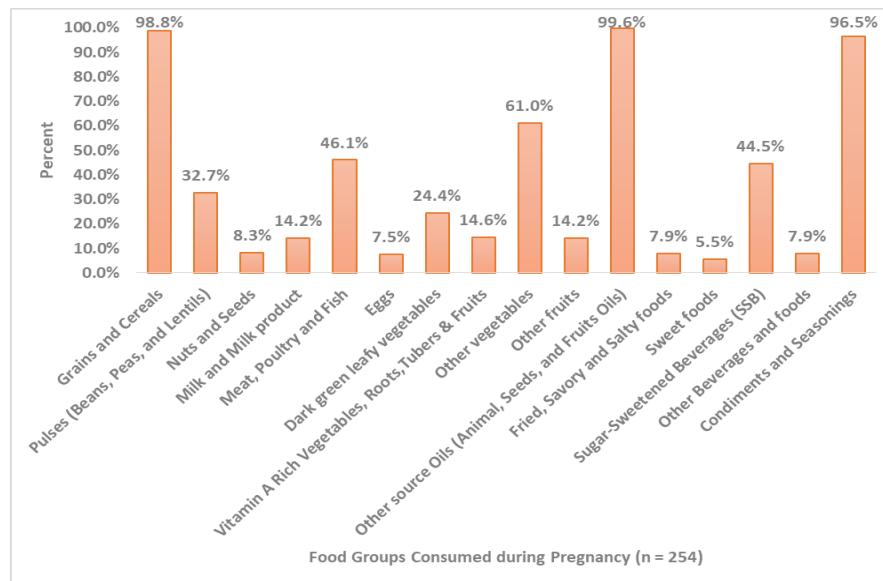


Figure 3. Food Groups Consumed Twice in the Last 24 hours of Dietary Recall Periods among Pregnant Women Attending Public Hospitals in Gambella Town, Southwest Ethiopia, 2024

Sociodemographic Characteristics

In this study, the mean age of the pregnant women was 24.24 ± 4.36 . The mean age of the partner was 32.47 ± 6.94 . The mean family size was 3.55 ± 1.54 . Ninety-six (78.6%) pregnant women in the age groups of 16–23 years practiced inadequate DD, and 98 (73.7%) pregnant women in the age groups of 23–38 years had inadequate DD practices. One hundred eighty-nine (75.9%) pregnant women who practiced inadequate DD were married and lived together with their partner, and 5 (100%) pregnant women who practiced inadequate DD were others (separated, cohabiting, and never

lived together with their partner). Protestants were the predominant believers among pregnant women (58.3%), and Nuer were 122 (82.4%) pregnant women with inadequate DD practices. Pregnant women with no formal class and those with primary education (Grade 1-8) had inadequate DD practices of 81.3%, while those women with a first degree or above had inadequate DD practices of 72.2%. Pregnant women who were homemakers were 138 (75.4%) exposed, and those employed by the government, the United Nations (UN), and Non-governmental Organizations (NGOs) were 25 (71.4%) exposed women (Table 2).

Table 2. Sociodemographic Characteristics of Exposed and Unexposed during Pregnancy among Women Attending Public Hospitals in Gambella Town, Southwest Ethiopia, 2024

Variables	Dietary diversity practices	
	Inadequate (exposed)	Adequate (unexposed)
Pregnant women's age group		
16-23 years	96 (78.7%)	26 (21.3%)
24-38 years	98 (74.2%)	34 (25.8%)
Marital relationship		

Married and lived together as a couple	189 (75.9%)	60 (24.1%)
Others*	5 (100%)	0 (0.0%)
Partner's age group		
17-31 years	92 (78.6%)	25 (21.4%)
32-60 years	97 (73.5%)	35 (26.5%)
Pregnant women's residence location in Gambella Town		
Kebele 01	126 (81.3%)	29 (18.7%)
Kebele 02	8 (72.7%)	3 (27.3%)
Kebele 03	12 (57.1%)	9 (42.9%)
Kebele 04	9 (69.2%)	4 (30.8%)
Kebele 05	39 (72.2%)	15 (27.8%)
Ethnicity		
Nuer	122 (82.4%)	26 (17.6%)
Amhara	20 (74.1%)	7 (25.9%)
Oromo	19 (76.0%)	6 (24.0%)
Anuak	12 (57.1%)	9 (42.9%)
Kambata	4 (40.0%)	6 (60.0%)
Tigre	4 (57.1%)	3 (42.7%)
Others**	13 (81.2%)	3 (18.8%)
Religious groups		
Protestant	114 (77.0%)	34 (23.0%)
Orthodox	28 (65.1%)	15 (34.9%)
Seventh-day Adventist and Church of God	40 (81.6%)	9 (18.4%)
Others***	12 (85.7%)	2 (14.3%)
Pregnant women's educational level		
No formal class and primary level (Grades 1-8)	65 (81.3%)	15 (18.7%)
Secondary education level (Grades 9-12)	83 (74.8%)	28 (25.2%)
Diploma or certificate level	33 (73.3%)	12 (26.7%)
First degree and above	13 (72.2%)	5 (27.8%)
Partner's educational level		
No formal class and primary level (Grades 1-8)	23 (79.3%)	6 (20.7%)
Secondary level (Grades 9-12)	41 (67.2%)	20 (32.8%)
Diploma or certificate level	26 (74.3%)	9 (25.7%)
First degree and above	99 (75.9%)	25 (24.1%)
Pregnant woman's occupation type		

Homemaker	138 (75.4%)	45 (24.5%)
Employed by the government, the UN, and NGOs	25 (71.4%)	10 (28.6%)
Trading	20 (83.3%)	4 (16.7%)
Daily laboring and farming	11 (91.7%)	1 (8.3%)
Partner's occupation type		
Employed by the government, the UN, and NGOs	85 (73.3%)	31 (26.7%)
Trading	27 (79.4%)	7 (20.6%)
Daily laboring and farming	77 (77.8%)	22 (22.2%)
Family size or family members, such as a pregnant woman, partner, other wives, and their children		
3-11 Members	136 (78.2%)	38 (21.8%)
1- 2 Members	58 (72.5%)	22 (27.5%)

Notes: * Cohabiting, Separated & Never lived together; ** Gamo, Hadiya, Dawro, Gurage, Kefa, Cheka, Welayta, Oppo, Shilluk, and Burun; *** Catholic, Islam/Muslim, Messianic Jewish, and Baba John

Abbreviations: UN United Nations; NGOs non-governmental organizations

Sociocultural Characteristics

The mean age at marriage was 18.74 ± 2.25 . The mean household size was 6.22 ± 5.39 , and the mean number of legal wives among partners was 1.22 ± 0.52 . The food items and non-food items prohibited (tabooed) during pregnancy in the community included non-scale fishes such as Teleostei and mudfish, honey, senafiche, telba or linseeds/flaxseeds, sweet potatoes, yogurt, gomen, ice cream, and alcoholic beverages. Only 11 (4.3%) women reported that there were taboos during pregnancy in their community. The reasons provided by community for avoidance of those items during pregnancy included abortion reported by 6 (54.6%) women for items such as honey, Sena fiche and telba, linseeds/flaxseeds, sweet potatoes, yogurt and gommen, religious beliefs against items reported by 4 (36.4%) women for non-scale fishes, and the coating on the newborn's head reported by 1 (9.1%) woman for ice cream. A total of 7 (63.6%) women reported that community leaders were

responsible for reinforcing the taboos, while 4 (36.4%) women reported that religious leaders reinforced the practices. A total of 215 (84.6%) pregnant women reported no child marriage practices in their community; they reported that minimum accepted age for legal marriage ranged from 18 years and above, while 32 (12.6%) pregnant women reported that child marriage practices existed, with 31 (12.2%) women who reported that age ranged from 15 to 17 years was the minimum accepted age for legal marriage, and 7 (2.8%) women did not have any information in their community. A total of 150 (59.0%) pregnant women reported that there were no community beliefs against weight gain during pregnancy; 23 (9.1%) reported beliefs against weight gain in their community; and 81 (31.9%) had no idea about the community's perception of weight gain during pregnancy. Thirty-two (91.3%) pregnant women accepted and practised meal-sharing, 4 (1.6%) practised against their will, and 18 (7.1%) rejected the practices (Table 3).

Table 3. Sociocultural Characteristics of Exposed and Unexposed during Pregnancy among Women Attending Public Hospitals in Gambella Town, Southwest Ethiopia, 2024

Variables	Dietary diversity practices	
	Inadequate (exposed)	Adequate (unexposed)
Prohibition (taboo) of food and non-food items during pregnancy in the community		
Yes	5 (45.5%)	6 (54.5%)
No	189 (77.8%)	54 (22.2%)
Beliefs against weight gain during pregnancy in the community		
Yes	14 (60.9%)	9 (39.1%)
No	120 (80.0%)	30 (20.0%)
Meal-sharing practices or eating together with pregnant women in the community		
Yes	180 (76.3%)	56 (23.7%)
No	14 (77.8%)	4 (22.2%)
Pregnant women's acceptance and practices of meal-sharing		
Yes	179 (77.2%)	53 (22.8%)
No	15 (68.2%)	7 (31.8%)
Family members or close relatives' influence on meal-sharing with pregnant women		
Yes	174 (76.3%)	54 (23.7%)
No	6 (75.0%)	2 (25.0%)
Age group in years at the time of the pregnant woman's marriage		
14-17 years	51 (72.9%)	19 (27.1%)
18-28 years	143 (77.7%)	41 (22.3%)
Partner's polygamy practices in the community		
Yes	36 (80.0%)	9 (20.0%)
No	153 (75.0%)	51 (25.0%)
Partner's support for the household with food, either in cash or in kind		
No	33 (78.6%)	9 (21.4%)
Yes	156 (75.4%)	51 (24.6%)
Children aged under five years among family members who lived in the same home as a household		
≥ 1 child	105 (79.5%)	27 (20.5%)
0 child	89 (73.0%)	33 (27.0%)
Relatives/visitors who lived for at least 24 hours as a household within a month of dietary assessments		
≥ 2 Persons	116 (81.1%)	27 (18.9%)
< 2 Persons	78 (70.3%)	33 (29.7%)
Household size or members who lived for at least 24 hours within a month of dietary assessments		
≥ 5 Persons	111 (81.6%)	25 (18.4%)
< 5 Persons	83 (70.3%)	35 (29.7%)

Household Characteristics

Socioeconomic

Households within the 1st, 2nd, 3rd, 4th, and 5th levels of wealth index quintiles were 33 (86.8%), 52 (67.5%), 42 (82.4%), 40 (80.0%),

and 27 (71.1%), respectively, among the exposed. Households with food security, mild food insecure, moderate food insecure, and severe food insecure were 38 (73.1%), 6 (85.7%), 15 (93.8%), and 135 (75.4%), respectively, among the exposed (Table 4)

Table 4. Household Socioeconomic Characteristics of Exposed and Unexposed during Pregnancy among Women Attending Public Hospitals in Gambella Town, Southwest Ethiopia, 2024

Variables	Dietary diversity practices (n = 254)	
	Inadequate (exposed)	Adequate (unexposed)
Household monthly income in Ethiopian birr		
< 6000.00 birr	92 (78.6%)	25 (21.4%)
≥ 6000.00 birr	102 (74.5%)	35 (25.6%)
Household monthly average income or per capita income		
< 1250.00 birr	81 (79.4%)	21 (20.6%)
≥ 1250.00 birr	113 (74.3%)	39 (25.7%)
Household food insecurity level		
Food secure	38 (73.1%)	14 (26.9%)
Mildly food insecure	6 (85.7)	1 (14.3%)
Moderately food insecure	15 (93.8%)	1 (6.2%)
Severely food-insecure	135 (75.4%)	44 (24.6%)
Household wealth indexes quintiles		
1st quintile (poorest 20% with the lowest wealth)	33 (86.8%)	5 (13.2%)
2nd quintile (poor)	52 (67.5%)	25 (32.5%)
3rd quintile (middle)	42 (82.4%)	9 (17.6%)
4th quintile (rich)	40 (80.0%)	10 (20.0%)
5th quintile (richest 20% with the highest wealth)	27 (71.1%)	11 (28.9%)
Household ownership of a television		
No	82 (88.2%)	11 (11.8%)
Yes	112 (69.6%)	49 (30.4%)
Household ownership of a refrigerator (fridge)		
No	122 (82.4%)	26 (17.6%)
Yes	72 (67.9%)	34 (32.1%)
Household ownership of a home or a mobile phone		
No	43 (79.6%)	11 (20.4%)
Yes	151 (75.5%)	49 (24.5%)
Household ownership of a car		
No	189 (76.8%)	57 (23.2%)
Yes	5 (62.5%)	3 (37.5%)
Household ownership of a bicycle		
No	186 (76.8%)	56 (23.2%)
Yes	8 (66.7%)	4 (33.3%)
Household ownership of cheap utensils with a price less than or equal to 50 USD or 2,750 ETB		

No	25 (69.4%)	11 (30.6%)
Yes	169 (77.5%)	49 (22.5%)
Household ownership of expensive utensils with a price greater than or equal to 300 USD or 16,500 ETB		
No	165 (75.3%)	54 (24.7%)
Yes	29 (82.9%)	6 (17.1%)
Quality of the household latrine		
Traditional pit latrine, hanging toilet, or no toilet	18 (90.0%)	2 (10.0%)
Public toilet, improved pit latrine	164 (75.2%)	54 (24.8%)
Private flush toilet	12 (75.0%)	4 (25.0%)
Quality of the household floor		
Earth, dung	31 (88.6%)	4 (11.4%)
Cement, concrete, raw wood	152 (75.2%)	50 (24.8%)
Parquet, carpet, tile, or ceramic	11 (64.7%)	6 (35.3%)
Household number of sleeping rooms		
0 or 1 sleeping room	66 (69.5%)	29 (30.5%)
2 sleeping rooms	24 (88.9%)	3 (11.1%)
3 more sleeping rooms	104 (78.8%)	28 (21.2%)
Household access to a quality potable water supply		
Unprotected well, borehole, spring, surface water	7 (63.6%)	4 (36.4%)
Tap, protected well, tanker truck.	186 (77.8%)	53 (22.2%)
Bottled water, or water piped.	1 (25.0%)	3 (75.0%)
Household access to the electric power supply		
Yes	150 (81.5%)	34 (18.5%)
No	44 (62.9%)	37.1%

Abbreviation: USD United States dollar; ETB Ethiopian birr

Individual Characteristics

The mean gravidity of pregnant women was 2.36 ± 1.46 . The mean weight of pregnant women at enrollment was 59.32 ± 8.96 . The mean dietary knowledge and attitude was 12.71 ± 3.19 , and the median was 13.0. Forty (83.3%) undernourished pregnant women had inadequate DD practices, while 8 (16.7%) undernourished pregnant women had adequate DD practices. A total of 154 (74.8%) women with normal nutritional status had inadequate DD practices, and 52 (25.2%) women with normal nutritional status had adequate DD practices. Seventy-two (77.4%) pregnant women with no previous ANC had inadequate DD practices, while 122 (75.8%) pregnant

women with previous ANC had inadequate DD practices. Pregnant women who experienced epigastric burning sensation (dyspepsia) or gastritis had inadequate DD practices in 92 (87.6%) cases, while 102 (68.5%) pregnant women with no signs of dyspepsia or gastritis had inadequate DD practices. Seventy-four (82.2%) pregnant women with excessive nausea or vomiting during pregnancy had inadequate DD practices, while 120 (73.2%) pregnant women with no nausea or vomiting had inadequate DD practices. One hundred thirteen (77.4%) women with unfavorable dietary knowledge and attitudes during pregnancy had inadequate DD practices, while 81 (75.0%) counterparts had inadequate DD practices (Table 5).

Table 5. Individual Characteristics of Exposed and Unexposed during Pregnancy among Women Attending Public Hospitals in Gambella Town, Southwest Ethiopia, 2024

Variables	Dietary diversity practices (n = 254)	
	Inadequate (exposed)	Adequate (unexposed)
Gravidity ever experienced (number of pregnancies)		
Primigravida	69 (76.7%)	21 (23.3%)
Multigravida	125 (76.2%)	39 (23.8%)
Parity ever experienced (number of births at or beyond 28 completed weeks)		
Nulliparous	74 (72.5%)	28 (27.5%)
Primiparous and above	120 (78.9%)	32 (21.1%)
Antenatal care services that were provided in the most recent pregnancy		
No	72 (77.4%)	21 (22.6%)
Yes	122 (75.8%)	39 (24.2%)
Postnatal care services that were provided after the most recent delivery		
No	145 (74.4%)	50 (25.6%)
Yes	49 (83.1%)	10 (16.9%)
Delivered in the health facilities in the past, the most recent delivery		
No	82 (78.8%)	22 (21.2%)
Yes	112 (74.7%)	38 (25.3%)
Had nutrition counseling or education provided by healthcare providers before pregnancy		
No	131 (72.8%)	49 (27.2%)
Yes	63 (85.1%)	11 (14.9%)
History of adverse pregnancy outcomes, such as anemia, preterm, and/or low birth weight		
Yes	37 (77.1%)	11 (22.9%)
No	157 (76.2%)	49 (23.8%)
History of anemia in the most recent pregnancy or delivery in the past		
Yes	34 (77.3%)	10 (22.7%)
No	160 (76.2%)	50 (23.8%)
History of preterm delivery and/or low birth weight in the most recent delivery in the past		
Yes	6 (85.7%)	1 (14.3%)
No	187 (76.0%)	59 (24.0%)
Family history of Diabetes Mellitus and/ or hypertensive disorders in pregnancy		
Yes	2 (33.3%)	4 (66.7%)
No	123 (77.8%)	35 (22.2%)
Bleeding via the birth canal during pregnancy		
Yes	13 (86.7%)	2 (13.3%)
No	181 (75.7%)	58 (24.3%)
Dyspepsia or gastritis during pregnancy		
Yes	92 (87.6%)	13 (12.4%)
No	102 (68.5%)	47 (31.5%)

Excessive nausea and/or vomiting in the first and second trimesters of pregnancy		
Yes	74 (82.2%)	16 (17.8%)
No	120 (73.2%)	44 (26.8%)
Malaria attacks that were confirmed with laboratory tests during pregnancy.		
Yes	81 (76.4%)	25 (23.6%)
No	113 (76.4%)	35 (23.6%)
Urinary tract and/or sexually transmitted infections during pregnancy		
Yes	37 (77.1%)	11 (22.9%)
No	157 (76.2%)	49 (23.8%)
Intestinal parasites and/or intestinal worms during pregnancy		
Yes	4 (100%)	0 (0.0%)
No	190 (76.0%)	60 (24.0%)
Regular physical activities or household chores for at least 30 minutes daily during pregnancy		
No	98 (84.5%)	18 (15.5%)
Yes	96 (69.6%)	42 (30.4%)
Frequencies of eating regular meals and snacks per day during pregnancy		
1-4 times	144 (86.2%)	23 (13.8%)
5-6 times	50 (57.5%)	37 (42.5%)
Preferred to coffee/tea immediately after meals, smoking, alcohol, soil, or charcoal		
Yes	100 (76.9%)	30 (23.1%)
No	94 (75.8%)	30 (24.2%)
Dietary knowledge and attitude/behaviour during pregnancy		
Unfavorable (scored < 70%)	113 (77.4%)	33 (22.6%)
Favorable (scored ≥ 70%)	81 (75.0%)	27 (25.0%)

Dietary Diversity Practices during Pregnancy and Associated Factors

A modified Poisson regression model was employed to explore the factors associated with inadequate DD practices in this study. Model fit was acceptable with a deviance to DF ratio of 0.395, a Pearson chi-square to DF ratio of 0.257, Likelihood Ratio χ^2 of 36.783, DF of 21, and p-value of 0.018. Pregnant women who lived in a household with at least one child under five years of age had a 26.8% higher risk of inadequate DD practices compared with those who lived in a household with no child under five years of age (ARR = 1.268, 95% CI = 1.025–1.569, P = 0.029). Pregnant women who did not attend ANC in the past had a 24.7%

higher risk of inadequate DD practices when compared with their counterparts (ARR = 1.247, 95% CI = 1.016–1.532, P = 0.035). Pregnant women from households without a TV had a 19.2% higher risk of inadequate DD practices than those with a TV (ARR = 1.192, 95% CI = 1.019–1.395, P = 0.029). Furthermore, pregnant women with dyspepsia or gastritis during pregnancy had a 28.8% higher risk of inadequate DD practices compared to their counterparts (ARR = 1.288, 95% CI = 1.132–1.466, P < 0.001). Mothers who ate 1–4 times for regular meals and snacks per day during pregnancy had a 40.9% higher risk of inadequate DD practices compared to those whose frequency of eating regular meals

and snacks daily was between 5–6 times per day
(ARR = 1.409, 95% CI = 1.172–1.694, P < 0.001) (Table 6).

Table 6. Factors Associated with Dietary Diversity Practices during Pregnancy among Women Attending Public Hospitals in Gambella Town, Southwest Ethiopia, 2024

Variables	Dietary diversity practices (n = 254)		RR (95%CI)	ARR (95%CI)
	Inadequate (Exposed)	Adequate (Unexposed)		
Pregnant women’s age group				
16-23 years	96 (78.7%)	26 (21.3%)	1.06 (0.92–1.22)	0.94 (0.79–1.11)
24-38 years	98 (74.2%)	34 (25.8%)	1	1
Pregnant women’s religious group				
SDA and others***	50 (84.7%)	9 (15.3%)	1.15 (0.99–1.31)**	1.08 (0.93–1.25)
Protestant and others****	144 (73.8%)	51 (26.2%)	1	1
Partner's educational level				
Below a diploma level	64 (71.1%)	26 (28.9%)	0.91 (0.77–1.05)*	0.89 (0.75–1.06)*
Diploma level and above	125 (78.6%)	34 (21.4%)	1	1
Number of children aged under five years among family members who lived in the household				
At least one child under five	105 (79.5%)	27 (20.5%)	1.09 (0.95–1.26)*	1.27 (1.03–1.57)**
No child under five	89 (73.0%)	33 (27.0%)	1	1
Number of household size (family and relatives/visitors who lived together for at least 24 hours)				
≥ 5 Persons	111 (81.6%)	25 (18.4%)	1.16 (1.01–1.35)**	1.11 (0.91–1.36)
< 5 Persons	83 (70.3%)	35 (29.7%)	1	1
Parity (number of births that occurred beyond 28 weeks of completed gestational age)				
Nulliparous and primiparous	130 (76.5%)	40 (23.5%)	1.00 (0.87–1.17)	1.17 (0.97–1.42)*
Multiparous	64 (76.2%)	20 (23.8%)	1	1
Household monthly average income or per capita income				
< 1250 birr	98 (81.7%)	22 (18.3%)	1.07 (0.93–1.22)	0.89 (0.74–1.06)*
≥ 1250 birr	96 (71.6%)	38 (28.4%)	1	1
Household wealth index quintiles				
1st to 2nd quintiles	85 (73.9%)	30 (26.1%)	0.94 (0.82–1.08)	0.96 (0.79–1.15)
3rd to 5th quintiles	109 (78.4%)	30 (21.6%)	1	1
Household with a television				
No	82 (88.2%)	11 (11.8%)	1.27 (1.12–1.44)**	1.19 (1.02–1.40)**
Yes	112 (69.6%)	49 (30.4%)	1	1
Household with a refrigerator (fridge)				
No	122 (82.4%)	26 (17.6%)	1.21 (1.05–1.43)**	1.11 (0.94–1.32)*
Yes	72 (67.9%)	34 (32.1%)	1	1
Households with two rooms or more for sleeping				
Yes	128 (80.5%)	31 (19.5%)	1.16 (1.00–1.37)*	0.81 (0.63–1.03)*
No	66 (69.5%)	29 (30.5%)	1	1
Household with access to a public electric power utility				
Yes	150 (81.5%)	34 (18.5%)	1.30 (1.09-1.61)**	1.13 (0.93-1.36)*

No	44 (62.9%)	26 (37.1%)	1	1
Household food insecurity level				
Moderate and severe FI	165 (76.7%)	50 (23.3%)	1.03 (0.89–1.25)	0.97 (0.80–1.16)
Food secure and mild FI	29 (74.4%)	10 (25.6%)	1	1
Antenatal care services that were provided in the most recent pregnancy				
No	72 (77.4%)	21 (22.6%)	1.02 (0.88–1.17)	1.25 (1.02–1.53)**
Yes	122 (75.8%)	39 (24.2%)	1	1
Had nutrition counseling or education provided by healthcare providers before pregnancy				
No	76 (72.4%)	29 (27.6%)	0.86 (0.75–0.98)**	1.11 (0.95–1.31)*
Yes	49 (83.1%)	10 (16.9%)	1	1
Malaria attacks that were confirmed with laboratory tests during pregnancy				
Yes	89 (78.1%)	25 (21.9%)	1.00 (0.87–1.15)	0.96 (0.84–1.11)
No	105 (75.0%)	35 (25.0%)	1	1
Urinary tract and/or sexually transmitted infections during pregnancy				
Yes	37 (77.1%)	11 (22.9%)	1.01 (0.83–1.18)	1.15 (0.95–1.38)*
No	157 (76.2%)	49 (23.8%)	1	1
Dyspepsia or gastritis during pregnancy				
Yes	92 (87.6%)	13 (12.4%)	1.28 (1.12–1.46)**	1.29 (1.13–1.47)**
No	102 (68.5%)	47 (31.5%)	1	1
Dietary knowledge and attitudes/behaviour during pregnancy				
Unfavorable (< 70%)	115 (78.8%)	31 (21.2%)	0.97 (0.84–1.11)	1.02 (0.88–1.18)
Favorable (≥ 70%)	79 (73.1%)	29 (26.9%)	1	1
Regular physical activities or household chores for at least 30 minutes daily during pregnancy				
No	97 (84.3%)	18 (15.7%)	1.21 (1.06–1.40)**	1.11 (0.95–1.31)*
Yes	96 (69.6%)	42 (30.4%)	1	1
Frequencies of eating regular meals and snacks during pregnancy				
1-4 times per day	144 (86.2%)	23 (13.8%)	1.50 (1.24–1.82)**	1.41 (1.17–1.69)**
5-6 times per day	50 (57.5%)	37 (42.5%)	1	1

Notes: * P -value < 0.25; ** P -value < 0.05; *** Church of God, Islam/Muslim, and Messianic Jewish; **** Orthodox, Catholic, and Baba John.

Abbreviations: SDA seven-day Adventist; RR risk ratio; ARR adjusted risk ratio; CI confidence interval; FI food insecure.

Discussion

This study aimed to assess dietary practices during pregnancy and their associated factors among pregnant women. A higher proportion (76.4%) of pregnant women had inadequate dietary diversity practices compared to only 23.6% of women with adequate dietary diversity practices. The proportion of pregnant women who consumed various food items from each of the ten food groups used for MDDS estimation was lower among women unexposed compared to exposed women in this study. The finding of low prevalence of adequate dietary

diversity practices among women in this study was consistent with findings from studies in low and middle-income countries [34]. The findings in the previous study have shown that the majority of pregnant women in the reproductive age group (15-49 years) had inadequate dietary diversity, with a mean of four food groups consumed [34]. This review study also indicated that over 66% of women consumed inadequately diversified diets or diets with less than five food groups on average [34]. Previous studies conducted in Ethiopia have also revealed that the prevalence of inadequate dietary diversity practices was over

fifty percent [2, 4, 11-13, 16]. This finding suggests that over 50% of women are exposed to dietary inadequacies by consuming fewer than five food groups during pregnancy.

This study also revealed several factors that were significantly associated with inadequate dietary diversity practices, including sociocultural, household socioeconomic, and individual characteristics. These factors were associated cumulatively with a 19–41% increased risk of inadequate dietary diversity practices. Pregnant women who lived in households with at least one child under five years of age among family members who lived together as a household had a higher risk of inadequate dietary diversity practices during pregnancy compared to women from households without children under five years among family members of the households. The risk of exposure to inadequate dietary diversity increased among women who had lived in households with at least one child under five years old, among family members. Although similar evidence is limited, previous studies' findings suggest that households with multiple members face greater economic strain, affecting the dietary diversity and quality of household diets [16, 28]. There are several reasons for this to happen in this study setting. The presence of more young children may imply household shifts in resources to young children and compromise the quality of maternal diets. This may be because most cultural practices prioritize young children for food and care in this setting. It may also be because maternal caring for more children interferes with the time they need for their own care and feeding practices.

Pregnant women who did not attend ANC services in their most recent pregnancy were more likely to experience inadequate dietary diversity practices than those who had attended ANC. Past ANC service attendance in the most recent pregnancy was found to be protective against inadequate dietary diversity practices among pregnant women in this study. Similarly,

previous studies in Ethiopia have shown that nutrition counselling and education have been linked to adequate dietary diversity practices during ANC, due to improvements in nutrition services through counselling or education on dietary supplements during pregnancy [28, 35]. This finding suggests a critical need for appropriate ANC nutrition counselling and education on adequate and quality diets for pregnant women.

Households' lack of TV was associated with a higher risk of inadequate dietary diversity practices among pregnant women in this study. Women from households without television were practicing inadequate dietary diversity. This finding is consistent with previous studies that highlight the roles of household assets and underlying household socioeconomic status on household dietary diversity [28]. Similarly, a previous study has shown that household ownership of a TV is associated with higher household income and access to nutrition and food-related information [36, 37]. This finding suggests nutrition and health communication play a crucial role in household socioeconomic determinants in maternal dietary diversity practices.

Meal frequency during pregnancy was significantly associated with dietary diversity practices during pregnancy. Pregnant women who consumed 1–4 meals and snacks per day had a significantly increased risk of inadequate diversity practices compared to those whose meal and snack frequencies were 5-6 times daily during pregnancy. This finding was consistent with previous studies linking meal frequency to improved dietary diversity practices [28, 35, 36]. Previous studies conducted in Ethiopia have shown that maternal dietary habits and healthy eating patterns are associated with adequate dietary diversity [2, 4, 9, 11, 12, 38]. This finding suggests that women's dietary habits and daily eating patterns, including consuming fewer than five meals and snacks during pregnancy, are critical maternal and individual characteristics that

predispose women to inadequate dietary diversity practices.

Pregnant women with dyspepsia or gastritis during pregnancy had an increased risk of inadequate dietary diversity practices. Pregnant women with dyspepsia or gastritis during pregnancy were significantly more likely to practice inadequate dietary diversity than their counterparts. A previous study has shown that nausea and or vomiting and food aversion during pregnancy have been associated with inadequate dietary diversity practices [39, 40]. This finding is probably due to the fact that gastrointestinal disorders reduce appetite, cause food aversions, and limit intake of certain food groups during early pregnancy, resulting in inadequate dietary diversity practices. This finding highlights the need for targeted screening, nutritional counselling, and management of gastritis or dyspepsia with smaller, more frequent meals during pregnancy.

This study model diagnostics indicate an acceptable fit, suggesting that predictors improve model performance and contribute to relevant explanatory power. Although this study employed a follow-up (longitudinal) study and two dietary recall assessments to ascertain the usual dietary diversity practices during pregnancy, some limitations were present. First, seasonality might affect the results as dietary diversity data were collected between July and September, a period when some food items, including mangoes, are not readily available in Gambella Town. Secondly, there was an ethnic-based conflict in the Gambella regional state and Gambella Town during the study period, which could also restrict movement within and outside the town. This might reduce household socioeconomic activities, could affect accessibility and availability of certain foods at the household and individual levels, and negatively limit maternal dietary diversity. Thirdly, the assessment of dietary intake was conducted based on the 24-hour recall method, which

might not accurately reflect past feeding experience due to recall bias.

Conclusion

A higher proportion of women had inadequate dietary diversity practices during pregnancy. Pregnant women who consumed fewer than five out of ten food groups were exposed to less diverse diets than their counterparts. A higher proportion of women were exposed during pregnancy in this study. The study also identified several independent predictors of inadequate dietary diversity practices among pregnant women, such as having under-five children among family members in the household, lack of ANC attendance in the past, household not owning a television, dyspepsia or gastritis during pregnancy, and eating fewer than five meals and snacks per day during pregnancy. These findings show the multifactorial nature of dietary diversity practices among pregnant women. The findings have important implications for the maternal nutrition program. The study also highlights important targets for policymakers and planners in public health interventions during pregnancy. Maternal nutrition and dietary interventions should prioritize households with young children, promote quality of ANC counselling, enhance household-focused nutrition education, and address gastrointestinal symptoms through screening and management with smaller, more frequent meals during pregnancy. Nutrition counselling by health workers during ANC should focus on increasing meal frequency as a simple and cost-effective strategy to improve dietary diversity practices during pregnancy. Future studies should further explore the connections among factors such as sociodemographics, sociocultural and socioeconomic factors, individual maternal characteristics, and dietary diversity practices, using a longitudinal design that accounts for seasonality and provides broader geographical coverage in the Gambella Regional State.

Data Sharing Statement

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Disclosure

The authors declare no conflicts of interest in this work.

Ethics Approval and Consent

This study was conducted in accordance with the principles of the Declaration of Helsinki. Ethical approval was granted by the Research Review Committee of the Gambella Regional Health Bureau on July 02, 2024, and a letter of permission was submitted to the GGH and GTPH before the start of data collection. Written informed consent was obtained from each participant after they received comprehensive information about the study's purpose, procedures, potential risks, and benefits. Pregnant women of reproductive age group (15-49 years) were eligible for participation, including those younger than 18 years, as this age group is recognized as being at increased risk for APOs. Participation was entirely voluntary, and participants were informed of their right to refuse participation or withdraw from the study at any time without any consequences for the care or services they received at the study hospitals. Confidentiality and anonymity were strictly maintained throughout all stages of the study.

References

- [1]. Stevens, G. A., Beal, T., Mbuya, M. N. N., Luo, H., Neufeld, L. M., 2022, Micronutrients deficiencies among preschool-aged children and women of reproductive age worldwide: A pooled analysis of individual-level data from population-representative surveys. *The Lancet Global Health*, 10, e1590–e1599.
- [2]. Getaneh, T., Asres, A., Hiyaru, T., Lake, S., 2021, Adverse perinatal outcomes and its associated factors among adult and advanced maternal age

Author Contributions

The corresponding author made substantial contributions to the conception and design of the study, data acquisition, analysis, interpretation of data, drafting of the manuscript, and critical revision for important intellectual content. The corresponding author also submitted the manuscript to the journal and accepts full responsibility for the integrity and accuracy of the work. The co-authors' contributions included scientific guidance, critical review of the manuscript for intellectual content, final approval of the version to be published, and agreeing to submit the manuscript to the current journal.

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- pregnancy in Northwest Ethiopia. *Scientific Reports*, 11. <https://doi.org/10.1038/s41598-021-93613-x>
- [3]. Gebremichael, M. A., Lema, T. B., 2023, Dietary Diversity, Nutritional Status, and Associated Factors among Pregnant Women in Their First Trimester of Pregnancy in Ambo District, Western Ethiopia. *Nutrition and Metabolic Insights*, 16, 1–12. <https://doi.org/10.1177/11786388231190515>
 - [4]. Bitew, Z. W., Alemu, A., Ayele, E. G., Worku, T., 2021, Dietary diversity and practice of pregnant and lactating women in Ethiopia: A systematic

- review and meta-analysis. *Food Science and Nutrition*, 9, 2686–2702. <https://doi.org/10.1002/fsn3.2228>
- [5]. Food and Agriculture Organization of the United Nations, 2021, Minimum Dietary Diversity for Women. *FAO, Rome*.
- [6]. Yang, J., Wang, M., Tobias, D. K., Rich-Edwards, J. W., Darling, A. M., Abioye, A. I., Noor, R. A., Madzorera, I., Fawzi, W. W., 2022, Dietary diversity and diet quality with gestational weight gain and adverse birth outcomes, results from a prospective pregnancy cohort study in urban Tanzania. *Maternal and Child Nutrition*, 18, 1–13. <https://doi.org/10.1111/mcn.13300>
- [7]. Galani, Y. J. H., Orfila, C., Gong, Y. Y., 2022, A review of micronutrients deficiencies and analysis of maize contribution to nutrient requirements of women and children in Eastern and Southern Africa. *Critical Reviews in Food Science and Nutrition*, 62, 1568–1591. <https://doi.org/10.1080/10408398.2020.1844636>
- [8]. Schulz, R., Slavin, J., 2021, Perspective: Defining Carbohydrate Quality for Human Health and Environmental Sustainability. *Advances in Nutrition*, 12, 1108–1121. <https://doi.org/10.1093/advances/nmab050>
- [9]. Abere, M., Azene, A. G., 2023, Food Taboo and associated factors among pregnant women attending antenatal clinics at Bahir Dar City, Northwest Ethiopia, 2021: Cross-sectional study. *Scientific Reports*, 13. <https://doi.org/10.1038/s41598-023-34964-5>
- [10]. Weerasekara, P. C., Withanachchi, C. R., Ginigaddara, G. A. S., Ploeger, A., 2020, Understanding Dietary Diversity, Dietary Practices and Changes in Food Patterns in Marginalised Societies in Sri Lanka. *Foods*, 9, 1–24. <https://doi.org/10.3390/foods9111659>
- [11]. Gudeta, T. G., Terefe, A. B., Mengistu, G. T., Sori, S. A., 2022, Determinants of Dietary Diversity Practice among Pregnant Women in the Gurage Zone, Southern Ethiopia, 2021: Community-Based Cross-Sectional Study. *Obstetrics and Gynecology International*, 8086793. <https://doi.org/10.1155/2022/8086793>
- [12]. Tilahun, A. G., Kebede, A. M., 2021, Maternal minimum dietary diversity and associated factors among pregnant women, Southwest Ethiopia, 2021. *BMC Nutrition*, 7, 1–10. <https://doi.org/10.1186/s40795-021-00474-8>
- [13]. Kebede, A. N., Sahile, A. T., Kelile, B. C., 2022, Dietary Diversity and Associated Factors among Pregnant Women in Addis Ababa, Ethiopia, 2021. *International Journal of Public Health*, 67, 1–7. <https://doi.org/10.3389/ijph.2022.1605377>
- [14]. Walle, B. M., Adekunle, A. O., Arowojolu, A. O., Dugul, T. T., Mebiratie, A. L., 2022, Low birth weight and its associated factors in East Gojjam Zone, Amhara, Ethiopia. *BMC Nutrition*, 8, 1–9. <https://doi.org/10.1186/s40795-022-00621-9>
- [15]. Adem, H. A., Usso, A. A., Hebo, H. J., Workicho, A., Ahmed, F., 2023, Determinants of acute undernutrition among pregnant women attending primary healthcare unit in Chinaksen District, Eastern Ethiopia: A case-control study. *PeerJ*, 11, e15416. <https://doi.org/10.7717/peerj.15416>
- [16]. Hidru, H. D., Berwo Mengesha, M., Hailesilassie, Y., Tekulu Welay, F., 2020, Burden and Determinant of Inadequate Dietary Diversity among Pregnant Women in Ethiopia: A Systematic Review and Meta-Analysis. *Journal of Nutrition and Metabolism*, 2020, 1–10. <https://doi.org/10.1155/2020/1272393>
- [17]. Makarem, N., Chau, K., Miller, E. C., Gyamfi-Bannerman, C., Tous, I., Booker, W., Catov, J. M., Haas, D. M., et al., 2022, Association of a Mediterranean Diet Pattern with Adverse Pregnancy Outcomes among US Women. *JAMA Network Open*, 5, e2248165. <https://doi.org/10.1001/jamanetworkopen.2022.48165>
- [18]. Parikh, N. I., Gonzalez, J. M., Anderson, C. A. M., Judd, S. E., Rexrode, K. M., Hlatky, M. A., Gunderson, E. P., Stuart, J. J., Vaidya, D., 2021, Adverse Pregnancy Outcomes and Cardiovascular Disease Risk: Unique Opportunities for Cardiovascular Disease Prevention in Women. *Circulation*, 143, e902–e916. <https://doi.org/10.1161/CIR.0000000000000961>

- [19]. Perry, A., Stephanou, A., Rayman, M. P., 2022, Dietary factors that affect the risk of pre-eclampsia. *BMJ Nutrition, Prevention and Health*, 5, e000399. <https://doi.org/10.1136/bmjnp-2021-000399>
- [20]. da Silva Lopes, K., Yamaji, N., Rahman, M. O., Suto, M., Takemoto, Y., Garcia-Casal, M. N., Ota, E., 2021, Nutrition-specific interventions for preventing and controlling anaemia throughout the life cycle: An overview of systematic reviews. *Cochrane Database of Systematic Reviews*, CD013092. <https://doi.org/10.1002/14651858.CD013092.pub2>.
- [21]. Akowuah, J. A., Owusu-Addo, E., Opuni, A. A., 2022, Predictors of Anaemia Prevalence among Ghanaian Pregnant Women: A Cross-Sectional Study. *INQUIRY: The Journal of Health Care*, 59, 1–8. <https://doi.org/10.1177/00469580221086919>
- [22]. Abu-Saad, K., Kaufman-Shriqui, V., Freedman, L. S., Belmaker, I., Fraser, D., 2021, Preconceptional diet quality is associated with birth outcomes among low socioeconomic status minority women in a high-income country. *European Journal of Nutrition*, 60, 65–77. <https://doi.org/10.1007/s00394-020-02221-4>
- [23]. Raut, A. K., Hiwale, K. M., 2022, Iron Deficiency Anemia in Pregnancy. *Cureus*, 14, e28918. <https://doi.org/10.7759/cureus.28918>
- [24]. Walle, B. M., Adekunle, A. O., Arowojolu, A. O., Dugul, T. T., Mebiratie, A. L., 2020, Micronutrients Deficiency and Their Associations with Pregnancy Outcomes: A Review. *Nutrition and Dietary Supplements*, 12, 237–254. <https://doi.org/10.2147/nds.s274646>
- [25]. Karakochuk, C. D., Zimmermann, M. B., Moretti, D., Kraemer, K., 2023, Nutrition and health: Nutritional anemia, in: *Nutrition and Health Series*. Springer Nature Switzerland AG, Cham, Switzerland. <https://doi.org/10.1021/ie50204a022>
- [26]. Ethiopian Public Health Institute, 2022, Ethiopia: Food-Based Dietary Guidelines–2022. Federal Democratic Republic of Ethiopia Ministry of Health, Addis Ababa, Ethiopia.
- [27]. Central Statistical Agency of Ethiopia, 2008, Summary and Statistical Report of the 2007 Population and Housing Census: Population Size by Age and Sex. Federal Democratic Republic of Ethiopia Population Census Commission, Addis Ababa, Ethiopia.
- [28]. Teferi, T., Endalk, G., Ayenew, G. M., Fentahun, N., 2023, Inadequate dietary diversity practices and associated factors among postpartum mothers in Gambella town, Southwest Ethiopia. *Scientific Reports*, 13. <https://doi.org/10.1038/s41598-023-29962-6>
- [29]. Smits, J., Steendijk, R., 2013, The International Wealth Index (IWI), *Nijmegen Center for Economics*. Netherlands.
- [30]. World Health Organization, 2022, WHO antenatal care recommendations for a positive pregnancy experience. Maternal and fetal assessment update: Imaging ultrasound before 24 weeks of pregnancy. *World Health Organization*, Geneva.
- [31]. Coates, J., Swindale, A., Bilinsky, P., 2007, Household Food Insecurity Access Scale (HFIAS) for Measurement of Food Access: Indicator Guide (v. 3). Food and Nutrition Technical Assistance Project, *Academy for Educational Development*, Washington, DC. <https://doi.org/10.1017/CBO9781107415324.004>
- [32]. Takagi, K., Nakamoto, O., Watanabe, K., Tanaka, K., Matsubara, K., 2022, A Review of the Best Practice Guide 2021 for the Diagnosis and Management of Hypertensive Disorders of Pregnancy (HDP). *Hypertension Research in Pregnancy*, 10, Takagi K. <https://doi.org/10.14390/jsshp.10.57>
- [33]. Federal Ministry of Health of Ethiopia, 2020, Management Protocol on Selected Obstetrics Topics for Hospitals. Federal Democratic Republic of Ethiopia Ministry of Health, Addis Ababa, Ethiopia.
- [34]. Islam, H., Nayan, M., Jubayer, A., Amin, R., 2024, A review of the dietary diversity and micronutrient adequacy among the women of reproductive age in low- and middle-income countries. *Food Science and Nutrition*, 12, 1367–1379. <https://doi.org/10.1002/fsn3.3855>
- [35]. Demilew, Y. M., Alene, G. D., Belachew, T., 2020, Effect of guided counseling on dietary practices of pregnant women in West Gojjam Zone,

Ethiopia. *PLoS ONE*, 15, e0233429. <https://doi.org/10.1371/journal.pone.0233429>

[36]. Anyanwu, O., Ghosh, S., Kershaw, M., Abuye, C., Kennedy, E., 2022, The Role of Household Assets in Improving Women's Dietary Diversity in Ethiopia. *Current Developments in Nutrition*, 6, nzab131. <https://doi.org/10.1093/cdn/nzab131>

[37]. Le, H. N., Nguyen, K. V., Phung, H., Hoang, N. T. D., Tran, D. T., Mwanri, L., 2023, Household Dietary Diversity among the Ethnic Minority Groups in the Mekong Delta: Evidence for the Development of Public Health and Nutrition Policy in Vietnam. *International Journal of Environmental Research and Public Health*, 20. <https://doi.org/10.3390/ijerph20020932>

[38]. O'Hara, C., Gibney, E. R., 2021, Meal Pattern Analysis in Nutritional Science: Recent Methods

and Findings. *Advances in Nutrition*, 12, 1365–1378. <https://doi.org/10.1093/advances/nmaa175>

[39]. Asim, M., Ahmed, Z. H., Nichols, A. R., Rickman, R., Neiterman, E., Mahmood, A., Widen, E. M., 2021, What stops us from eating: A qualitative investigation of dietary barriers during pregnancy in Punjab, Pakistan. *Public Health Nutrition*, 25, 760–769. <https://doi.org/10.1017/S1368980021001737>

[40]. Wallin, A. R., Tielsch, J. M., Khatri, S. K., Mullany, L. C., Englund, J. A., Chu, H., Leclercq, S. C., Katz, J., 2020, Nausea, vomiting, and poor appetite during pregnancy and adverse birth outcomes in rural Nepal: An observational cohort study. *BMC Pregnancy and Childbirth*, 20, 1–12. <https://doi.org/10.1186/s12884-020-03141-1>

Effect of an Educational Intervention on Menstrual Hygiene Knowledge and Associated Determinants among Female University Students in Uganda

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Abstract

Menstrual hygiene management is an important public health concern among young women, but there is a paucity of evidence on theory-based interventions at the university level. This study aimed at determining the effect of an educational Intervention on menstrual hygiene knowledge and associated determinants among female university students in Uganda. A quasi-experimental design based on Social Cognitive Theory and Health Promotion Model was used between October-December, 2025. We surveyed 436 participants from Campus A (Intervention group) and Campus B (Control Group). Propensity Score Matching, Difference-in-Differences approach and logistic regression analysis were done. The statistical significance level was $p < 0.05$. A theory-based educational intervention significantly enhanced knowledge and reduced sociocultural barriers. Campus A students displayed a significant improvement in their knowledge (baseline: 5.61 $\pm$ 0.99; endline: 6.00 $\pm$ 0.91; DiD = 0.807, $p < 0.001$) and less sociocultural barriers (DiD = 0.422, $p = 0.001$). While the hygiene practices of menstruation were better in both groups, the extra impact of the intervention on practices was not significant (DiD = 0.000, $p = 1.000$). The translation of knowledge into practice was not significant implying that there might be other interventions needed in addition to the educational intervention. Findings imply that education is necessary but not sufficient for changing menstrual hygiene practices among the study participants.

Keywords: Health Education, Health Promotion Model, Menstrual Hygiene, Social Ecological Model, Uganda, University Students.

Introduction

Menstrual hygiene management is a vital aspect of the health of 1.9 billion girls and women aged 15 to 49 years, particularly in developing countries where access to menstrual products and WASH facilities is limited [1]. Appropriate Menstrual Hygiene Management (MHM) requires not only access

to safe and affordable menstrual materials but also appropriate water, sanitation, and hygiene (WASH) facilities, accurate information on menstrual biology and hygiene, and supportive social and institutional conditions. In most of the low- and middle-income countries (LMICs), menstruation is stigmatized and most of the women and girls do not have the

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resources and knowledge on how to practice safe menstrual hygiene [1].

MHM issues are prevalent in sub-Saharan Africa (SSA). Recent studies have reported a pooled prevalence estimate of good menstrual hygiene practices among adolescent girls of 45%, highlighting the lack of informational, material, and infrastructural assistance in the region [2]. Certain causes linked to the low MHM practices are poor access to water and sanitation, inaccessibility to cheap menstrual supplies, cultural taboos, and poor access to education on menstruation [3-5].

Globally, MHM Intervention studies and activities have reported more on young girls in primary and secondary schools than older girls in tertiary institutions [6-8]. As such, there is limited evidence regarding MHM among female students at the university level.

In Uganda, menstrual hygiene studies have also majorly focused on girls in primary and secondary schools [9]. Indicatively, it has been shown that among secondary school students, there are high rates of poor MHM practices that are associated with infrastructural deficiency, poor sanitary amenity, and insufficient menstrual education [10]. Nonetheless, the literature exploring MHM among female students at tertiary institutions is limited. A cross-sectional study done from a private health-sciences based university showed poor attitude and practice towards menstrual hygiene among female students. However, this study seemed narrow in scope and not grounded in theory, intervention, or time-based research [11].

Reviews of the literature regularly report that MHM interventions have the potential to enhance knowledge and hygiene behaviours, but the evidence base is fragmented, and few of the interventions are articulated using well-defined behavioral frameworks [12-14]. In Uganda, the MENISCUS intervention is one of the few studies that have systematically examined multi-level determinants of menstrual hygiene behaviour and

operationalised constructs, including self-efficacy, observational learning, social support, and outcome expectations, using a specified theory of change [10, 15].

The scarcity of studies with rigorous theory informed quasi-experiments among university students, implies that there is little evidence to inform the university health policies, WASH investments, or menstrual health education programs designed with the higher education context in mind.

Objective

The primary objective of this research was to investigate the effect of an educational intervention on Menstrual Hygiene Knowledge and Associated Determinants among Female Students in two selected Universities in Uganda.

Specific Objectives

1. To assess the level of knowledge of menstrual hygiene among female students in two selected Universities in Uganda.
2. To determine factors influencing menstrual hygiene among Female Students in two selected Universities in Uganda.
3. To determine the effect of a health education intervention on the menstrual Hygiene knowledge and practices among Female Students in two selected Universities in Uganda.

Theoretical and Conceptual Frameworks on Menstrual Hygiene Management

This study combined the Social Cognitive Theory (SCT) [16, 17], and Health Promotion Model (HPM) to inform the design and assessment of interventions [18]. The two models have a solid basis in designing MHM interventions that go beyond knowledge acquisition to include motivation, skills development, social norms, and environmental reinforcement. The fact that HPM and SCT are not widely used in current MHM interventions

constitutes a serious theoretical gap. The direct response to this gap with the incorporation of both models in the current research is to allow linking of the intervention components to behavioral constructs and expected outcomes in a systematic way, thus enhancing causal inference, interpretability, and scalability of menstrual hygiene promotion strategies.

The SCT constructs included behavioral capacity where skills and knowledge in effective management of menstruation were taught to the intervention group, self-efficacy through belief in hygienic actions, observational learning through the peer and facilitator learning, reinforcement by teaching the advantages of good practice as well as the interplay of personal, behavioral and environmental factors [16]. The HPM constructs as targets for behavior change interventions include: (1) perceived benefits of action, (2) perceived barriers to action, (3) perceived self-efficacy, (4) activity-related affect, (5) interpersonal influences (including norms, modeling/vicarious learning, and social support), (6) situational influences, (7) commitment to plan of action, and (8) immediate competing demands and preferences (alternative behavior that compete for a person's attention and time). Factors influencing health-promoting behaviour are divided into three categories: "individual characteristics and experiences," "behaviour-specific cognitions and affect," and "behavioural outcome" [17, 18]. In this study HPM constructs included personal experiences and individual aspects such as past practices, socio-demographic and cultural beliefs. Behaviour-specific cognitions include perceived advantages and obstacles, interpersonal factors, and effects of activities. The behavioral results expected were good healthy menstrual hygiene practices. Peer demonstrations were used to capitalize on observational learning (SCT), interactive communication was to increase self-efficacy and perceived barriers (HPM), role-play and

group activities were for reinforcement of correct practices (SCT).

Materials and Methods

Study Design and Setting

The study employed a quasi-experimental design with a non-equivalent control group, which was used in order to test the impact of a menstrual health education intervention on female undergraduate students. The study was undertaken from a private University in the Central Uganda (Campus A-intervention group) and a public University in South Western Uganda (Campus B- control group) respectively. Geographical separation minimized contamination. Both groups had comparable characteristics in age, course undertaken, and mode of study.

Study Population

The target population was female undergraduate students. Accessible population was limited to female students who had menstruated in the previous year. The total number of female students was 4,936 (Campus A: 2,036; Campus B: 2,900).

Sample Size Determination

The sample size was based on a previous study by Hennegan et al., in Mukono District, which allowed deriving a minimum of 600 participants [19]. The sample size was adjusted at 10% non-response to obtain a target of 667 participants. Proportional allocation resulted in 276 participants for Campus A and 391 participants for Campus B. The quasi-experimental pre-post design used the formulae for comparing two proportions (intervention and control), assumed 15% between the groups, 5% level of significance, and 80% power, and non-response of 10%. Thus, a sample of 188 participants per group yielded an overall sample size of 376. Therefore, the proposed sample size of 667 participants was substantially above the statistical minimum, offering sufficient power

to improve the validity and ability to generalise the findings.

Sampling Technique

Multi-stage sampling technique was used. The two universities were chosen using purposive sampling. The control B is a public University while intervention A is private university. At baseline, a total of 631 respondents were enrolled comprising 276 respondents in Campus A and 355 participants in Campus B. Consecutive sampling was used to recruit participants from each university, with the samples proportionally allocated across faculties. This strategy provided representative sample of the faculties. While at end-line, complete data was obtained from 475 participants, 239 in Campus A and 236 in Campus B. The reduction in number of participants was attributed to attrition, specifically the temporary absenteeism of participants during the end-line data collection period, withdrawal from campus, and incomplete or unmatched responses at end-line that could not be reliably linked to baseline records for analysis. Matching was performed at individual level using the most significant covariates including age, academic year, prior knowledge on menstruation, religion, marital status, living arrangement (who one lives with), parents' level of education, and the occupation of the parents or guardians. This resulted in a final matched sample of 436 participants, of which 218 were in Campus A and 218 in Campus B, reflecting a successful individual-level matching.

Inclusion and Exclusion Criteria

Female undergraduate students of reproductive age who expressed a willingness to take part in the study were recruited; because they were the ones mostly available at campus. Those excluded were individuals who had never menstruated or had not menstruated in the year preceding the research. Post Graduate students were left out because of the

nature of their courses being online and modular. Also, medical students were also excluded because it was assumed that they had prior knowledge of menstruation.

Data Collection

The intervention program on menstrual health education was based on the guidelines set by UNICEF [20, 21] and Water Aid. Baseline data was gathered from both campuses. After baseline data collection, the learning intervention was delivered over a 6-week period at Campus A. Ten 45-minute sessions were devoted to the menstrual hygiene knowledge, practices, menstrual disorders, cycle control, and menstrual pain factor reduction strategies as well as health risks of poor hygiene. Health education was provided through mini-lectures, handouts, educational video demonstrations, peer demonstrations, role-play, and group activities.

Endline data were collected three months after the intervention in both the intervention and control universities to measure its effectiveness. Data was collected using a pretested structured self-administered questionnaire. The questionnaire was mapped to SCT and HPM constructs such as knowledge, sociocultural factors and practice at baseline and end-line. A pretest was conducted among 50 students at the Institute of Allied Health and Management Sciences - Mulago. Three experts in reproductive health, public health and academia assessed the clarity and reliability of the tool. Training for research assistants was conducted over 3 days.

Data Analysis

All analyses were conducted in Stata version 15. The outcome variables and demographic characteristics were summed up using frequencies and percentages for categorical variables, while means and standard deviations were for continuous variables. To assess the temporal changes within each group, paired t-tests were

performed. These tests compared mean outcome values at baseline and end-line.

To minimize selection bias in a non-randomized design, Propensity Score Matching (PSM) was used. The most significant covariates were matched. Propensity scores were estimated with logistic regression and nearest-neighbor matching was done to match participants in both groups [22]. Participants in the intervention group were then matched one-to-one with individuals in the comparison group who had similar propensity scores. Only those who fit the region of common support and whose matches were appropriate, were selected and the end result was a final analysis sample of 218 Campus A students and 218 Campus B students.

After matching, group equivalence was tested at the baseline. The matched dataset was used to estimate intervention effects using the Difference-in-Differences (DiD) approach, which compared changes in menstrual hygiene knowledge, attitudes, and practices over time between intervention and control conditions in each study. The treatment effect was estimated using logistic regression, and results are presented as odds ratios with 95% confidence intervals; statistical significance was set at $p < 0.05$.

Methodological Rigor

The quantitative quasi-experimental study has scientific rigor strategies that cover internal validity, reliability, and generalisation. The design used was a pre-test-post-test intervention and control study, which allowed evaluation of changes in menstrual hygiene knowledge, socio-cultural attitudes, and practices in relation to the intervention and control, and adjustment for baseline differences between the two groups. This was

done by first reading the baseline data at the time before the intervention and then using an educational intervention during six weeks, after which the end-line data was collected three months after the intervention in both groups.

In order to reduce selection bias, comparable universities were purposively chosen as the intervention and control arm, and the identical eligibility criteria were used in both intervention and control groups. Both time points were used to administer standardised, structured questionnaires so as to ensure uniformity of measurement. Training of data collectors was done before data collection, and pre-testing of the tool. This increased the tool's reliability.

The Difference-in-Differences (DiD) analysis was used to estimate the effect of the intervention by controlling for the unobserved time-invariant confounders. Multivariable regression models were also applied where necessary to control for possible baseline covariates.

Results

A total of 667 participants were sampled including 355 in the control and 276 in the intervention group. However, the final matched sample was 436 participants of which 218 were in Campus A and 218 in campus B.

The age distribution was comparable in both campuses (23 $\pm$ 2 years, Campus A ; 22 $\pm$ 2 years, Campus B), with most of the students being Anglican, single, non-resident in both campuses. Campus A mainly consisted of second-year students; however, the experimental and control populations markedly differed in parental level of education and with whom they were living, as shown in Table 1.

Table 1. Socio-Demographics Distribution of Respondents in Campus A and Campus B

Variables (n,436)	Campus A (n, 218)	Campus B (n, 218)
Age	Mean =23 years, SD+ 2	Mean = 22 years,SD+2
Religion		
Catholic	71 (32.6%)	76 (34.9%)
Anglican	103 (47.2%)	88 (40.4%)
Muslim	8 (3.7%)	20 (9.2%)
Pentecostals	33 (15.1%)	32 (14.7%)
Others	3 (1.4%)	2 (0.9%)
Current Year		
First year	40 (18.3%)	103 (47.2%)
Second year	164 (75.2%)	105 (48.2%)
Third year	14 (6.4%)	6 (2.8%)
Fourth year	0 (0.0%)	4 (1.8%)
Marital status		
Single	198 (90.8%)	191 (87.6%)
Engaged	16 (7.3%)	25 (11.5%)
Married	4 (1.8%)	2 (0.9%)
Residence status		
Resident	40 (18.3%)	24 (11.0%)
Non-Resident	178 (81.7%)	194 (89.0%)
Ugandan/ International student		
Domestic student	190 (87.2%)	201 (92.2%)
International student	28 (12.8%)	17 (7.8%)
Family type		
Nuclear	131 (60.1%)	153 (70.2%)
Extended	77 (35.3%)	56 (25.7%)
Blended	9 (4.1%)	6 (2.8%)
Not defined/foster	1 (0.5%)	3 (1.4%)
Living with Whom		
Alone	29 (13.3%)	125 (57.3%)
Both parents	119 (54.6%)	61 (28.0%)
Father	4 (1.8%)	3 (1.4%)
Mother	52 (23.9%)	16 (7.3%)
Husband	3 (1.4%)	7 (3.2%)
Other relatives	10 (4.6%)	6 (2.8%)
Others	1 (0.5%)	0 (0.0%)
Parents Level of education		
No formal education	6 (2.8%)	57 (26.1%)
Primary	7 (3.2%)	48 (22.0%)
Secondary	33 (15.1%)	41 (18.8%)
Tertiary	121 (55.5%)	52 (23.9%)
Don't know	51 (23.4%)	20 (9.2%)
Occupation of parent/guardian		

Self-employed	111 (50.9%)	129 (59.2%)
Employed in public service	57 (26.1%)	38 (17.4%)
Employed in private sector	43 (19.7%)	26 (11.9%)
Others	2 (0.9%)	19 (8.7%)
Don't know	5 (2.3%)	6 (2.8%)

Comparison of Scores for Knowledge, Sociocultural and Practice Variables

Campus A showed a significant improvement in knowledge and practice scores as well as a non-significant change in

sociocultural scores. Campus B, in contrast, demonstrated knowledge and sociocultural score declines, but an improvement in practice scores as shown in table 2.

Table 2. Comparison of Scores for Knowledge, Sociocultural and Practice Variables

University	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Campus B								
Endline knowledge – Baseline Knowledge	-.413	1.863	.126	-.661	-.164	-3.273	217	.001
Endline Sociocultural Baseline Sociocultural	-.344	1.366	.093	-.526	-.162	-3.717	217	.000
Endline-Baseline Practice	.606	2.487	.168	.274	.937	3.595	217	.000
Campus A								
Endline knowledge – Baseline Knowledge	.394	1.334	.090	.216	.573	4.367	217	.000
Endline-Baseline Sociocultural	.078	1.167	.079	-.078	.234	.986	217	.325
Endline-Baseline practice	.606	1.854	.126	.358	.853	4.822	217	.000

Difference-in-Differences Analysis of Intervention Effect on Knowledge

There was no significant difference in the baseline knowledge scores between treatment and control groups, which implies that they were comparable before the intervention. The

DiD estimate indicated that knowledge among students in the intervention campus was statistically significantly greater than that of the students in the control campus at endline (DiD = 0.81, $p < 0.001$) as shown in table 3.

Table 3. Difference-in-Differences Analysis of the Effect of Intervention on Knowledge

Knowledge	Group	Mean	SE	t	P
Baseline	Control (Campus B)	5.69	—	—	—
	Treatment (Campus A)	5.61	—	—	—
	Difference (T–C)	–0.08	0.10	–0.78	0.438
Endline	Control (Campus B)	5.28	—	—	—
	Treatment (Campus A)	6.01	—	—	—

	Difference (T–C)	0.73	0.12	6.35	0.000
Difference-in-Differences	—	0.81	0.16	5.20	0.000
R-square	0.05				

Difference-in-Differences Analysis of Intervention effect on Sociocultural Factors

The baseline scores of the socio-cultural factors were significant between the treatment and the control group but were no longer

significant at the endline. The DiD value showed that the sociocultural attitudes in the intervention campus A were significantly better than in the control campus B (DiD = 0.42, $p = 0.001$) as indicated in table 4.

Table 4. Difference-in-Differences Analysis of Intervention Effect on Sociocultural Factors

Sociocultural	Group	Mean	SE	t	P
Baseline	Control (Campus B)	2.055	—	—	—
	Treatment (Campus A)	1.596	—	—	—
	Difference (T–C)	–0.459	0.094	–4.87	0.000
Endline	Control (Campus B)	1.711	—	—	—
	Treatment (Campus A)	1.674	—	—	—
	Difference (T–C)	–0.037	0.079	0.46	0.642
Difference-in-Differences	—	0.422	0.122	3.47	0.001
R-square	0.04				

Difference-in-Differences Analysis of Intervention Effect on Hygiene Practice

After the intervention, menstrual hygiene practice scores in both groups registered an increment of about the same magnitude.

However, the DiD estimate revealed that the intervention effect on the hygiene practices was not statistically significant (DiD = 0.00, $p = 1.000$) as shown in table 5.

Table 5. Difference-in-Differences Analysis of Intervention Effect on Hygiene Practice

Practice	Group	Mean	SE	t	P
Baseline	Control (Campus B)	6.390	—	—	—
	Treatment (Campus A)	7.596	—	—	—
	Difference (T–C)	1.206	0.134	9.01	0.000
Endline	Control (Campus B)	6.995	—	—	—
	Treatment (Campus A)	8.202	—	—	—
	Difference (T–C)	1.206	0.161	7.48	0.000
Difference-in-Differences	—	0.000	0.210	0.00	1.000
R-square	0.16				

Discussion

This study focused on the effectiveness of a menstrual hygiene education program on menstrual hygiene knowledge and associated determinants among female university students in Uganda.

Findings noted similarities in the socio-demographic characteristics of students in both campuses, with a mean age of 22 years for Campus A and 23 years for campus B, unmarried, non-residents and majorly of Ugandan nationality. This is representative of many universities in Uganda where majority

students are single, younger and living off campus [23]. In SCT terms, such relative homogeneity implies that the social norms, peer influences, and institutional environments that shape health behaviour are all similar. Nevertheless, variations in year of study, parental education levels and living arrangements were noted between campus A and B, which could have influenced exposure to health information and hygiene behavior in the two groups.

Regarding the knowledge of menstrual hygiene, most of the female students had basic knowledge about menstruation as shown in Table 3. Descriptive and inferential analyses revealed a similar and positive change in menstrual hygiene knowledge in the intervention campus where knowledge scores increased from a baseline mean of 5.61 to an endline mean of 6.00. Furthermore, DiD analysis revealed a significant intervention effect, which is similar to studies conducted by [24-26]. This enhancement is due to improved behavior capability as provided by SCT whereby people learn and develop the knowledge and skills required to adopt a given behavior. Interventions that are based on health education directly address this construct by raising awareness, debunking myths and enhancing cognitive knowledge of health practices.

Paired T-Tests confirmed that practice scores improved significantly ($M = 0.606$, $t = 4.822$, $p < .001$), showing that the program successfully translated knowledge into improved menstrual hygiene behavior at Campus A and B. Despite an increase in the score of menstrual hygiene practice between baseline and end-line in the intervention and control groups, the difference between them was not statistically significant with a DiD estimator of 0.000 ($SE = 0.210$, $p = 1.000$) This indicates that although the intervention had an effect on practice over time in the experimental group, it did not have a significant effect on the behavior of menstrual

hygiene. This finding suggests that other factors play a role in changing practices. The same has been noted in school-based MHM intervention research where general practice had significantly improved but that the differences between intervention and comparison cases were not statistically significant, which highlights the need for other MHM interventions in form of policy, and structural Menstrual interventions [24].

In the present study, the educational intervention increased perceived susceptibility and severity in the intervention group. This indicates that, after the education, the intervention group believed that not practising proper menstrual hygiene would lead to consequences for their menstrual health. The interventional groups' perceived reality increased as a result of the educational materials delivered through mini-lectures, educational video demonstrations, and handouts. Also, role-play and group activities and, the experiences from peer demonstrations had an effect. Johnson et al., indicated that knowledge about menstrual hygiene was significantly correlated with perceived barriers [27]. In contrast a Ghimire et al., study done in Nepal knowledge was correlated to perceived benefits and self-efficacy with improved menstrual hygiene [24].

From a sociocultural influence context, the majority of the students resided outside their home, possibly with limited support from their families to deal with menstrual challenges, and unreliable WASH facilities on campus; as such, they tended to experience varying socio-cultural experiences. This is contrary to a study done in Ghana, where students who lived with their parents received adequate menstrual supplies and support [28]. After the intervention, there was an improvement in the socio- cultural perspectives of students in the experiment group compared to the control group with a DiD value of 0.42, which was significant with a p-value of $p = 0.001$. This showed that the negative cultural norms of

students from Campus A decreased as compared to those of Campus B. This is in line with SCT that includes reciprocal determinism, whereby attitudes were affected by the interaction between peers and facilitators. The explanation of this is given by HPM in terms of interpersonal influences and perceived barriers lessened, which proves that restrictive beliefs can be challenged by culturally sensitive education. This is consistent with similar findings in studies conducted in Nigeria, and Ghana [29, 30].

Study Limitations

The study's two groups were not exactly similar, however, propensity score matching was applied to minimize the differences between the two groups. Also, the time of 3 months allocated between the intervention and the end-line was minimal, because changing practices requires time. And perhaps only short-term changes in practice were captured although the goal was to capture long long term changes. Further studies focusing on long-term time periods between baseline intervention and end-line should be considered for future MHM improvements.

Conclusion

Findings showed that the intervention had a significant effect on the knowledge of menstrual hygiene and this could have contributed to a significant change in the sociocultural perception of menstruation. Although the MHM practices were positively impacted, without significant changes, implying that there are other interventions that may be required to change practice.

Recommendation

The findings offer strong support that incorporation of behavioural theory in menstrual hygiene programming can yield long-term positive changes in hygienic knowledge and determinants among female students in universities. Further validation of scalable menstrual health promotion

interventions should be tested with a similar theory across more diverse higher-education settings and assess longer-term outcomes, including outcomes related to academic participation and psychosocial wellbeing.

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Ethical Review and Approval

Approval to conduct the study was granted from Texila American University. Research ethics clearance was granted by the Research Ethics Committee of Uganda Christian University (UCUREC-2025-1908). Administrative permission was sought and granted from all the institutions where the study was carried out. All participants provided written consent. Data was stored securely and anonymized so that confidentiality and privacy were observed. The participants were compensated for their time and had the freedom to pull out at any given stage without consequences.

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Data Availability

Raw data collected in this study will not be made public owing to the confidentiality agreement with the research subjects. The data will, however, be accessible to interested authors upon request. There is also an opportunity to provide the anonymized data, which can be confirmed by qualified researchers to verify the findings of the research in accordance with the requirements of the confidentiality agreement in the

accepted protocols of ethics. The interested parties can request for access through the secure data-sharing portal of the project.

Competing Interests

The authors declare no competing interest regarding the conduct of this research.

References

- [1]. Adane, Y., Ambelu, A., Yenesew, M. A., Mekonnen, Y., Kassahun, T., 2025, Effect of menstruation on school attendance of girls along with water, sanitation, and hygiene services in Northwest Ethiopia. *Pan Afr Med J*, 50:28, <https://doi.org/10.11604/pamj.2025.50.28.45413>
- [2]. Anbesu, E. W., Asgedom, D. K., 2023, Menstrual hygiene practice and associated factors among adolescent girls in sub-Saharan Africa: A systematic review and meta-analysis. *BMC Public Health*, 23(1):33, <https://doi.org/10.1186/s12889-022-14942-8>
- [3]. Worku, Y., Kassa, G. M., Mekonen, B., Desta, M., Bishaw, K. A., Gedfaw, M., Tesfaw, E., Degu, G., Shiferaw, A., 2024, Menstrual hygiene management practice and associated factors among high school and preparatory school adolescent students in Debre Markos town, Northwest Ethiopia: A mixed-method study. *BMC Women's Health*, 24(1):420, <https://doi.org/10.1186/s12905-024-03265-y>
- [4]. Harerimana, A., Mchunu, G., Pillay, J. D., 2025, Menstrual hygiene management among girls and women refugees in Africa: A scoping review. *Conflict and Health*, 19(1):20, <https://doi.org/10.1186/s13031-025-00657-1>
- [5]. Asumah, M. N., Abubakari, A., Aninanya, G. A., Salisu, W. J., 2022, Perceived factors influencing menstrual hygiene management among adolescent girls: A qualitative study in the West Gonja Municipality of the Savannah Region,

Authors' Contributions

Josephine Namyalo, Edward Mukooza, Robert Basaza, Emmanuel Otieno, Timothy Onyango, and Gloria Seruwagi participated in the conception of the study, development of the study design and guide. All the six authors performed data analyses, interpreted results, drafted the original manuscript, and reviewed the manuscript. All the authors read and approved the final version of the manuscript.

- Ghana. *Pan Afr Med J*, 41:146, <https://doi.org/10.11604/pamj.2022.41.146.33492>
- [6]. Ayele, A., G/Mariam, M., Beyene, H., Tolcha, A., Tediso, D., Shalamo, T., Belayneh, T., 2025, Menstrual hygiene practice and associated factors among adolescent primary school females in Dale Woreda, Sidama, Ethiopia: A cross-sectional study. *Front Reprod Health*, 7:1458132, <https://doi.org/10.3389/frph.2025.1458132>
- [7]. Tshivule, M. Z., Rasweswe, M. M., Mothiba, T. M., Bopape, M. A., 2025, Factors influencing menstrual hygiene knowledge, attitudes, and practices among adolescent girls in African rural schools: A scoping review. *Front Reprod Health*, 7:1553101, <https://doi.org/10.3389/frph.2025.1553101>
- [8]. Namuwonge, F., Kizito, S., Ssentumbwe, V., Namatovu, P., Namuli, F., Tutlam, N. T., Nabunya, P., Ssewamala, F. M., 2025, Culture, self-esteem and menstrual hygiene management among adolescent girls in Uganda: The impact of economic and family strengthening. *BMC Women's Health*, 25(1):230, <https://doi.org/10.1186/s12905-025-03778-0>
- [9]. Dvalishvili, D., Namuwonge, F., Ahmed, R. F., Andom, F., Sensoy Bahar, O., Nabunya, P., Ssewamala, F. M., 2025, School absenteeism during menstruation among adolescent girls in Southern Uganda: A multi-level risk factors analysis. *Children and Youth Services Review*, 179:108562, <https://doi.org/10.1016/j.childyouth.2025.108562>
- [10]. Kansime, C., Hytti, L., Nalugya, R., et al., 2020, Menstrual health intervention and school

- attendance in Uganda (MENISCUS-2): A pilot intervention study. *BMJ Open*, 10:e031182, <https://doi.org/10.1136/bmjopen-2019-031182>
- [11]. Ameade, E. P., Garti, H. A., 2016, Relationship between female university students' knowledge on menstruation and their menstrual hygiene practices: A study in Tamale, Ghana. *Adv Prev Med*, 2016:1056235, <https://doi.org/10.1155/2016/1056235>
- [12]. Sumpter, C., Torondel, B., 2013, A systematic review of the health and social effects of menstrual hygiene management. *PLoS One*, 8(4):e62004, <https://doi.org/10.1371/journal.pone.0062004>
- [13]. Hennegan, J., Montgomery, P., 2016, Do menstrual hygiene management interventions improve education and psychosocial outcomes for women and girls in low- and middle-income countries? A systematic review. *PLoS One*, 11(2):e0146985, <https://doi.org/10.1371/journal.pone.0146985>
- [14]. Betsu, B. D., Medhanyie, A. A., Gebrehiwet, T. G., Wall, L. L., 2024, Menstrual hygiene management interventions and their effects on schoolgirls' menstrual hygiene experiences in low- and middle-income countries: A systematic review. *PLoS One*, 19(8):e0302523, <https://doi.org/10.1371/journal.pone.0302523>
- [15]. Hennegan, J., Brooks, D. J., Schwab, K. J., Melendez-Torres, G. J., 2020, Effects and costs of a multi-component menstrual health intervention (MENISCUS) on mental health, educational performance and menstrual health in Ugandan secondary schools: Theory of change and study protocol. *BMJ Open*, 10:e031182.
- [16]. Bandura, A., 1986, Social foundations of thought and action. *Englewood Cliffs*, NJ.
- [17]. Ssemata, AS., Ndekezi, D., Kansiime, C., Bakanoma, R., Tanton, C., Nelson, KA., et al., 2023, Understanding the social and physical menstrual health environment of secondary schools in Uganda: A qualitative methods study. *PLOS Glob Public Health*, 3(11):e0002665, <https://doi.org/10.1371/journal.pgph.0002665>
- [18]. Pender, N., 2011, Health promotion model. Burlington, MA: Jones & Bartlett Learning.
- [19]. Hennegan, J., Kibira, S. P., Exum, N. G., Schwab, K. J., Makumbi, F. E., Bukenya, J., 2020, 'I do what a woman should do': A grounded theory study of women's menstrual experiences at work in Mukono District, Uganda. *BMJ Global Health*, 5(11):e003433, <https://doi.org/10.1136/bmjgh-2020-003433>
- [20]. Sommer, M., Caruso, B. A., Torondel, B., Warren, E. C., Yamakoshi, B., Haver, J., Long, J., Mahon, T., Nalinponguit, E., Okwaro, N., Phillips-Howard, P. A., 2021, Menstrual hygiene management in schools: Midway progress update on the "MHM in Ten" 2014–2024 global agenda. *Health Res Policy Syst*, 19(1):1, <https://doi.org/10.1186/s12961-020-00669-8>
- [21]. UNICEF, 2019, Guidance on menstrual health and hygiene.
- [22]. Gomez-Montero, A., Garcia-Lopez, A., Cabas, S., et al., 2026, Methodological guidance on implementing propensity score matching in observational studies of kidney transplantation. *Sci Rep*, 16:1878, <https://doi.org/10.1038/s41598-025-31596-9>
- [23]. Nakame, R. M., Kiwanuka, F., Robert, A., 2018, Dysmenorrhoea among students aged 18–45 years attending university in Uganda: A cross-sectional multicenter study of three universities in Uganda. *Nurs Open*, 6(2):268–275, <https://doi.org/10.1002/nop2.207>
- [24]. Ghimire, S., Gahatraj, N. R., Shrestha, N., Manandhar, S., Dhital, S. R., 2024, Effects of health education intervention on menstrual hygiene knowledge and practices among adolescent girls of Pokhara Metropolitan, Nepal. *PLoS One*, 19(9):e0291884, <https://doi.org/10.1371/journal.pone.0291884>
- [25]. Dahal, A., Acharya, K. P., 2019, Effectiveness of information education and communication on menstrual hygiene among adolescent school girls of Jumla District. *J Nobel Med Coll*, 8(2):4–9, <https://doi.org/10.3126/jonmc.v8i2.26714>
- [26]. Dorle, A. S., Gavel, S., Mannapur, B. S., 2019, Impact of health education on knowledge and practices about menstruation among college-going adolescent girls. *Medica Innovatica*, 8:21–25.

- [27]. Johnson, E., Seed, L., Biju, A., Tulinius, C., 2025, Experiences, perceptions and barriers to use of reusable menstrual products among university students globally: A systematic review. *BMJ Open*, 15(8):e103159, <https://doi.org/10.1136/bmjopen-2025-103159>
- [28]. Appiah-Agyekum, N. N., Nyamekye, M. A., Agbenu, I. A., Otoo, D. D., 2025, Menstrual hygiene knowledge and practices among female senior high school students in the New Juaben North Municipality of Ghana: A cross-sectional study. *BMC Public Health*, 25(1):1563, <https://doi.org/10.1186/s12889-025-22836-8>.
- [29]. Obiageri, C. J., Uwaezu, O. E., Ifeanyi, N. H., 2025, Assessment of menstrual hygiene management practices and societal attitude towards menstruation among female undergraduate students of Federal Polytechnic Nekede Owerri, Imo State. *J Obstet Gynecol Reprod Sci*, 9(7), <https://doi.org/10.31579/2578-8965/281>
- [30]. Gbogbo, S., Wuresah, I., Gbogbo, E., Axame, W. K., Klutse, P., Dowou, R. K., Mantey, S. O., Ayitey, S. A. Y., Boateng, I., Nelson, P. E., Kugbey, N., 2025, The socio-cultural construction of menstruation in the Ghanaian context: A qualitative study of the perspectives of parents, teachers, and adolescent girls. *Int J Environ Res Public Health*, 22:349, <https://doi.org/10.3390/ijerph22030349>

Exploring Hand Hygiene Practices for Preventing Influenza Infections among Batswana University Students during the Peak Pandemic Period

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Abstract

During influenza pandemics, university settings with huge number of students who are highly active and mobile can become serious outbreak centres. As outbreak management is crucial for disease control, the current research aimed to explore hand hygiene practices to prevent influenza infections among Batswana university students during the peak of the pandemic. A quantitative, cross-sectional study was performed by collecting data from 200 Batswana university students during peak influenza season. Data was analysed using descriptive statistics. The findings showed significant insights on hand hygiene knowledge, attitudes, behaviours and practices of Batswana university students towards preventing influenza infection. The study demonstrates that Batswana university students hold strong positive attitudes, mixed levels of knowledge and compliant behaviours regarding hand hygiene for influenza prevention. The narrowing knowledge–practice gap and resourceful use of soap, water, sanitisers and wipes indicated effective internalisation of technical guidance while low adherence to the 20-second handwashing rule underscored the need for health educational campaigns. Findings also indicated that relying on self-reports, lower confidence in biomedical interventions and persistent structural barriers (costs, facilities, forgetfulness) signals ongoing vulnerabilities. Future research should incorporate objective behavioural or clinical measures, qualitative exploration of vaccine and mask hesitancy, and intervention trials that integrate behavioural practices with improved infrastructural support to ensure effective prevention of influenza.

Keywords: Attitude, Hand Hygiene, Influenza, Knowledge, Pandemic, Practices.

Introduction

Study Background

As a highly contagious illness, influenza remains a major global health problem due to its ability to cause widespread seasonal epidemics and occasional pandemics [1]. According to [2], influenza affects between 5–15% of the world's population annually, accounting for about 290,000 to 650,000 deaths which outpaces fatalities from all other vaccine preventable diseases. The influenza virus can be transmitted by infected persons within 24 hours prior to symptoms onset. Individuals with compromised health are at increased risk of

infection which leads to significant community or institutional outbreaks [2, 3] noted that university settings can be particularly vulnerable during influenza outbreaks due to large concentration of young adults who are highly mobile and interactive. In Botswana, public health authorities have advocated for basic preventive measures during pandemic periods. During influenza and COVID-19 pandemics for instance, authorities considered frequent handwashing with soap and water as an effective way to reduce viral transmissions [4].

In reducing microbial transmission, alcohol-based hand sanitisers and frequent

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handwashing are widely viewed as the key to infection prevention [5]. Leading organisations like WHO and CDC report that effective hand hygiene is crucial in mitigating how infectious diseases spread [6]. While reducing person-to-person transmission of viruses through contaminated hands and surfaces, hand hygiene has been preferred due to simplicity, accessibility and evidence of effectiveness. When there is influenza outbreak, the relevance of hand hygiene practices intensifies due to increased incidence of viral infections. Against this background, understanding the knowledge, attitudes and practices (KAP) among communities in regards to hand hygiene during influenza season is crucial for developing targeted public health interventions.

To align with recommended practices, the knowledge on how influenza is transmitted as well as the effectiveness of hand hygiene practices in reducing infections becomes a necessity. Existing research holds that increased awareness of how influenza is transmitted present positive effects on adherence to hand hygiene practices [7]. However, other researches highlight gaps in public knowledge when determining specifics of hand hygiene like duration of handwashing, use of hand sanitisers or appropriate techniques [8]. At the same time, attitudes towards hand hygiene practices during influenza outbreaks has significant influence on behavioural patterns. In particular, positive attitudes towards hand hygiene that includes perceived severity of contracting influenza usually predict higher adherence to regular handwashing [9]. Contrary to these, underestimation or misconceptions about influenza virus can result in complacency or limited handwashing practices [1]. Across populations, consistency, contexts and technique of hand hygiene practices varies significantly. This evident in cross-sectional studies among students which have shown maintenance of hand hygiene standards to be universally inconsistent [3, 10].

Together, there dynamic and complex relationship between knowledge, attitudes and practices surrounding influenza prevention. Whereas enhanced knowledge may result in more positive attitudes that encourage better practices, higher knowledge and positive attitudes could be affected by limited access to handwashing facilities that affect implementation of recommended hand hygiene practices [11, 12]. In light of these, the current research aims at exploring the knowledge, attitudes, behaviours and practices of Batswana university students in regards to hand hygiene practices that prevent influenza by underscoring the importance of proper and consistent hand hygiene practices during influenza season.

Research Problem

According to [13], Botswana remains vulnerable to pandemic-prone respiratory diseases that includes seasonal influenza which occurs throughout the year but peaks between April and October. Recent experiences with COVID-19 and previous influenza outbreaks have exposed gaps in influenza outbreak preparedness and highlighted the need for robust preventive practices in communities. In February 2024, the Ministry of Health reported a surge in influenza-like illness cases across Botswana (8,627 per week) and explicitly urged the public to “*follow hand hygiene protocols*” as protective measure [14]. Such call to action reflects practical consensus that encouraging hand hygiene is a critical strategy to reduce influenza transmission in community settings. However, it also raises important questions about compliance and effectiveness at population level.

While health authorities can recommend frequent handwashing, the actual attitudes and behaviours of individuals especially young adults such as university students determine how well these measures are adopted in practice [3]. Given that university students are highly mobile and socially active, they can act as

vectors for viral spread both on campus and in their communities. In Botswana, the uptake and effectiveness of hand hygiene practices among university students have not been well documented.

Additionally, the majority of existing research on hand hygiene and influenza prevention comes from high-income countries, healthcare environments or other settings. For instance, [1] evaluated the knowledge, attitudes and practices concerning hand hygiene among Chinese healthcare workers and found that majority of healthcare workers have comprehensive knowledge, positive attitudes and practiced effective hand hygiene measures. Similarly, [2] showed that knowledge has significant influence on the attitudes and practices with regard to prevention of seasonal influenza among Singaporean healthcare workers. In German household settings, [15] found that facemasks and intensified hand hygiene practices can significantly reduce influenza transmission when used diligently. However, a review by [5] demonstrated that hand hygiene education and practices may not be effective against influenza, with inconsistent evidence on how frequently hand hygiene should be performed. These studies highlight inconsistencies and significant research gaps that is worthy of investigation from the context of Botswana university students.

Research Significance

Theoretically, this study will contribute to the body of knowledge on the knowledge–attitude–practice (KAP) framework of health behaviours by examining it in a sub-Saharan African university context. It will shed light on whether global findings about hand hygiene’s role in influenza prevention could be transferred to Botswana university students, thereby extending current theories of health behaviour to new population. From practical perspective, the research findings can guide campus health policies and national influenza preparedness plans. If certain misconceptions

or barriers to handwashing are identified, university health services and public health authorities in Botswana can design more effective awareness campaigns or facility improvements such as installing more handwashing stations. Moreover, by evaluating how effective students’ hygiene practices are during peak influenza period, this research could inform whether additional interventions such as providing hand sanitizers or integrating hand hygiene education into curricula are warranted to protect student health.

Research Aim and Specific Research Questions

In line with the above, this research explores hand hygiene practices for preventing influenza infections among Botswana university students during the peak pandemic period. The specific research questions are crucial in answering the research aim.

1. What are the attitudes of Botswana university students towards hand hygiene practices for preventing influenza infections?
2. What are the knowledge and behaviours of Botswana university students associated with hand hygiene for preventing influenza infections?
3. How effective are the hand hygiene practices adopted for preventing influenza transmissions among Botswana university students?

Research Methods

Research Designs

The current research deployed quantitative research design to explore the effectiveness of hand hygiene practices for preventing influenza infections among Botswana university students during the peak pandemic period. According to [16], quantitative research designs focusses on exploring the relationships between variables by collecting numerical data from several research subjects that are analysed through statistical methods. To gather quantitative data,

the researcher can utilise survey questionnaires, observations or experiments. In this study, quantitative research design allows the researcher to explore the relationship between Botswana university students' attitudes and the adopted hand hygiene practices for influenza prevention. More specifically, a quantitative design enables the researcher to examine whether knowledge levels predict students' attitudes and behaviours regarding hand hygiene measures to prevent influenza. However, a qualitative research design would be inappropriate for this study, given that it involves fewer research subjects, which reduces sample representativeness and thus affects the validity of the research findings [17].

In addition to quantitative design, this research deploys a cross-sectional design, which gathers data from participants at a single point in time or over a short period to capture a "snapshot" of the variables of interest [18]. In this research, the cross-section will coincide with the peak influenza period, that is, during the winter months when influenza cases traditionally surge or during a pandemic wave). This design is appropriate for assessing prevalence and relationships. For example, what proportion of students have good handwashing practices and do those who practice more report fewer illnesses at that time. However, it does not establish causality definitively since we are not manipulating variables or observing changes over time, but it is efficient and suitable for exploratory and correlational analysis in a natural setting [19].

Study Area and Participants Sampling

Participants were recruited from University of Botswana, a public university located within Gaborone city with student population of about 19,000 [20]. As the largest and most representative university, the institution is suitable for exploring the knowledge, attitudes, behaviours and practices associated with prevention of influenza during outbreaks. The research participants were recruited through

convenience sampling strategy because it selects subjects based on ease of access and availability [21]. The students were recruited through active class WhatsApp groups where those with flu or flu-like symptoms. While convenience sampling allowed the researcher to gather data quickly and cost-effectively from readily available subjects, it has inherent limitations. For instance, [22] observed that the sample may be unrepresentative of the broader population which results in biasness. To ensure sample representativeness, the researcher recruited subjects from active class WhatsApp groups, official university communication channels and social media groups frequented by students. About 200 students were recruited into the study.

Data Collection Method

The quantitative data was collected through online survey questionnaires which gathers large volumes of quantitative data from several research participants within a short time [23]. This implies that the researcher collected large quantities of data from several students within the University of Botswana. This data can then be generalised to represent the wider population of students in Botswana. Given that survey questionnaires are closed-ended and the participants choose responses from the provided list, they are easy to analyse and compare which speeds up the research process. While survey questionnaires are effective for this research, they have low response rate which may affect representativeness of results [24]. To address this, the researcher sent follow up reminders to research participants to remind them to key in their responses and send.

When collecting data, the researcher sent participant information sheet which explains the research purpose, research questionnaires and any risks that may be involved. The questionnaire included detailed questions on demographic characteristics, attitudes towards hand hygiene practices, knowledge and behaviours towards hand hygiene protocols,

and reported hand hygiene practices. Questions on attitudes were used to assess students' perceptions towards influenza pandemic while questions on knowledge and behaviours were used to assess the student's general knowledge on pandemic influenza and recommended response measures. questions on the hand hygiene practices were used to assess actual adherence to practices. Participants who signs the consent form received an online questionnaire link on their WhatsApp account. They were then requested to fill in the questionnaires and submit their responses. The researcher targets to collect about 200 valid questionnaires.

Data Analysis

Quantitative data were analysed using descriptive and inferential statistics. As noted by [25], descriptive statistical analysis describes and summarises the main characteristics of a dataset using measures of central tendency, measures of dispersion, frequency distributions, and graphical representations to understand patterns within the dataset. Through descriptive statistics, the researcher summarized the characteristics of study sample and distribution of attitudes, knowledge and hand hygiene practices adopted by Batswana university students to address influenza outbreak.

Inferential statistics such as correlation and regression analysis are used to determine the relationship between research variables [26]. Precisely, correlation analysis is ideal when examining the strength and direction of relationship between variables [26]. For this

research, correlation analysis will be used to determine the extent to which the knowledge levels affect the attitudes and behaviours of Batswana university students towards hand hygiene practices in addressing influenza pandemic. On the other hand, regression analysis aims to describe and predict relationships among interrelated variables [27]. In this study, regression analysis is used to determine how the attitudes and knowledge of Batswana university students affects their hand hygiene practices to prevent influenza transmission. Overall, quantitative findings are visualized using charts, tables or graphs to enhance understanding.

Ethical Considerations

As this research involves collecting quantitative data from human subjects, the researcher first sought the informed consent of participants by providing consent form that explains the research purpose, questions, risks involved [28]. Only participants who signed the consent form were recruited. After recruitment, the participants were informed that their participation is voluntary and they can exit the research study at any time. The collected quantitative data were only accessed by the researcher to ensure that they do not get into unauthorised hands. While storing quantitative data, the researcher utilised password protection or encryption to prevent unauthorised access.

Research Findings

Demographic Characteristics and Warm Up Questions

Table 1. Demographic Information and Warm Up Questions

Demographic information and warm up questions		
	Type	Percentage
Gender	Male	49
	Female	51
Age	Under 20	25
	20-24	49
	25-29	18

	30 and above	8
Current level of study	Undergraduate	66%
	Diploma	25%
	Postgraduate	9%
Have you received formal education or training on hand hygiene	Yes	65
	No	24
	Not Sure	11
Have you experienced flu or flu-like symptoms	Yes	97
	No	3
How often do you use public/shared university facilities	Rarely	1
	Occasionally	2
	Frequently	22
	Daily	75

From table 1, it is evident that the gender of participants was 49% male and 51% female which aligns with [29] who noted that 52% of student population was female in University of Botswana with males accounting for 48%. Additionally, the data above showed that majority of the participants were young students aged between 20-24, less than 20 years and 25-29, which reflects the age group of university students. Of the sampled participants, 66% were undergraduate students with 25% taking diploma courses while 9% were post-graduate students. However, majority of the participants stated that they have received formal education or training with regards to hand hygiene practices. This

demonstrates that they are aware of hand hygiene practices that can reduce influenza transmission. Further, a significant 97% of participants acknowledged experiencing flu or flu-like symptoms which demonstrates their suitability for this research. Notably, majority of the participants stated that they often use public or shared university facilities like cafeteria, washroom, lecture halls and libraries on a daily or frequent basis. This implies that there are high chances of contracting influenza virus from the surfaces of facilities.

Attitudes of Batswana University Students towards Hand Hygiene Practices that Prevent Influenza Infections

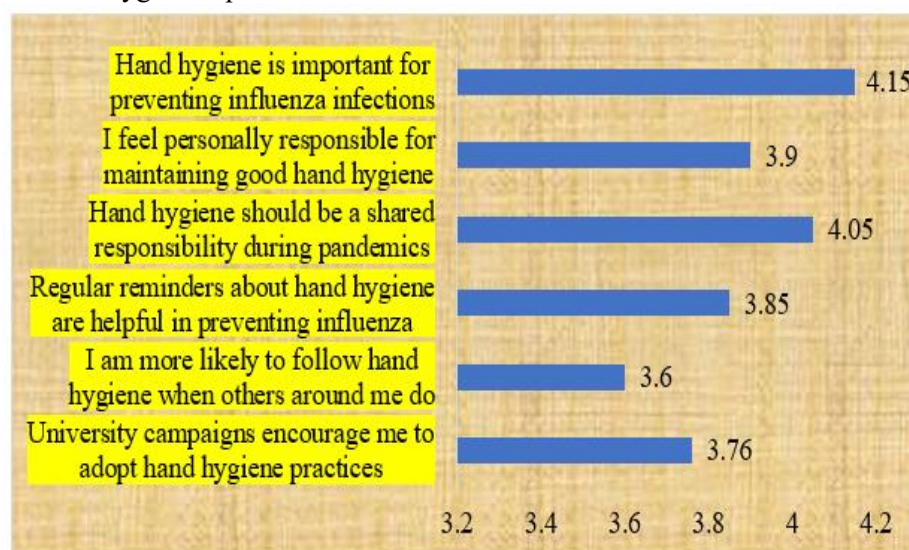


Figure 1. Attitudes Towards Hand Hygiene Practices

From Figure 1, the average score for each statement exceeds 3.5, indicating that the majority of participants have positive attitudes towards hygiene practices that prevent influenza infections. Specifically, the statement ‘hand hygiene is important for preventing influenza infections’ had the highest average of 4.15, indicating strong student consensus in recognising the importance of hand hygiene in preventing disease, suggesting widespread health risk awareness. Additionally, the statement ‘Hand hygiene should be a shared responsibility during pandemics’ posted a higher average score of 4.05. This implies that students view hygiene not only as a personal duty but also as a social duty during public health crises. Further, item ‘I feel personally responsible for maintaining good hand hygiene’ generated higher mean score of 3.9. this high score reflects strong individual

accountability, showing that university students acknowledge their role in disease prevention. However, the statement ‘I am more likely to follow hand hygiene when others around me do’ posted a moderate score of 3.6, which suggests moderate peer influence, indicating social modelling matters, but internal motivation may play a stronger role in their behaviour.

Knowledge and Behaviours of Batswana University Students associated with Hand Hygiene for Preventing influenza Infections

From the quantitative results, majority of participants stated that they frequently washed their hands after using public or shared surfaces during influenza seasons (figure 2 below). This indicates that they are knowledgeable and actively practice precautions that can limit influenza transmission.

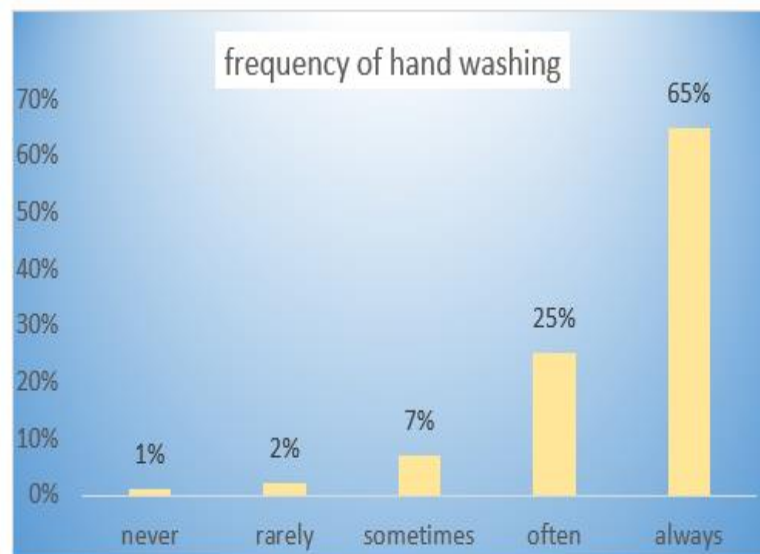


Figure 2. Frequency of Handwashing

Additionally, a significant proportion of students (90%) reported using soap and water regularly for hand hygiene, while 45% utilised hand sanitiser (figure 3). Only 11% utilised antibacterial wipes. Further, the majority of

students (43%) indicated that they wash their hands for 10 seconds to remove the influenza-causing virus, while 25% showed that they wash their hands for 20 seconds, with only 22% washing their hands for 5 seconds (figure 4).

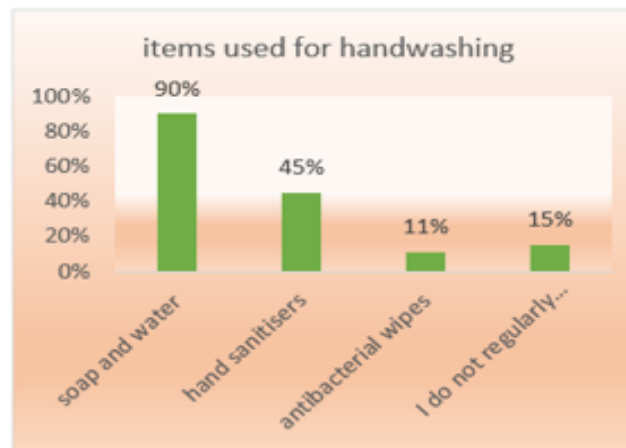


Figure 3. Items used for Handwashing

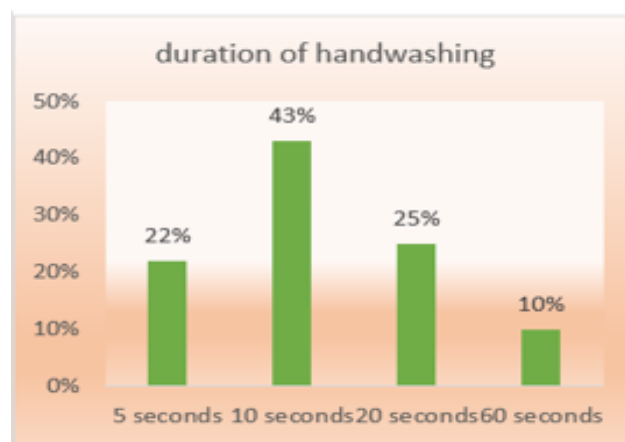


Figure 4. Duration of Handwashing

More important, Likert scale findings on the knowledge and behaviours of Batswana students towards prevention of influenza

transmission generated the following findings (figure 5).



Figure 5. Knowledge and Behaviours towards Hand Hygiene Practices during Influenza Season

From figure 5 above, the average mean score of each statement is higher than 3.5 which implies that majority of participants are knowledgeable and behave appropriately in regards to hand hygiene practices that prevent influenza infections. Precisely, the statement ‘It is recommended that I wash my hands after coughing or sneezing’ posted average highest score of 4.25. This reflects high compliance with one of the most emphasized hygiene behaviours in public health messaging during influenza outbreaks. Additionally, the statement ‘Hand hygiene is important even when the hands are not visibly dirty’ which generated average score of 4.15. Such a high score suggests strong conceptual understanding among students that pathogens can be invisible thus reflecting internalized knowledge from health education. However, the statement

‘Hand sanitisers should contain at least 60% alcohol to be effective’ posted moderate score of 3.77. This reflects limited technical knowledge regarding product efficacy, as students likely prioritise availability over content verification.

Effectiveness of hand hygiene practices adopted for preventing influenza transmissions among Batswana university students

Based on quantitative results, a significant proportion of participants believed that handwashing, avoidance of crowds and social distancing contributed their reduction in influenza infections (Figure 6). However, only 35% and 13% of participants believed that facemasks and vaccination helped in reducing their chances of influenza infection.

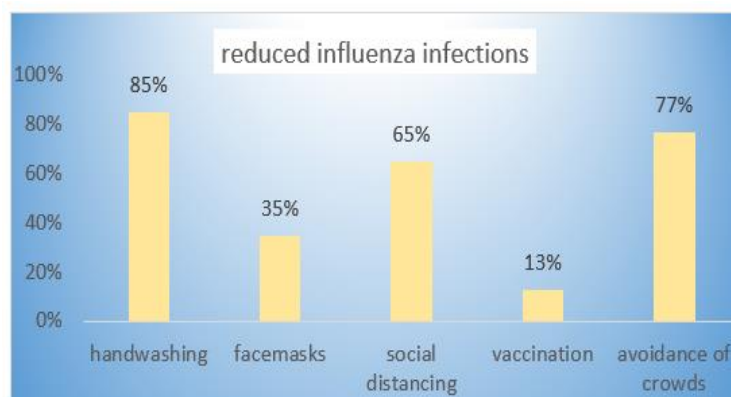


Figure 6. Reducing Influenza Infections

Additionally, a significant 87% of participants noticed reduction in influenza symptoms after adhering to hand hygiene practices with only 10% seeing no changes in symptom reduction (figure 7). Meanwhile, a

significant (82%) stated that they have not been diagnosed with influenza after practicing hand hygiene with 11% having contrary opinion (figure 8).

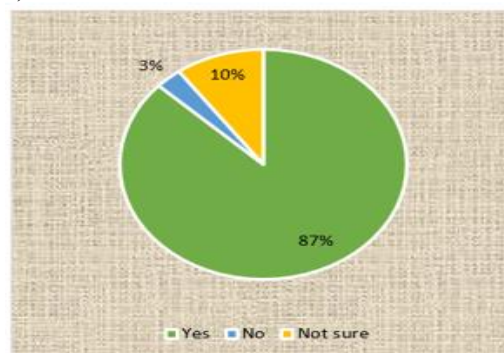


Figure 7. Reduction in Influenza Symptoms

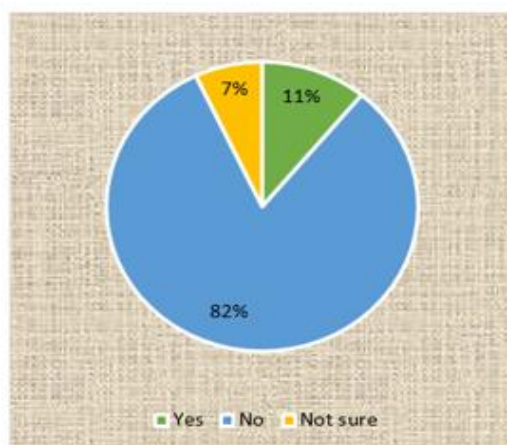


Figure 8. Influenza Diagnosis

Further, majority of participants found soap and water as the most effective during influenza outbreaks with 22% stating alcohol based

sanitisers and 10% going for mix of soap, water and alcohol-based sanitisers (figure 9).

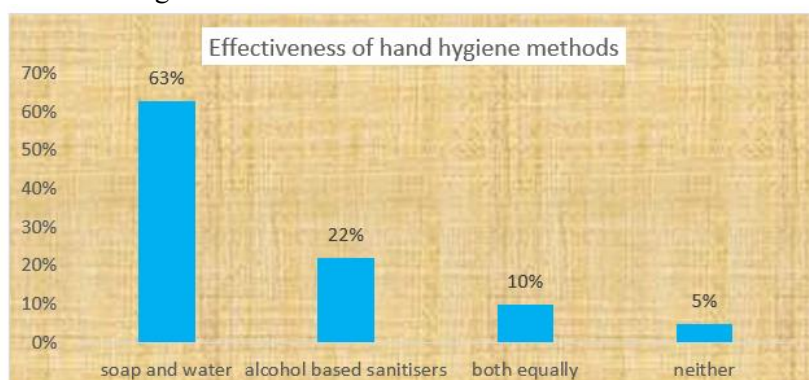


Figure 9. Effectiveness of Hand Hygiene Methods

More important, the participants highlighted forgetfulness, limited access to facilities, cost of sanitizers and soap as well as lack of

awareness as the challenges to hand hygiene practices (figure 10).



Figure 10. Challenges to Hand Hygiene Practices

Discussion

Attitudes of Batswana University Students towards Hand Hygiene Practices to Prevent Influenza Infections

Given that higher education institutions have the potential of becoming serious outbreak centres for influenza pandemic, the attitudes of university students towards pandemic are crucial for complying to health directives. The research findings above showed that Batswana university students have positive attitudes towards hygiene practices that prevent influenza infections. This stronger consensus could be due to effective health education and recent pandemic experiences which cultivate greater awareness. Research across different regions generally show high appreciation of handwashing's importance during public health crises. For instance, during the 2009 H1N1 influenza pandemic, [10] found that significant majority of Korean university students (over 95%) perceived hand washing as effective measure to prevent influenza transmission. In line with this, a recent post-COVID survey in the UAE [30] reported a positive attitude score of about 74.7%, reflecting strong endorsement of hygiene practices among university students.

Key finding is that the university students clearly viewed infection prevention as individual duty and collective social responsibility in times of crisis. Accordingly, the strong agreement among these students suggests they have internalized the notion of communal effort in disease prevention. This finding is backed by extant research which reveals that the highest rates of hand hygiene compliance occur when people perceive it as a collective duty rather than an isolated personal task [12]. However, these findings contradict prior research which focussed on individual knowledge and habits without explicitly measuring attitudes about collective action [31]. On this account, the current study holds that Botswana's strong communal ethic may have led to strong emphasis on shared

responsibility among the students. Another key finding indicated that Batswana students feel personally responsible for maintaining proper hand hygiene. This resonates with emphasis on personal duty that many health education campaigns promote. These results are confirmed by [32] who found that South African university students have very high hygiene attitude scores (91%) but that attitude was the strongest predictor of their hygiene practices more than knowledge. As such those who personally believed in the importance of hygiene were more likely to actually practice it. Contrary to these, handwashing compliance was influenced more by social pressure than by the students' own risk perception or attitude [33]. As such, this research suggests that the students are less reliant on external pressure and more driven by internal motivation to maintain hygiene.

More important, findings reveal that regular reminders about hand hygiene are helpful to Batswana University students in preventing influenza. The implication is that they value ongoing health campaigns to sustain good hygiene practices. These results support [10], who pointed out that intense media campaigns during H1N1 influenza successfully educated Korean students, as evidenced by positive attitude and practice of hand hygiene. Importantly, the results demonstrated that while social influence/peer behaviour do play a role in students' hand hygiene habits, their impact may be less than that of their internal drive. This indicates that the students do not rely exclusively on others' actions to prompt their own hygiene practices. Such findings augment the views by [1] who showed that seeing others perform preventive behaviours during pandemic can encourage an individual to do the same due to the desire to conform to healthy behaviours. This study holds that, while students are influenced by others to some degree, they are also prepared to act autonomously and even influence others,

adding a fresh perspective to the understanding of hand hygiene attitudes.

Theoretically, this research contributes to health belief model which highlights that individuals adopt health behaviours when they perceive high susceptibility and severity of disease [34]. The high mean scores for the perceived importance of hand hygiene, personal and collective responsibility suggest strong perceived severity and benefits which support the predictive capacity of the HBM in the Botswana university context. Overall, this study reinforces existing literature by confirming that positive attitudes are crucial and today's students not only believe in hand hygiene at personal level but also view it as a collective responsibility.

Knowledge and Behaviours of Botswana University Students associated with Hand Hygiene for Preventing Influenza Infections

The quantitative findings above depict comparatively mixed hand-hygiene knowledge and self-reported compliance among Botswana university students. High frequencies of handwashing after touching public/shared surfaces and dominance of soap-and-water use are broadly consistent with post-pandemic studies in university settings, which report improved awareness and practice of hand hygiene for respiratory infection control [30]. However, failure to practice hand hygiene regularly and washing hands for only ten seconds depict knowledge gaps. Previous KAP studies identified substantial gaps between knowledge and behaviour as the students acknowledged the importance of handwashing but failed to wash hands consistently after high-risk contacts. However, the present results suggest that this knowledge–practice gap could be narrowing in this context.

The use of both soap and sanitiser and some uptake of hand sanitisers and antibacterial wipes indicates diversified prevention strategies. Previous studies have focused on

either soap-and-water or sanitiser access, particularly in low- and middle-income settings, by highlighting infrastructural constraints as barriers to practice [35]. The current pattern suggests more resourceful and multi-modal approach to influenza prevention. However, significant proportion of respondents' report washing hands for 10 seconds with only 25% washing hands for the recommended 20 seconds. Existing research show that even when students wash hands, duration is typically shorter than WHO recommendation of at least 20 seconds [12]. Accordingly, low adherence to the 20-second rule is therefore discouraging which highlights the need for educational campaigns to boost knowledge awareness.

From the data analysis, a high level of hand-hygiene knowledge and self-reported adherence among Botswana university students is evident. However, existing literatures on university populations show adequate knowledge but inconsistent practice. According to [36], Bangladeshi university students understood the importance of handwashing yet regular compliance after key coughing or sneezing was limited. From the findings, hand hygiene is important even when hands are not visibly which highlights conceptual understanding that microbes are invisible. This affirms the position by [3] who showed that university students often have good awareness of such principles but this does not always translate into consistent behaviour. These findings reinforce the growing evidence that university populations can achieve a high level of cognitive alignment with WHO guidance.

More importantly, alcohol-based sanitiser is recognised as a valid substitute when soap and water are unavailable, a common situation in resource-constrained African settings where access to water is a challenge. Prior African studies by [35] among Tanzanian students and nurses have emphasised structural barriers to handwashing, with less attention to substitution strategies. In contrast, this research suggests

that students not only accept sanitiser use but also understand its situational role, thus contributing new insight into adaptive hygiene behaviours under infrastructural constraints. However, the finding that sanitisers should contain at least 60% alcohol reveals specific technical knowledge deficit. This consistent with evidence that while students know that sanitiser works, they rarely appreciate formulation thresholds despite clear CDC guidance that more than 60% alcohol is required for optimal effectiveness [37]. The divergence between strong behavioural norms and weaker product-specific literacy is a key nuance that many earlier KAP studies have not explored. Overall, this research holds that Batswana university students have mixed level of hand-hygiene knowledge and self-reported adherence with regard to influenza prevention.

Effectiveness of Hand Hygiene Practices Adopted for Preventing Influenza Transmissions among Batswana University Students

Analysis of quantitative findings above indicate that Batswana university students strongly endorse behavioural interventions such as handwashing, crowd avoidance and social distancing as key practices for reducing influenza infection while showing relatively low confidence in face masks and vaccination. This pattern partly aligns with literatures in low-middle income countries and student populations where handwashing is perceived as the most familiar and low-cost protection, whereas vaccine uptake and mask use are constrained by scepticism, access and risk communication among African and Asian university students [38]. Compared with studies that report modest perceived effectiveness of hand hygiene and a stronger emphasis on vaccination in high-income settings [6], these results reverse this priority hierarchy and highlight a context in which everyday hygiene practices are more trusted than biomedical barrier methods.

Additionally, research findings showed high proportion of participants who perceive reduced symptoms (87%) and absence of diagnosis (82%) after practising hand hygiene. Previous research on influenza or respiratory-virus prevention rarely captures this kind of self-attributed causal link. Most research studies by [30] and [39] focuses on KAP scores or laboratory and epidemiological endpoints rather than perceived health outcomes. Therefore, the current findings contribute novel subjective dimension where students attribute tangible health benefits to their behaviours. Further, the preference for soap and water over alcohol-based sanitiser is consistent with some African studies in which water-based hygiene is culturally normative and sanitisers are seen as costly [35]. However, the relatively small proportion favouring combined approach contrasts with post-COVID guidance that emphasises complementary use of both depending on contexts [5]. The identification of forgetfulness, facility access, cost and lack of awareness as key barriers echoes established structural and behavioural constraints [39], but packaged within university setting in Botswana where empirical evidence has been limited. This enhances contextual understanding of why high knowledge does not always translate into optimal and consistent practice. Future researchers should triangulate self-reports with clinical or surveillance data on influenza incidence, use qualitative methods to unpack vaccine and mask hesitancy or model the combined effect of non-pharmaceutical interventions and vaccination on influenza burden in university environments.

Conclusion

The current research presents significant insights into hand hygiene knowledge, attitudes, behaviours and practices of university students towards preventing influenza infection. The study demonstrates that Batswana university students hold strong positive attitudes, mixed levels of knowledge

and broad compliant behaviours regarding hand hygiene for influenza prevention. The narrowing knowledge–practice gap and resourceful use of soap, water, sanitisers and wipes indicate effective internalisation of technical guidance, while low adherence to the 20-second handwashing rule underscores the need for health educational campaigns. At the same time, reliance on self-reports, lower confidence in biomedical interventions and persistent structural barriers (costs, facilities, forgetfulness) signal ongoing vulnerabilities. Future research should incorporate objective behavioural or clinical measures, qualitative exploration of vaccine and mask hesitancy, and intervention trials that integrate behavioural practices with improved infrastructural support to ensure effective influenza prevention.

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Ethical Approval

The research was approved by the University of Gaborone Ethics Committee before data collection

Conflict of Interest

The Author declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

Data Availability

The datasets generated and/or analysed during the current study are available from the corresponding author upon reasonable request.

Author Contribution

The author was responsible for the study design, data collection, data analysis, and research paper preparation.

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References

- [1]. Hong, Q., & Xu, Y., 2024, Evaluating hand hygiene knowledge, attitudes, and practices among healthcare workers in post-pandemic H1N1 influenza control: a cross-sectional study from China. *Frontiers in Public Health*, 12, 1432445. <https://doi.org/10.3389/fpubh.2024.1432445>
- [2]. Yang, X., Tang, W., Tan, Q., Mao, D., & Ding, X., 2022, The vaccine hesitancy profiles and determinants of seasonal influenza among Chinese community healthcare workers: a cross-sectional study. *Vaccine*, 10, 1547. Doi: 10.3390/vaccines10091547
- [3]. Akan, H., Gurol, Y., Izbirak, G., Ozdathl, S., Yilmaz, G., Vitrinel, A., & Hayran, O., 2010, Knowledge and attitudes of university students toward pandemic influenza: a cross-sectional study from Turkey. *BMC Public health*, 10(1), 413.
- [4]. Seloilwe, E. S., Kealeboga, K. M., & Khutjwe, J. V., 2023, A coordinated health policy in response to COVID-19: A case of Botswana. *Journal of nursing scholarship: an official publication of Sigma Theta Tau International Honour Society of Nursing*, 55(1), 163–166. <https://doi.org/10.1111/jnu.12821>
- [5]. Gozdzielewska, L., Kilpatrick, C., Reilly, J., Stewart S., Butcher, J., & Price, L., 2022, The effectiveness of hand hygiene interventions for preventing community transmission or acquisition of novel coronavirus or influenza infections: a systematic review. *BMC Public Health*, 22, 1283. <https://doi.org/10.1186/s12889-022-13667-y>
- [6]. Vogel, O. A., & Manicassamy, B., 2020, Broadly protective strategies against influenza viruses: universal vaccines and therapeutics. *Frontiers Microbiology*, 11, 517828. doi: 10.3389/fmicb.2020.00135

- [7]. Fulchini, R., Kohler, P., Kahlert, C. R., Albrich, W. C., Kuhn, R., Hoffmann, M., & Schlegel, M., 2018, Hand hygiene adherence in relation to influenza season during 6 consecutive years. *American journal of infection control*, 46(11), 1311-1317. doi: 10.1016/j.ajic.2018.04.203
- [8]. Neo, J. R. J., Sagha-Zadeh, R., Vielemeyer, O., & Franklin, E., 2016, Evidence-based practices to increase hand hygiene compliance in health care facilities: An integrated review. *American Journal of Infection Control*, 44(6), 691-704.
- [9]. Jo, S., Han, S. Y., & Howe, N., 2023, Factors associated with handwashing behaviours during the COVID-19 pandemic: an analysis of the community health survey in Korea. *SAGE open nursing*. 9, 23779608231172364. Doi: 10.1177/23779608231172364
- [10]. Park, J. H., Cheong, H. K., Son, D. Y., Kim, S. U., & Ha, C. M., 2010, Perceptions and behaviours related to hand hygiene for the prevention of H1N1 influenza transmission among Korean university students during the peak pandemic period. *BMC infectious diseases*, 10, 222. <https://doi.org/10.1186/1471-2334-10-222>
- [11]. Aiello, A. E., Murray, G. F., Perez, V., Coulborn, R. M., Davis, B. M., Uddin, M., & Monto, A. S., 2010, Mask use, hand hygiene, and seasonal influenza-like illness among young adults: a randomized intervention trial. *The Journal of infectious diseases*, 201(4), 491-498. doi: 10.1086/650396.
- [12]. Moncion, K., Young, K., Tunis, M., Rempel, S., Stirling, R., & Zhao, L., 2019, Effectiveness of hand hygiene practices in preventing influenza virus infection in the community setting: A systematic review. *Canada communicable disease report*, 45(1), 12-23. <https://doi.org/10.14745/ccdr.v45i01a02>
- [13]. Patient Info, 2024, *Botswana: Travel health advice, vaccines and risks*. Retrieved from <https://patient.info/travel-and-vaccinations/botswana>
- [14]. Xinhua, 2024, *Botswana reports increase in cases of influenza-like illness, COVID-19*. Retrieved from <https://english.news.cn/africa/20240222/97fedec7a1594472a5a33b327de782f7/c.html>
- [15]. Suess, T., Remschmidt, C., Schink, S. B., Schweiger, B., Nitsche, A., Schroeder, K., & Buchholz, U., 2012, The role of facemasks and hand hygiene in the prevention of influenza transmission in households: results from a cluster randomised trial; Berlin, Germany, 2009-2011. *BMC infectious diseases*, 12(1), 26. <https://doi.org/10.1186/1471-2334-12-26>
- [16]. Bruce, N., Pope, D., & Stanistreet, D., 2018, Quantitative methods for health research: a practical interactive guide to epidemiology and statistics. *John Wiley & Sons*.
- [17]. Renjith, V., Yesodharan, R., Noronha, J. A., Ladd, E., & George, A., 2021, Qualitative methods in health care research. *International journal of preventive medicine*, 12(1), 20.
- [18]. Hunziker, S., & Blankenagel, M., 2024, Cross-sectional research design. In *Research design in business and management: A practical guide for students and researchers* (pp. 187-199). Wiesbaden: Springer Fachmedien Wiesbaden.
- [19]. Spector, P. E., 2019, Do not cross me: Optimizing the use of cross-sectional designs. *Journal of business and psychology*, 34(2), 125-137.
- [20]. University of Botswana. 2025, *Annual Report 2023/24*. Retrieved from <https://www.ub.bw/sites/default/files/2025-04/UB-Annual-Report-202324-17042025.pdf>
- [21]. Golzar, J., Noor, S. & Tajik, O., 2022, Convenience sampling. *International Journal of Education & Language Studies*, 1(2), 72-77.
- [22]. Etikan, I., Musa, S. A., & Alkassim, R. S., 2016, Comparison of convenience sampling and purposive sampling. *American journal of theoretical and applied statistics*, 5(1), 1-4.
- [23]. Saunders, M. N. K., Lewis, P., & Thornhill, A., 2019, *Research methods for Business students*. 8th edition. Harlow: Pearson
- [24]. Saris, W. E., & Gallhofer, I. N., 2014, Design, evaluation, and analysis of questionnaires for survey research. *John Wiley & Sons*.
- [25]. Bulanov, N. M., Suvorov, A. Y., Blyuss, O. B., Munblit, D. B., Butnaru, D. V., Nadinskaia, M. Y.,

- & Zaikin, A. A., 2021, Basic principles of descriptive statistics in medical research. *Сеченовский вестник*, 12(3), 4-16.
- [26]. Hazra, A., 2023, Descriptive and inferential statistics in biomedical sciences: An overview. *The quintessence of basic and clinical research and scientific publishing*, 461-478.
- [27]. Keeler, C., & Curtis, A.C., 2024, Descriptive and Inferential Statistics in Nursing Research. *AJN The American Journal of Nursing*, 124(1), 48-52.
- [28]. Drolet, M. J., Rose-Derouin, E., Leblanc, J. C., Ruest, M., & Williams-Jones, B. 2023, Ethical issues in research: Perceptions of researchers, research ethics board members and research ethics experts. *Journal of Academic Ethics*, 21(2), 269-292.
- [29]. Adeyinka, T., & Mutula, S. M., 2008, Gender differences in computer literacy among undergraduate students at the University of Botswana: Implications for library use. *Malaysian Journal of Library and Information Science*, 13(1), 59-76.
- [30]. Mohamed, Y. S., Spaska, A., Andrade, G., Baraka, M. A., Ahmad, H., Steele, S., . & Panigrahi, D., 2024, Hand hygiene knowledge, attitude, and practice before, during and post COVID-19: a cross-sectional study among university students in the United Arab Emirates. *Infection Prevention in Practice*, 6(2), 100361. DOI: 10.1016/j.infpip.2024.100361
- [31]. Bernard, L., Biron, A., Lavigne, G., Frechette, J., Bernard, A., Mitchell, J., & Lavoie-Tremblay, M., 2018, An exploratory study of safety culture, biological risk management and hand hygiene of healthcare professionals. *Journal of advanced nursing*, 74(4), 827-837.
- [32]. Dlalisa, S., Jama, S., Duma, N., Mnguni, G., & Pillay, T., 2025, Exploring the knowledge, attitudes and practices of students at Mangosuthu University of Technology on hand hygiene. *Student's Journal of Health Research Africa*, 6(10), 1. <https://doi.org/10.51168/sjhrafrica.v6i10.2127>
- [33]. Fudolig, M. A., Davis, R. E., Batra, K., & Sharma, M., 2025, Profile Analysis of Handwashing Behavior Among a Sample of College Students in the Multi-Theory Model Framework. *Hygiene*, 5(1), 7. <https://doi.org/10.3390/hygiene5010007>
- [34]. Green, E. C., Murphy, E. M., & Gryboski, K., 2020, The health belief model. *The Wiley encyclopedia of health psychology*, 211-214.
- [35]. Silago, V., Manzi, M. J., Mtemisika, C. I., Damiano, P., Mirambo, M. M., & Mushi, M. F., 2022, Knowledge, attitude and practices of hand hygiene among students and nurses staff in Mwanza Tanzania: a cross-sectional hospital-based study during global COVID-19 pandemic. *East Africa Science*, 4(1), 11-20.
- [36]. Sultana, M., Mahumud, R. A., Sarker, A. R., & Hossain, S. M., 2016, Hand hygiene knowledge and practice among university students: evidence from private universities of Bangladesh. *Risk management and healthcare policy*, 13-20.
- [37]. CDC, 2024, *Hand Sanitizer Facts*. Retrieved from https://www.cdc.gov/clean-hands/data-research/facts-stats/hand-sanitizer-facts.html?utm_source=chatgpt.com
- [38]. Ahmed, J., & Ali, D., 2019, Assessment of knowledge, attitude and practices regarding H1N1 pandemic influenza among the health care providers working at a tertiary care hospital in Kashmir: a cross sectional study. *International Journal of Advanced Community Medicine*, 2(2), 23-27. DOI: <https://doi.org/10.33545/comed.2019.v2.i2a.05>
- [39]. Wong, V. W. Y., Cowling, B. J., & Aiello, A. E., 2014, Hand hygiene and risk of influenza virus infections in the community: a systematic review and meta-analysis. *Epidemiology and Infection*, 142(5), 922-932. doi:10.1017/S095026881400003X

Mismatch Between Perceived and Objective HIV Risk Among Individuals Discontinuing PrEP in Homa Bay and Kisii Counties, Kenya

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Abstract

Pre-exposure prophylaxis (PrEP) is highly effective HIV prevention strategy, yet discontinuation may leave individuals vulnerable. Guided by the Health Belief Model, this study examined whether perceived reductions in HIV susceptibility among PrEP discontinuers aligned with objectively assessed epidemiological risk in Homa Bay and Kisii Counties. A cross-sectional analytical study was conducted among 293 clients, of whom 175 reported a decreased perceived risk. Participants were selected using proportionate stratified random sampling across population groups. HIV risk was objectively evaluated using NASCOP-Risk Assessment Screening Tool (RAST). Descriptive statistics, chi-square and Fisher's exact tests, and logistic regression were applied to examine alignment between perceived and actual risk and identify predictors of high-risk status. Marked discrepancies were observed between perceived and objective HIV risk. 91.4% of participants who perceived reduced HIV risk were classified as high or substantial risk by RAST. County-underestimation was 94.7% in Homa Bay and 72.0% in Kisii ($p < 0.01$). Despite reporting reduced perceived risk, many continued to engage in high-risk behaviors, including multiple sexual partnerships (48.4%), condomless sex (28.6%), prior sexually transmitted infections (18.7%), and low consistent condom use (22.5%). County of residence was the only significant predictor of objective high risk ($aOR = 0.15$; 95% CI: 0.04–0.58); Age, sex, marital status, education, and income were not independently associated. Substantial mismatch between perceived and actual HIV risk exists among PrEP discontinuers, particularly in high-prevalence settings. Strengthened risk assessment, tailored counseling, psychosocial support, and county-specific interventions are critical to prevent premature discontinuation and maintain HIV prevention gains.

Keywords: Discontinuation, PrEP, Risk-Assessment, Risk-Perception.

Introduction

In 2022, an estimated 39 million people were living with HIV globally, with approximately 1.3 million new infections recorded that year. Africa remained the most heavily affected region, accounting for about 25.6 million people living with HIV, 660,000 new infections, and 60% of all AIDS-related deaths worldwide [1]. Compared to 2010, new HIV infections had declined by 38% by 2022 [1].

When taken correctly, HIV pre-exposure prophylaxis (PrEP) significantly reduces the likelihood of acquiring HIV [2]. Its effectiveness is well established among individuals at elevated risk [13], with protection levels reaching up to 99% when adherence is consistent and accurate [3].

Despite these clear benefits, adherence to PrEP remains suboptimal. Globally, up to 40% of users stop taking PrEP within the first six months, and only about one-third maintain optimal adherence [4]. Around 35%

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discontinue within the first year [5]. Perceived low HIV risk is one of the most frequently cited reasons for discontinuation, reported by nearly half of PrEP users [3]. Notably, as many as 50% of those who stop PrEP eventually restart within the same year [4].

Although PrEP is one of the most effective biomedical tools for preventing HIV among high-risk populations, discontinuation threatens to undermine its overall impact. Many individuals stop PrEP because they believe their risk has decreased; however, this perception is not always accurate. Some clients may continue to face significant exposure during periods of non-use, placing them at avoidable risk of HIV infection. A clearer understanding of actual HIV risk during perceived low-risk discontinuation is therefore critical for strengthening prevention strategies, particularly in high-prevalence settings.

Evidence from various global and regional studies illustrates the complexity of PrEP discontinuation and its associated outcomes. In Antwerp, Belgium, 10% of PrEP users discontinued within one year, largely due to perceived low risk, logistical barriers, and concerns about follow-up schedules, with no documented HIV seroconversions among discontinuers [6]. In contrast, a study among sexual and gender minorities in Boston reported that four clients seroconverted after discontinuing PrEP, highlighting persistent risk even when individuals self-identify as low risk [7]. Operational research from Northern California similarly demonstrated seroconversions among clients who discontinued PrEP due to loss of insurance, while high sexually transmitted infection (STI) incidence suggested continued exposure to HIV risk [8, 9].

In West Africa, a demonstration study among female sex workers in Benin found high discontinuation rates, with two seroconversions occurring among clients who had discontinued PrEP for nearly a year. STI incidence remained substantial among those retained on PrEP,

underscoring ongoing behavioral vulnerability [10]. In East Africa, population-based PrEP delivery in Kenya and Uganda showed that up to 66% of clients discontinued PrEP within five years, with 72% of HIV seroconversions occurring among individuals who had stopped taking PrEP for more than one month [11]. Qualitative research from Western and Central Kenya further revealed that PrEP discontinuation is often a deliberate and context-driven decision, primarily motivated by perceived reductions in risk, although many clients remain open to reinitiating PrEP when circumstances change [12].

Collectively, these findings illustrate that while some individuals appropriately discontinue PrEP due to genuine reductions in HIV exposure, others may remain at significant risk during discontinuation periods. The mismatch between perceived and actual risk, coupled with structural and behavioral factors influencing discontinuation, underscores the need for better risk assessment tools, more responsive prevention approaches, and enhanced monitoring systems. These gaps are particularly relevant in high-prevalence counties such as Homa Bay and Kisii in Kenya, where PrEP uptake and adherence remain central to HIV prevention efforts.

This study examined the mismatch between perceived and objective HIV risk among individuals who discontinued PrEP due to self-assessed low vulnerability in Homa Bay and Kisii Counties, Kenya. It aims to determine the extent to which objective behavioral and biological risk persists following discontinuation. The study further characterizes participants' socio-demographic, behavioral, and clinical profiles, including sexual practices, partner risk dynamics, history of sexually transmitted infections, and prior adherence patterns.

Theoretical Framework

This study is grounded in the Health Belief Model (HBM), which posits that engagement in

preventive health behavior is primarily determined by perceived susceptibility, perceived severity, perceived benefits, and perceived barriers. In the context of PrEP use, perceived susceptibility to HIV infection is a key determinant of continuation or discontinuation. When individuals perceive

their HIV risk to be low, they may discontinue PrEP despite objective exposure. This study therefore conceptualizes perceived HIV risk as a cognitive determinant influencing preventive behavior and examines the alignment between perceived susceptibility and objectively measured epidemiological risk (Figure 1).

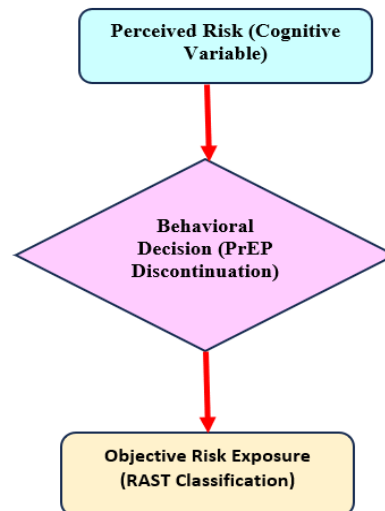


Figure 1. Conceptual Framework

Materials and Methods

Description of the Site

The study was conducted in Homa Bay and Kisii Counties in Western Kenya. Homa Bay, located along Lake Victoria, has a population of approximately 1.31 million across 262,036 households. The county is served by 304 health facilities—202 public, 74 private, and 28 faith-based—and 284 community health units staffed by 2,950 volunteers providing primary healthcare. Homa Bay ranks second nationally in HIV burden, with 109,786 people living with HIV, an overall prevalence of 10.6% (7.4% men, 13% women), 984 new infections, a mother-to-child transmission rate of 7.9%, and 1,404 HIV-related deaths. Kisii County has 1.27 million residents in 312,665 households, 156 health facilities—84 public, 46 private, 26 faith-based—and 190 community health units supported by 2,100 volunteers. Kisii ranks tenth nationally, with 48,202 people living with HIV, a prevalence of 3.8% (2.5% men, 5% women),

443 new infections, 11.1% mother-to-child transmission, and 663 HIV-related deaths. Both counties maintain robust health systems, yet their HIV burden highlights the need for targeted interventions.

Research Design

A cross-sectional analytical study design was employed to assess the association between perceived HIV risk and objectively measured HIV risk among individuals who discontinued PrEP, using data collected at a single point in time.

Sampling and Sample Size

The study sample size was determined using standard sample size estimation procedures for cross-sectional studies. The calculated minimum sample size was 292.87, which was rounded up to 293 participants to account for whole-number requirements.

A proportionate stratified random sampling technique was employed to ensure adequate and representative inclusion of key population

subgroups accessing PrEP services. The study population was first stratified into predefined categories based on programmatic HIV risk profiles, including high-risk populations, fisherfolk, individuals in Sero discordant relationships, adolescents and young people, and pregnant and breastfeeding women. The number of participants selected from each stratum was proportional to the size of that subgroup within the target population, as summarized in Table 1. Within each stratum, participants were randomly selected to participate in the study.

A structured questionnaire was administered to all 293 selected respondents. Individuals whose PrEP discontinuation was attributed to reasons other than perceived low HIV risk, as documented in program records, were excluded from further analysis, as illustrated in Figure 2. Additional eligibility screening was conducted to include only participants who reported a declining perception of HIV risk while continuing PrEP, resulting in a final analytical sample of 175 respondents, as shown in Figure 2. The HIV risk status of these 175 participants—who had discontinued PrEP due to a perceived reduction in HIV risk—was assessed using the NASCOP-approved Risk Assessment Screening Tool (RAST). This tool is routinely used in Kenyan PrEP programs to objectively evaluate ongoing HIV vulnerability and guide decisions related to PrEP initiation, continuation, or enhanced risk-reduction counseling.

Study Population

The study targeted 1,224 individuals from Homa Bay and Kisii Counties who stopped using PrEP after assessing themselves as being at low risk of HIV infection. Participants were identified using a PrEP line list generated from the Kenya EMR database by the LVCT Vukisha95 health informatics team. This line list captured whether clients were still on PrEP or had discontinued, as well as their reported reasons for discontinuation. All individuals had

initiated PrEP within LVCT Vukisha95-supported health facilities.

The target population of 1,224 represented the annual average number of PrEP discontinuations recorded by the project in the two counties over the last three years. Homa Bay and Kisii were selected due to their strong involvement in the Vukisha95 program, which focuses on enhancing HIV prevention and care. From this population, the sample size was determined using the formula recommended by Kothari and Garg (2016).

$$n = \frac{Z^2 \cdot p \cdot q \cdot N}{e^2 \cdot (N - 1) + Z^2 \cdot p \cdot q}$$

This resulted in a calculated sample size of 292.87, which was rounded up to 293 participants. A stratified random sampling technique was employed to achieve proportional representation of key population groups, including high-risk populations, fisherfolk, individuals in Sero discordant relationships, adolescents and young people, and pregnant and breastfeeding women, as summarized in Table 1. Within each stratum, participants were randomly selected for inclusion in the study. A structured questionnaire was administered to all 293 respondents. Individuals whose PrEP discontinuation was attributed to reasons other than perceived low HIV risk, as documented in program records, were excluded, as illustrated in Figure 2.

Further screening was conducted to include only respondents who reported a declining perception of HIV risk while on PrEP, resulting in a final analytical sample of 175 participants, as shown in Figure 2. The HIV risk profile of these 175 individuals—who had discontinued PrEP due to a belief that their risk of HIV acquisition had diminished—was then assessed using the NASCOP-approved Risk Assessment Screening Tool (RAST).

The RAST is used to support objective evaluation of ongoing HIV vulnerability and to guide decisions regarding PrEP initiation,

continuation, or the provision of enhanced risk-reduction counselling. It is routinely applied during follow-up visits and when clients are considering discontinuing PrEP. The tool assesses multiple behavioral and clinical risk factors, including having multiple sexual partners, engagement in condomless sex, a recent history of sexually transmitted

infections, having a sexual partner who is HIV-positive or of unknown HIV status, involvement in transactional sex, inconsistent condom use, recent use of post-exposure prophylaxis (PEP), and alcohol or substance use that may compromise safer sexual practices.

Table 1. Distribution of Participants Across Various Strata

Population Typology (Strata)	Population Count	Percentage of Population	Calculation (Sample of 293)	Sample Count
Discordant relationship	159	13%	0.13×293	38
Dreams Girl	79	6%	0.6×293	19
Female Sex Worker	192	16%	0.16×293	46
Fisher fork	104	8%	0.8×293	25
General Population	468	38%	0.38×293	112
MSM	63	5%	0.5×293	15

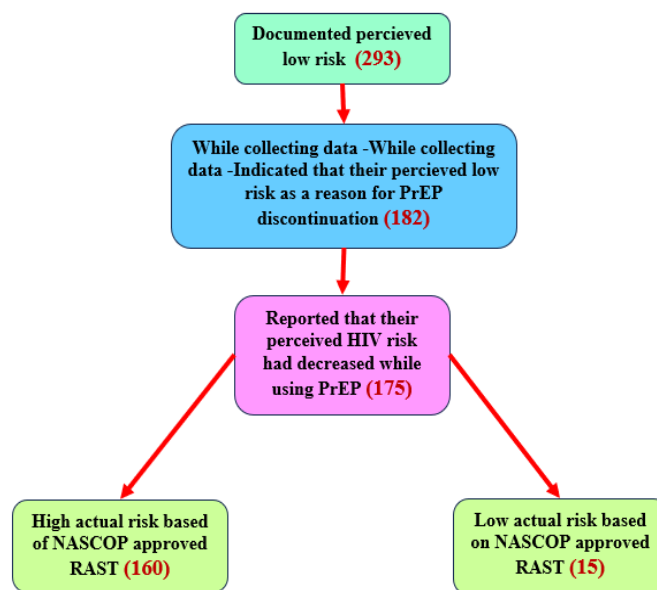


Figure 2. Perception vs Actual Risk Matrix

Inclusion and Exclusion Criteria

Eligible participants for this study were individuals who were initiated on PrEP at LVCT Vukisha95-supported health facilities in Homa Bay and Kisii Counties, were followed up by healthcare workers in these facilities, and discontinued PrEP within three months prior to the interview due to a perceived low risk of HIV infection.

Research Instruments

A structured questionnaire incorporating the NASCOP Risk Assessment Screening Tool (RAST), which included both open- and closed-ended questions was used. It was pilot-tested with twenty respondents to assess clarity, effectiveness, and reliability, with adjustments made based on feedback. Validity was ensured through expert review and field testing, which

confirmed that the questions accurately captured the intended variables. Ambiguous, complex, or leading questions were avoided, and response scales carefully structured. Standardized administration procedures ensured consistency in questioning and recording, providing reliable and accurate data for the study.

Ethical Clearance

The protocol was submitted to the Amref Ethics and Scientific Review Committee (ESRC) and the Kisii Teaching and Referral Hospital Institutional Scientific and Ethics Review Committee (KTRH-ISERC). Both committees reviewed the evaluation for technical rigor and ethical compliance. After receiving ethical clearance, permission to conduct the study was obtained from the National Council for Science, Technology and Innovation (NACOSTI) and the County Health Management Teams (CHMTs), following stakeholder engagement meetings that introduced and explained the study. Key personnel with ethics certification also completed an online ethics course before the evaluation began.

Data Analysis

Data were analyzed using descriptive and inferential statistical methods to examine the demographic characteristics of participants, the alignment between perceived and objectively assessed HIV risk, and predictors of high-risk status. Descriptive statistics, including frequencies and percentages, were used to summarize participant characteristics by county (Homa Bay and Kisii). Chi-square and Fisher's exact tests were used to assess differences in categorical variables across counties, with p -values < 0.05 considered statistically significant.

The HIV risk profile was assessed using the NASCOP-approved Risk Assessment Screening Tool (RAST). The proportion of participants whose self-perceived HIV risk

decreased but were classified as high-risk according to RAST was calculated to quantify risk underestimation. A one-sample proportion test was conducted to determine whether the proportion of participants classified as high objective risk among those reporting decreased perceived risk was significantly greater than 50%, representing substantial discordance between perception and epidemiological risk. County-level differences in misclassification were assessed using Pearson's chi-square test and Fisher's exact test where appropriate. These analyses allowed testing of the null hypothesis, which states that the proportion of individuals classified as high objective risk among those reporting decreased perceived risk is fewer than or equal to 50%.

To identify potential predictors of high objective HIV risk, a logistic regression model was fitted with high objective risk status as the binary outcome variable (Yes = 1, No = 0). The predictor variables included county, age, sex, marital status, education level, and income. Model diagnostics were performed to assess stability and goodness of fit. However, due to substantial outcome imbalance—approximately 91% of participants were classified as high objective risk—evidence of quasi-complete separation was observed. This imbalance resulted in inflated standard errors and wide confidence intervals for several covariates, thereby limiting the precision and interpretability of the estimated effects for most demographic predictors. Given these methodological challenges, future studies may benefit from using penalised logistic regression to improve model stability and yield more reliable parameter estimates in the presence of highly imbalanced outcomes.

Behavioral data were analyzed to corroborate the validity of RAST classifications. The prevalence of high-risk behaviours—including multiple sexual partners, condomless sex, recent sexually transmitted infections, and inconsistent condom use—was compared between participants

categorised as high-risk and low-risk. These analyses provided evidence that participants classified as high-risk were indeed engaging in behaviors associated with increased vulnerability to HIV infection.

All analyses were performed using R statistical software, and results were presented in tables and figures to illustrate patterns of perceived versus actual risk, county-level differences, and behavioral correlates of risk. Statistical significance was set at $p < 0.05$, and 95% confidence intervals were reported where applicable.

Results

As shown in Table 2, 293 participants were included in the analysis, with 200 (68.3%) from Homa Bay County and 93 (31.7%) from Kisii County. The age distribution differed between the two counties, with Kisii having a relatively younger population. Participants aged 15–24 years constituted a larger proportion in Kisii (56.0%) compared to Homa Bay (22.5%), while Homa Bay had higher representation in the 25–44-year age groups, particularly those aged 30–34 years (24.5%).

Females predominated in both counties, accounting for 69.0% in Homa Bay and 77.4% in Kisii, although this difference was not statistically significant ($p = 0.14$). Marital status varied significantly by county ($p = 0.002$). A higher proportion of participants in Homa Bay

were married (52.0%) compared to Kisii (31.2%), whereas single participants were more common in Kisii (52.7%) than in Homa Bay (32.0%).

Educational attainment differed markedly between the two counties ($p < 0.001$). Homa Bay had a higher proportion of participants with primary education (44.5%), while Kisii had a greater share with secondary (50.5%) and tertiary education (26.9%). Participants with no formal education were more common in Kisii (8.6%) than in Homa Bay (1.5%).

Significant differences were also observed in occupation status ($p < 0.001$). Formal employment was more prevalent in Homa Bay (58.0%), whereas unemployment was substantially higher in Kisii (43.0%) compared to Homa Bay (18.0%). Income levels varied significantly across counties ($p = 0.006$), with the majority of participants earning less than KES 10,000, particularly in Kisii (81.7%) compared to Homa Bay (63.0%).

Documented HIV risk classification showed significant county-level variation ($p < 0.001$). In Kisii, over half of participants were classified as having very low risk (53.8%), whereas the majority in Homa Bay were categorized as low risk (59.0%). Notably, Kisii had a higher proportion of participants in the high and very high-risk categories (20.5%) compared to Homa Bay (4.0%), despite many reporting low perceived risk.

Table 2. Demographic Characteristics

Variable	Homa Bay N = 2001	Kisii N = 931	p-value ²
Age			
15-19 years	17 (8.5%)	22 (23.7%)	
20-24 years	28 (14.0%)	30 (32.3%)	
25-29 years	41 (20.5%)	21 (22.6%)	
30-34 years	49 (24.5%)	10 (10.8%)	
40-44 years	31 (15.5%)	3 (3.2%)	
45-49 years	17 (8.5%)	3 (3.2%)	
35-39 years	6 (3.0%)	2 (2.2%)	
50+ Years	11 (5.5%)	2 (2.2%)	
Sex			0.14

Female	138 (69.0%)	72 (77.4%)	
Male	62 (31.0%)	21 (22.6%)	
Marital status			0.002
Married	104 (52.0%)	29 (31.2%)	
Single	64 (32.0%)	49 (52.7%)	
Divorced/Separated	22 (11.0%)	13 (14.0%)	
Widowed	10 (5.0%)	2 (2.2%)	
Education Level			<0.001
No Formal education	3 (1.5%)	8 (8.6%)	
Primary education	89 (44.5%)	13 (14.0%)	
Secondary education	82 (41.0%)	47 (50.5%)	
Tertiary education	26 (13.0%)	25 (26.9%)	
Occupation Status			<0.001
Unemployed	36 (18.0%)	40 (43.0%)	
Self-employed	7 (3.5%)	7 (7.5%)	
Informal employment	41 (20.5%)	18 (19.4%)	
Formal employment	116 (58.0%)	28 (30.1%)	
Income level			0.006
Less than KES 10,000	126 (63.0%)	76 (81.7%)	
KES 10,001 to KES 20,000	54 (27.0%)	12 (12.9%)	
KES 20,001 to KES 30,000	14 (7.0%)	2 (2.2%)	
More than KES 30,000	6 (3.0%)	3 (3.2%)	
Documented risk			<0.001
Very low	48 (24.0%)	50 (53.8%)	
Low	118 (59.0%)	15 (16.1%)	
Moderate	26 (13.0%)	9 (9.7%)	
High	4 (2.0%)	9 (9.7%)	
Very high	4 (2.0%)	10 (10.8%)	
¹ n (%)			
² NA; Pearson's Chi-squared test; Fisher's exact test			

Table 3 illustrates the distribution of clients classified as having high objective HIV risk according to self-reported changes in risk perception, disaggregated by county. Overall, the results reveal a pronounced discrepancy between subjective risk perception and objectively assessed HIV risk, particularly among clients who reported a decline in perceived risk.

In Homa Bay County, most participants (150) stated that they believed their HIV risk

had decreased. Despite this perception, nearly all of them (142; 94.7%) were objectively assessed as being at high risk of HIV acquisition. This finding points to a substantial underestimation of continued exposure among individuals who felt their risk had diminished. Although very few clients reported no change or an increase in perceived risk, all such individuals were also classified as high risk (100%), though the small sample sizes limit interpretability.

Table 3. Actual High Risk by Perception Change Category

County	Perception Change	Total Clients	High Risk Count	% High Risk
Homa Bay	Yes, my perceived risk decreased	150	142	94.7%
Homa Bay	No, it remained the same	1	1	100.0%
Homa Bay	Yes, my perceived risk increased	4	4	100.0%
Kisii	Yes, my perceived risk decreased	25	18	72.0%
Kisii	No, it remained the same	0	0	0.0%
Kisii	Yes, my perceived risk increased	2	2	100.0%

A comparable, though less pronounced, pattern was observed in Kisii County. Among the 25 clients who perceived their risk to have decreased, 18 (72.0%) remained at high objective risk, indicating ongoing vulnerability despite reduced perceived risk. All participants who reported an increase in perceived risk (2; 100%) were accurately identified as high risk. No respondents in Kisii reported unchanged risk perception, and consequently no high-risk cases were recorded in that category.

Taken together, these findings indicate that a substantial proportion of clients—particularly in Homa Bay—who believed their HIV risk had declined continued to face considerable objective risk. This misalignment highlights the limitations of relying on self-perceived risk to guide HIV prevention decisions and underscores the importance of continuous risk assessment and targeted counselling to support appropriate PrEP continuation.

Consistent with these findings, HIV risk assessment using the NASCOP-approved Risk

Assessment Screening Tool (RAST) revealed a marked and concerning divergence between perceived and objectively measured risk. Overall, 160 of the 175 participants (91.4%) who reported a reduction in perceived HIV risk were classified as having high or substantial risk of HIV acquisition based on RAST criteria (Table 4). Notably, the majority of individuals who discontinued PrEP due to perceived lower risk remained objectively vulnerable to infection, highlighting a critical gap between self-assessment and clinical evaluation. This discordance reflects shortcomings in risk awareness and communication within PrEP programs, where decisions to discontinue may be driven by inaccurate perceptions, leaving clients unprotected during periods of continued exposure. These findings reinforce the need for enhanced counselling, routine risk reassessment, and tailored communication strategies to support informed and sustained PrEP use.

Table 4. Risk Underestimation Among Clients with Decreased Perception

County	N with Decreased Perception	N Actually High Risk	% Under estimators	N Accurate	% Accurate
Homa Bay	150	142	94.7%	8	5.3%
Kisii	25	18	72.0%	7	28.0%
TOTAL	175	160	91.4%	15	8.6%

Table 4 summarizes the extent of HIV risk underestimation among clients who reported a decrease in their perceived risk, disaggregated by county. Overall, the findings demonstrate a high level of discordance between perceived and objectively assessed HIV risk, with the majority of clients underestimating their actual vulnerability.

In Homa Bay County, all 150 clients included in the analysis reported a decreased perception of HIV risk. Of these, 142 clients (94.7%) were objectively classified as being at high risk of HIV acquisition, indicating widespread risk underestimation (Figure 3).

Only 8 clients (5.3%) had risk perceptions consistent with their assessed risk status, suggesting limited accuracy in self-assessment in this population.

In Kisii County, 25 clients reported a reduction in perceived risk. Among them, 18 clients (72.0%) were assessed as high risk, reflecting substantial underestimation, though to a lesser extent than in Homa Bay (Figure 3). Conversely, 7 clients (28.0%) demonstrated accurate alignment between perceived and actual risk, indicating comparatively better risk awareness.

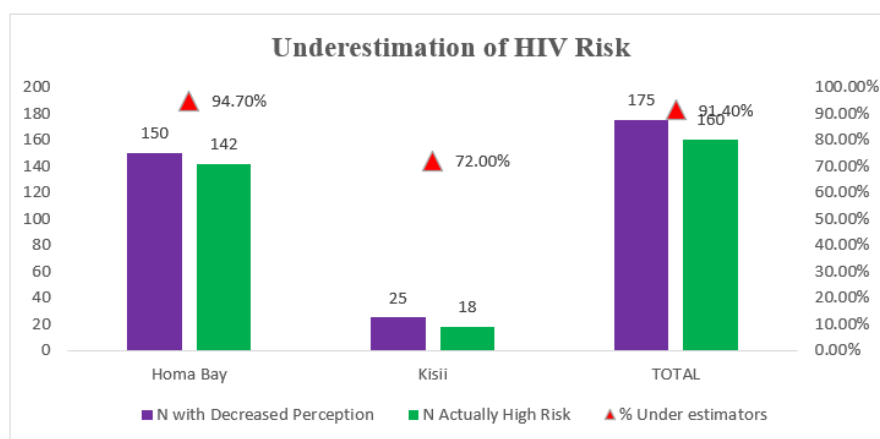


Figure 3. Underestimation of HIV Risk Among Clients Who Stopped PrEP

When data from both counties were combined, 175 clients reported decreased risk perception. Of these, 160 clients (91.4%) were objectively classified as high risk, confirming that risk underestimation was pervasive across the study population. Only 15 clients (8.6%) accurately assessed their HIV risk.

Statistical findings presented in Table 5 revealed significant county-level differences in HIV risk underestimation. Both Fisher's Exact Test ($p = 0.0016$) and the chi-square test ($p = 0.0008$) demonstrated a statistically significant variation in the discrepancy between perceived and objectively measured HIV risk across the study sites. Furthermore, the one-sample proportion test indicated that the proportion of individuals categorized as high objective risk among those reporting reduced perceived risk was significantly above the 50% threshold ($p =$

0.0004). Consequently, the null hypothesis that this proportion is $\leq 50\%$ was rejected, indicating that more than half of participants who believed their risk had declined were, in fact, still at high objective risk. This reflects considerable misalignment in risk perception, with notable contextual or behavioural variation between Homa Bay and Kisii counties.

To further interrogate this relationship, a one-sample proportion test was conducted to determine whether the observed proportion of high objective risk among those perceiving reduced risk exceeded the hypothesized 50% benchmark. Differences in misclassification across counties were assessed using Pearson's chi-square and Fisher's exact tests, as appropriate. The overall prevalence of risk underestimation was high, averaging 83.3%

across the two counties. Both county-level tests ($p = 0.0016$ and $p = 0.0008$) confirmed significant variation in the extent of discordance. The one-sample proportion test ($p = 0.0004$) further supported the conclusion that the observed proportion was significantly greater than 50%.

Taken together, these results provide strong statistical evidence against the null hypothesis and confirm a marked and significant mismatch

between perceived and objectively assessed HIV risk. The findings highlight the need for enhanced counseling approaches, systematic risk reassessment, and targeted risk communication strategies to ensure that individuals discontinuing PrEP make well-informed decisions and remain adequately protected during periods of continued HIV exposure.

Table 5. Hypothesis Testing Results

Test	P-Value	Interpretation
Fisher's Exact Test	0.001577	Significant difference between counties
Chi-square Test	0.0007729	Significant difference between counties
One-sample Proportion Test	0.0003865	Underestimation is significantly >0%

Table 6 presents the findings of a multivariable logistic regression analysis assessing factors associated with high objective HIV risk. The predictor variables included in the model were county of residence, age, sex, marital status, education level, and income. Overall, the model indicates that the county of residence was the only variable that showed a statistically significant association with the outcome after adjustment for potential confounders.

Residence in Kisii County was significantly associated with lower odds of the outcome compared with those from the reference county (Homa Bay). Participants from Kisii had an 85% reduction in odds ($OR = 0.15$; 95% CI: 0.04–0.58; $p = 0.006$), indicating a strong and statistically significant county-level effect even after controlling for age, sex, marital status, education, and income. This finding suggests important contextual or programmatic differences between the two counties that may influence client outcomes.

Across age categories, none of the estimates was statistically significant. Although some age groups showed odds ratios above or below unity—for example, individuals aged 30–34 years had higher estimated odds ($OR = 2.36$)—the wide confidence intervals and non-

significant p -values suggest substantial uncertainty and no clear age-related pattern in the adjusted analysis. Several age categories (35–39 years and ≥ 50 years) were omitted from interpretation, likely due to sparse data or serving as reference categories. This suggests that, within this study population, age did not independently predict the outcome after controlling for other factors.

With respect to sex, males had slightly lower odds compared to females ($OR = 0.80$), but this association was not statistically significant ($p = 0.784$), indicating no meaningful difference by sex in the adjusted model. For marital status, single and divorced/separated participants showed lower odds relative to the reference group, with divorced/separated individuals approaching statistical significance ($OR = 0.12$; 95% CI: 0.01–1.31; $p = 0.071$). However, these findings did not meet conventional significance thresholds.

Education level was not associated with the outcome, as reflected by null estimates and infinite confidence intervals, suggesting limited variability or small cell sizes within education categories. At the same time, income level showed no statistically significant associations. Although participants earning KES 10,001–20,000 had higher estimated odds ($OR = 1.77$),

the confidence interval was wide and crossed unity ($p = 0.561$).

The regression findings indicate that county of residence emerged as the main predictor of the outcome, whereas individual socio-demographic factors—including age, sex, marital status, education, and income—were not independently associated with high

objective HIV risk. This suggests that contextual and structural influences operating at the county level may play a more significant role than individual demographic characteristics. Consequently, geographically targeted interventions may yield greater impact than strategies focused solely on personal attributes.

Table 6. Logistic Regression Results

Term	Estimate	Std. Error	Statistic	OR	(95%CI Lower)	(95%CI Upper)	P-value
(Intercept)	-	-	0.00297	-	-	-	0.99763
County Kisii	0.1527	0.68727	-2.73447	0.15270	0.03728	0.57890	0.00625
Age_20-24 years	0.92636	0.83759	-0.09132	0.92636	0.17224	4.94959	0.92724
Age_25-29 years	0.67235	1.04857	-0.37859	0.67235	0.08300	5.58704	0.70499
Age_30-34 years	2.35857	1.32141	0.64935	2.35857	0.21104	57.97330	0.51611
Age_40-44 years	0.4721	1.62942	-0.46063	0.47210	0.02204	18.29920	0.64507
Age_45-49 years	0.08964	1.74996	-1.37831	0.08964	0.00257	3.67752	0.16811
Age_35-39 years	-	-	0.00456	-	-	-	0.99636
Age_50+ Years	-	-	0.00465	-	-	-	0.99629
Sex Male	0.80495	0.79313	-0.27357	0.80495	0.17856	4.40238	0.78442
Marital Single	0.26556	0.8654	-1.53216	0.26556	0.04319	1.40538	0.12548
Divorced/Separated	0.12081	1.17133	-1.80435	0.12081	0.01089	1.30620	0.07118
Marital Widowed	-	-	0.00546	-	-	-	0.99565
Primary education	0	-	-0.00229	-	-	Inf	0.99817
Secondary education	0	-	-0.00245	-	-	Inf	0.99805
Tertiary education	0	-	-0.00247	-	-	Inf	0.99803
Income							
KES 10,001- 20,000	1.77016	0.98177	0.58168	1.77016	0.29463	16.24880	0.56079
KES 20,001- 30,000	-	-	0.00676	-	-	-	0.9946
>KES 30,000	-	-	0.00479	-	-	-	0.99618

Table legend: Inf=infinite; Conf. low= Lower bound of 95% Confidence Interval; Conf. high= higher bound of 95% Confidence Interval; OR = Odds ratio; STD. Error =Standard Error

The behavioral findings were consistent with the RAST-based HIV risk classification (Table 7). Clients categorized as high risk frequently reported behaviors strongly associated with increased HIV acquisition, including multiple sexual partnerships, condomless sexual activity, prior sexually transmitted infections, and inconsistent condom use. These findings suggest that, despite perceiving themselves to be at low risk, many clients continued to engage in behaviors that sustained substantial vulnerability to HIV infection. This divergence

between perceived and objectively assessed risk highlights the critical need for strengthened risk assessment processes, targeted counselling, and tailored prevention messaging, particularly in Homa Bay County (Table 8).

As shown in Table 7, multiple sexual partnerships were the most commonly reported risk behavior, affecting nearly half of participants (48.4%), indicating considerable ongoing exposure. Condomless sex was reported by 28.6% of participants, further elevating risk. A history of sexually transmitted

infections was documented among 18.7% of respondents, reflecting biological susceptibility to HIV. In addition, 14.3% reported having a sexual partner living with HIV, representing direct exposure, while consistent condom use

was reported by only 22.5%, suggesting limited adoption of protective practices. Collectively, these behaviors point to sustained high-risk practices despite variations in individual risk perception.

Table 7. Behavioral Comparison

Multiple partners	Condomless sex	STI infection	Partner HIV	Condom use
0.4835165	0.2857143	0.1868132	0.1428571	0.2252747

Table 8 summarizes HIV risk classification by county. In Homa Bay County, an overwhelming majority of clients (94.8%) were assessed as being at high risk of HIV acquisition, with only 5.2% classified as low

risk. Although Kisii County demonstrated comparatively lower risk levels, a substantial proportion of clients (74.1%) were still categorized as high risk, while 25.9% were assessed as low risk.

Table 8. County Level Summary

County	n	# high risk	Percent high risk	# low risk	Percent low risk
Homa Bay	155	147	94.8	8	5.2
Kisii	27	20	74.1	7	25.9

Taken together, the behavioral profiles and county-level risk distributions confirm persistent HIV exposure across both settings, with a particularly high burden in Homa Bay. The convergence of multiple partnerships, condomless sex, and low condom use with high objective risk classification underscores the urgency of implementing intensified, behavior-focused risk reduction strategies, enhanced counselling, and context-specific prevention interventions to address ongoing HIV vulnerability at both individual and county levels.

Overall, these findings reveal a serious mismatch between perceived and actual HIV risk among clients who discontinued PrEP. They emphasize the urgent need for strengthened risk assessment, enhanced counselling, and tailored prevention messaging to ensure that clients make informed decisions about PrEP use and understand their true HIV risk profile. Without these interventions, discontinuation based on inaccurate self-perception may undermine HIV prevention

efforts and increase vulnerability, particularly in high-prevalence settings like Homa Bay.

Discussion

This study provides important insights into the discrepancy between perceived and objectively assessed HIV risk among clients who discontinued pre-exposure prophylaxis (PrEP) due to their belief that their risk of acquiring HIV had decreased. Our findings show that a substantial majority of clients who reported a decline in perceived risk remained objectively at high risk. Specifically, 94.7% of clients in Homa Bay and 72.0% in Kisii who believed their risk had decreased were, in fact, classified as high-risk according to the NASCOP-approved Risk Assessment Screening Tool (RAST). This significant mismatch underscores a critical challenge for HIV prevention programs: client reliance on self-perceived risk may result in premature discontinuation of PrEP, leaving individuals vulnerable to HIV infection during periods of ongoing risk.

A key finding of this study is that over 90% of participants who reported a decreased perception of HIV risk were objectively classified as high risk using the NASCOP-approved Risk Assessment Screening Tool. This level of risk underestimation exceeds that reported in many international studies and highlights a serious vulnerability in HIV prevention programming. While several studies from Europe and North America have documented PrEP discontinuation driven by perceived reductions in risk, many of those contexts reported genuinely reduced exposure through partner viral suppression, monogamy, or consistent condom use, with minimal subsequent HIV seroconversion [6, 15]. In contrast, the present study demonstrates that, in high-prevalence settings such as Homa Bay, perceived reductions in risk frequently occur in the absence of meaningful behavioral or contextual risk reduction.

These findings align more closely with evidence from sub-Saharan Africa and the United States, where a substantial proportion of HIV seroconversions occur among individuals who discontinue PrEP based on perceived low risk [7, 11]. For example, in Kenya and Uganda, most HIV seroconversions occurred among clients who had stopped PrEP, highlighting the potential consequences of misperceived low-risk behavior [11]. Similarly, clients in Western and Central Kenya frequently made deliberate decisions to stop PrEP based on reduced perceived exposure, such as ending sexual relationships with HIV-positive partners or relying on partners achieving viral suppression [14]. However, many of these individuals remained at substantial risk due to ongoing sexual behaviors or partner exposures, emphasizing that subjective assessments of risk may not fully reflect actual vulnerability. This aligns closely with our findings, which show that clients' perceptions are often misaligned with their epidemiological reality. The high level of underestimation observed in this study suggests that risk perception among clients is

often shaped by cognitive heuristics, relationship assumptions, or temporary changes in circumstances, rather than by sustained reductions in exposure.

The county-level variations identified in this study underscore the critical role of contextual factors in shaping HIV risk perception and PrEP discontinuation. Clients in Homa Bay were significantly more likely to underestimate their HIV risk than those in Kisii, reflecting differences in local epidemiological contexts. Homa Bay's exceptionally high HIV prevalence may contribute to this pattern through normalization of HIV within the community, potentially fostering cognitive biases such as risk compensation, whereby individuals modify their perceived vulnerability despite ongoing exposure. As a result, perceived risk may diverge from actual epidemiological and behavioral realities, reinforcing the need for geographically tailored prevention strategies.

County of residence was the sole variable that remained significantly associated with risk underestimation in multivariable analysis, highlighting the influence of structural and contextual determinants beyond individual socio-demographic characteristics. In high-prevalence settings like Homa Bay, dense sexual networks can sustain elevated HIV risk even when individuals perceive reductions in their personal exposure. The combination of a high proportion of objectively classified high-risk clients and pronounced risk underestimation suggests that individuals may discount cumulative or moderate-risk behaviors in environments where HIV is highly prevalent.

By contrast, Kisii County demonstrated a closer alignment between perceived and objectively assessed risk, although underestimation persisted. Variations in education, employment, service delivery environments, and the quality of risk counselling may partly account for these differences. Comparable regional disparities in PrEP discontinuation and HIV risk perception

have been documented in Kenya and Nigeria, reinforcing the importance of context-specific, geographically responsive interventions rather than uniform national approaches [14, 16].

Contrary to findings from several international studies, this study did not identify age, sex, marital status, education, or income as independent predictors of the outcome after adjustment. While younger age, female sex, marital status, and socioeconomic vulnerability have been linked to PrEP discontinuation elsewhere [17-19], the present findings suggest that socio-demographic characteristics alone do not adequately explain risk underestimation in this context. Instead, risk perception appears to be shaped by broader contextual, relational, and behavioral factors that cut across demographic groups.

This reinforces evidence from Kenya and Uganda showing that PrEP discontinuation is often a deliberate decision informed by perceived “seasons of risk,” even when those perceptions are inaccurate [14, 15]. The absence of strong demographic predictors underscores the limitation of targeting interventions solely based on age, gender, or marital status and highlights the need for universal, high-quality risk assessment and counselling.

Behavioral factors were strongly associated with high-risk classification in our cohort. High-risk clients frequently reported multiple sexual partnerships, condomless sex, exposure to partners with unknown HIV status, and recent sexually transmitted infections. These behaviors are well-established predictors of HIV acquisition and mirror evidence from Northern California, where elevated rates of sexually transmitted infections were observed among individuals who discontinued PrEP, indicating ongoing engagement in high-risk sexual practices even after stopping prophylactic use [8, 9]. Likewise, studies among female sex workers in Benin have documented continued sexual risk and STI incidence following PrEP discontinuation,

demonstrating that stopping PrEP does not inherently correspond to a reduction in HIV vulnerability [10]. Collectively, these studies reinforce the critical need for behavioral assessment and targeted counseling interventions that address both perceived and actual risk. The persistence of these behaviors among clients who perceived themselves to be at low risk demonstrates that PrEP discontinuation was often not accompanied by effective alternative prevention strategies. This contrasts with findings from lower-prevalence or well-resourced settings, where discontinuation is sometimes offset by consistent condom use or stable viral suppression among partners [6].

The alignment between behavioral indicators and RAST classification strengthens the validity of the objective assessment and suggests that the primary challenge lies not in misclassification by providers, but in clients’ understanding and interpretation of risk. This gap highlights deficiencies in risk communication and shared decision-making within PrEP services.

The findings underscore the critical role of healthcare providers in shaping risk perception and PrEP continuation decisions. While the literature emphasizes counselling, adherence reminders, and flexible service delivery as effective strategies [4, 20], this study suggests that counselling may not sufficiently address cognitive biases and contextual realities that drive risk underestimation. Clients may interpret reduced sexual frequency, trust in partners, or short-term relationship changes as indicators of safety, even when objective risk remains high.

Strengthening provider capacity to deliver nuanced, behaviorally informed counselling is therefore essential. Routine, structured risk reassessment, use of visual or scenario-based risk communication tools, and explicit discussion of local HIV epidemiology may help clients better contextualize their risk. Additionally, post-discontinuation follow-up

and clear guidance on re-initiating PrEP during periods of increased exposure are critical to preventing HIV acquisition during PrEP gaps.

The observed gap between perceived and actual risk also underscores the importance of psychosocial and cognitive factors in PrEP decision-making. Clients may base their risk perception on trust in partners, assumptions about fidelity, or reliance on partner viral suppression. Studies in different settings indicate that younger age, mental health challenges, substance use, and gender identity can also influence risk perception and adherence behaviors [7, 14]. For instance, individuals with lower risk perception may be less likely to use condoms consistently, more likely to engage in concurrent sexual partnerships, or experience challenges in negotiating safer sex practices. These factors highlight that discontinuation decisions are shaped not only by epidemiological reality but also by individual psychology, social relationships, and contextual circumstances.

Our findings demonstrate the urgent need for strengthened counseling and tailored communication strategies within PrEP programs. Routine and structured risk assessments, such as the RAST, are essential for objectively identifying clients who remain at high risk despite their own perceptions of reduced vulnerability. Integrating these assessments into follow-up visits and PrEP discontinuation consultations can help align clients' understanding with their actual risk, promoting more informed decision-making. Enhanced counseling should include clear discussions about the dynamic nature of HIV risk, the role of sexual networks, partner status, and behavioral risk factors. In addition, client education should emphasize that perceived risk can fluctuate and that discontinuation may not always reflect a reduced probability of HIV acquisition.

County-specific strategies may further improve PrEP retention and mitigate premature discontinuation. In Homa Bay, where risk

underestimation was particularly pronounced, interventions could include community-level awareness campaigns, partner-inclusive counseling, and peer education initiatives to promote accurate risk perception. In Kisii, while underestimation was less pronounced, targeted counseling and behavioral support remain crucial for preventing seroconversions during periods of discontinuation. Tailoring interventions to the local epidemiological context, cultural norms, and social dynamics enhances their effectiveness and sustainability.

Evidence from higher-income settings also underscores the universal relevance of misperceived risk. Study in Antwerp, Belgium, clients discontinued PrEP due to perceived low risk, yet ongoing risk was mitigated by protective behaviors such as condom use or monogamous partnerships [6]. Conversely, in the U.S., seroconversions among clients who stopped PrEP for similar reasons illustrate that even with relatively robust healthcare systems, reliance on self-perception can have tangible consequences [7]. These international comparisons emphasize that interventions to improve risk assessment, counseling, and adherence support are broadly applicable, regardless of resource setting, though local adaptation is essential.

The public health implications of these findings are significant. Premature discontinuation of PrEP due to perceived low risk undermines the effectiveness of HIV prevention programs and may contribute to ongoing transmission, particularly in high-prevalence regions. Integrating objective risk assessment, behavioural counselling, and ongoing monitoring into PrEP programs is therefore critical for sustaining HIV prevention gains. Moreover, proactive strategies to support timely re-initiation of PrEP when risk increases can reduce vulnerability during periods of discontinuation. These measures are essential for aligning programmatic goals with real-world behaviors and ensuring that high-risk populations remain protected.

Despite the contributions of this study, certain limitations must be acknowledged. While we documented a substantial perception–reality gap, we did not explore the underlying cognitive, psychosocial, or relational factors driving clients’ misperceptions. Future research should investigate determinants such as trust in partners, stigma, mental health, and substance use to design interventions that address both informational gaps and social determinants of behavior. Additionally, the study focused on behavioral and clinical risk indicators at a single point in time, without longitudinal follow-up to assess how risk perception and behavior evolve after PrEP discontinuation. Longitudinal studies would provide richer insights into dynamic risk patterns, adherence decisions, and potential seroconversions, enabling more precise intervention design.

This study reveals a substantial underestimation of HIV risk among individuals who discontinued PrEP based on perceived low vulnerability, with clear disparities across counties. Consistent with the Health Belief Model, diminished perceived susceptibility appeared to outweigh objective measures of exposure, leading to premature PrEP discontinuation despite persistent behavioral and epidemiological risk. Clients’ subjective risk appraisals frequently did not reflect their actual exposure, thereby increasing their susceptibility to HIV acquisition.

These findings highlight the need to strengthen objective risk assessment, provide more individualized counseling, and implement tailored risk-communication strategies to better align perceived and actual risk. Such measures are vital to preventing premature discontinuation, supporting informed decision-making, and sustaining effective HIV prevention in high-burden settings such as Homa Bay and Kisii Counties, Kenya. Addressing both behavioral and psychosocial drivers of risk perception will enable PrEP programs to enhance adherence, mitigate HIV acquisition following discontinuation, and

improve overall population-level prevention outcomes.

Conclusion

This study demonstrates a substantial and concerning mismatch between perceived and objectively assessed HIV risk among clients who discontinued PrEP due to their belief of reduced vulnerability. Overall, 94.7% of clients in Homa Bay and 72.0% in Kisii who perceived a decrease in HIV risk were, in fact, classified as high-risk according to the NASCOP-approved Risk Assessment Screening Tool (RAST). This discrepancy highlights a critical challenge for HIV prevention programs: reliance on self-perceived risk may lead to premature PrEP discontinuation, leaving individuals vulnerable to HIV acquisition during periods of ongoing exposure.

Our findings align with prior studies across sub-Saharan Africa and other regions. In Kenya and Uganda, majority of HIV seroconversions occurred among clients who had stopped PrEP, emphasizing the real-world consequences of misperceived low-risk behavior [11]. In Western and Central Kenya often made deliberate decisions to discontinue PrEP based on reduced perceived exposure, such as ending sexual relationships with HIV-positive partners or relying on partners achieving viral suppression, yet many remained at high risk due to ongoing behaviors [14]. Comparable trends have been reported in high-income settings. In the United States, HIV seroconversions have occurred among individuals who discontinued PrEP based on a perceived reduction in risk [7]. In contrast, findings from Belgium indicate that PrEP discontinuation did not consistently lead to seroconversion, largely because many clients compensated by adopting alternative protective strategies, such as consistent condom use or maintaining monogamous relationships [6]. Collectively, these studies underscore the need for accurate risk assessment, tailored counseling, and behavioral support to mitigate HIV vulnerability during PrEP discontinuation.

County-level differences in our study highlight the importance of contextual factors. Clients from Homa Bay, a high-prevalence region, were more likely to underestimate risk compared to Kisii. This may reflect normalization of HIV in high-prevalence settings or cognitive biases such as risk compensation. Behavioral factors—multiple sexual partners, condomless sex, exposure to partners of unknown HIV status, and STIs—were strongly associated with objectively assessed high risk, consistent with findings in other settings [8-10]. Psychosocial determinants, including trust in partners, assumptions about fidelity, mental health, and substance use, further influence risk perception and decision-making [7, 14].

Recommendations

Healthcare workers (HCWs) should conduct routine and structured risk assessments for all clients using PrEP, including those seeking to discontinue it. Tools such as the NASCOP-approved Risk Assessment Screening Tool (RAST) should be incorporated into follow-up and discontinuation consultations to accurately identify individuals who remain at high risk despite perceiving themselves as low-risk.

Health managers should focus on enhancing counselling and risk communication by providing personalised guidance that addresses dynamic HIV risk, sexual networks, partner HIV status, and behavioural factors. Clients should be made aware that a perceived low risk does not always reflect a reduced likelihood of HIV exposure.

County-specific interventions are recommended to improve risk perception and PrEP adherence. In high-prevalence areas like Homa Bay, this may include community awareness campaigns, partner-inclusive counseling, and peer education programs. In Kisii, targeted behavioral support should remain a priority.

All PrEP clients should receive behavioral and psychosocial support to address factors

influencing risk perception, including trust in partners, stigma, mental health challenges, and substance use, enabling informed decisions about PrEP use. Finally, health managers should implement monitoring and re-initiation strategies to track clients whose HIV risk increases after discontinuation and to facilitate timely re-initiation of PrEP, thereby reducing vulnerability to infection.

Conflict of Interest

The author reports no conflicts of interest associated with this study and affirms that the research, analysis, and reporting were conducted with full impartiality and objectivity.

Ethical Clearance

The protocol was submitted to the Amref Ethics and Scientific Review Committee (ESRC) and the Kisii Teaching and Referral Hospital Institutional Scientific and Ethics Review Committee (KTRH-ISERC). Both committees reviewed the evaluation for technical rigor and ethical compliance. After receiving ethical clearance, permission to conduct the study was obtained from the National Council for Science, Technology and Innovation (NACOSTI) and the County Health Management Teams (CHMTs), following stakeholder engagement meetings that introduced and explained the study. Key personnel with ethics certification also completed an online ethics course before the evaluation began.

Data Availability

De-identified raw data supporting the conclusions of this manuscript will be made available by the authors, without undue reservation, to any qualified researcher. Requests to access these datasets should be directed to the corresponding author.

Author Contributions

Polycarp Musee Muchele conceptualized and designed the study, carried out data collection and analysis, and prepared the initial

manuscript. Professor Collins Ouma provided technical oversight of the study design and the interpretation of results. All authors reviewed and approved the final version of the manuscript.

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Reference

- [1]. World Health Organization, 2023, HIV statistics, globally and by WHO regions, 2023, *Global HIV, Hepatitis and Sexually Transmitted Infections Programs*.
<https://www.who.int/teams/global-hiv-hepatitis-and-stis-programmes/hiv/strategicinformation/hiv-data-and-statistics>
- [2]. Tailor, J., Rodrigues, J., Meade, J., Segal, K., Benjamin Mwakyosi, L., 2022, Correlations between oral Pre-Exposure Prophylaxis (PrEP) initiations and policies that enable the use of PrEP to address HIV globally. *PLOS Glob Public Health*, 2022 Dec 7;2(12):e0001202, Doi: 10.1371/journal.pgph.0001202.
- [3]. Whitfield, T. H., John, S. A., Rendhina, A. J., Grov, C., Parsons J. T., 2018, Why I quit pre-exposure prophylaxis (PrEP)? A mixed-method study exploring reasons for PrEP discontinuation and potential re-initiation among gay and bisexual men. *AIDS Behaviour*, 2018 Nov;22(11):3566-3575, Doi: 10.1007/s10461-018-2045-1.
- [4]. Zhang, J., Li, C., Xu, J., Hu, Z., Rutstein, S. E., & Tucker, J. D., Ong, J. J., Jiang, Y., Geng, W., et al., 2022, Discontinuation, suboptimal adherence, and reinitiation of oral HIV pre-exposure prophylaxis: a global systematic review and meta-analysis. *Lancet HIV*, 2022 Apr;9(4):e254-e268, Doi: 10.1016/S2352-3018(22)00030-3.
- [5]. Stankevitz, K., Grant, H., Lloyd, J., Gomez, G. B., Kripke, K., Torjesen, K., Terris-Prestholt, F., 2020, Oral preexposure prophylaxis continuation, measurement and reporting. *AIDS*, 2020 Oct 1;34(12):1801-1811, Doi: 10.1097/QAD.0000000000002598.
- [6]. Vanbaelen, T., Rotsaert, A., Jacobs, B. K., Florence, E., Kenyon, C., Vuylsteke, B., Laga, M., Thijs, R., 2022, Why Do HIV Pre-Exposure Prophylaxis Users Discontinue Pre-Exposure Prophylaxis Care? A Mixed Methods Survey in a Pre-Exposure Prophylaxis Clinic in Belgium. *AIDS PATIENT CARE and STDs*, 2022 Apr;36(4):159-167, Doi: 10.1089/apc.2021.0197.
- [7]. Krakower, D., Maloney, K. M., Powell, V. E., Levine, K., Grasso, C., Melbourne, K., Marcus, J., Mayer Kenneth H, 2019, Patterns and clinical consequences of discontinuing HIV preexposure prophylaxis during primary care. *International AIDS Society*, 2019 Feb;22(2):e25250, doi: 10.1002/jia2.25250.
- [8]. Marcus, J. L., Hurley, L. B., Hare, C. B., Nguyen, D. P., Phengrasamy, T., Silverberg, M. J., Stoltey, J. E., Volk Johnathan, E., 2017, Preexposure Prophylaxis for HIV Prevention in a Large Integrated Health Care System: Adherence, Renal Safety, and Discontinuation. *Pub Med Central*, 540-546, Doi: 10.1097/QAI.0000000000001129.
- [9]. Marcus, J. L., Hurley, L. B., Ngoyen, D. P., Silverberg, M. J., Volk Johnathan, E., 2017, Redefining Human Immunodeficiency Virus (HIV) Preexposure Prophylaxis Failures. *Clinical Infectious Diseases*, 1768 – 1769, Doi: 10.1093/cid/cix593.
- [10]. Mboup, A., Behanzin, L., Guedou, F. A., Geraldo, N., Matsetse, E. G., Giguere, L., Aza-Gnandji, M., et al., 2018, Early antiretroviral therapy and daily pre-exposure prophylaxis for HIV

- prevention among female sex workers in Cotonou, Benin: a prospective observational demonstration study. *Journal of International AIDS Society*, 21(11), 21:e25208, <https://doi.org/10.1002/jia2.25208>
- [11]. Koss, C. A., Havlir, D. V., Ayieka, J., Kwarisiima, D., Kabami, J., Chamie, G., Atukunda, M., Mwinike, J., et al., 2021, HIV incidence after pre-exposure prophylaxis initiation among women and men at elevated HIV risk: A population-based study in rural Kenya and Uganda. *PLOS Medicine*, 2021 Feb 9;18(2):e1003492, Doi: 10.1371/journal.pmed.1003492, eCollection 2021 Feb.
- [12]. Ogolla, M., Nyabiage, O. L., Musingila, P., Gachau, S., Odero, T. M., June, E. O., Ochanda, B., Appolonia, A., Katiku, E., et al., 2023, Uptake and continuation of HIV pre-exposure prophylaxis among women of reproductive age in two health facilities in Kisumu County, Kenya. *Journal for International AIDS Society*, 023 Mar;26(3):e26069, Doi: 10.1002/jia2.26069.
- [13]. Blumenthal, J., Jain, S., Mulvihill, E., Sun, S., Marvin, H., Ellorin, E., Graber, S., Haubrich, R., Morris, S., 2019, Perceived Versus Calculated HIV Risk: Implications for Pre-exposure Prophylaxis Uptake in a Randomized Trial of Men Who Have Sex With Men. *J Acquir Immune Defic Syndr*, 80(2): e23–e29, Doi: 10.1097/QAI.0000000000001888.
- [14]. Ongolly, F. K., Dolla, A., Irungu, E. M., Odoyo, J., Wamoni, E., Peebles, K., Mugwanya, K., Mugo, N. R., Bukusi, E. A., Morton, J., Baeten, J. M., O'Malley, G., 2022, "I just decided to stop:" Understanding PrEP discontinuation among individuals initiating PrEP in HIV care centers in Kenya. *J Acquir Immune Defic Syndr*, 2021 May 1;87(1):e150–e158, Doi: 10.1097/QAI.0000000000002625.
- [15]. Gilbert, H. N., Wyatt, M. A., Pisarki, E. E., Mumonge, T. R., Heffron, R., Katabira, E. T., Celum, C. L., Baeten, J. M., Haberer, J. E., Ware Norman, C., 2019, PrEP Discontinuation and Prevention-Effective Adherence: Experiences of PrEP Users in Ugandan HIV Serodiscordant couples. *Journal Acquired Immune Deficiency Syndrom*, 2019 Nov 1;82(3):265-274, Doi: 10.1097/QAI.0000000000002139.
- [16]. Anyasi, H., Idemudia, A., Badru, T., Onyegbule, S., Isang, E., Sanwo, O., Pandey, S.R., Chiegil, R., et al., 2024, Discontinuation of HIV oral pre-exposure prophylaxis: findings from programmatic surveillance within two general population HIV programs in Nigeria. *BMC Public Health*. 2024 May 16;24(1):1325, Doi: 10.1186/s12889-024-18808-z.
- [17]. Dzenga, T., Moyo, E., Moyo, P., Kamangu, J., Dzinamarira, T., 2023, Factors influencing the retention of clients in oral pre-exposure prophylaxis (PrEP) care at 3 months after initiation in the Omusati region of Namibia. *International Journal of Africa Nursing Sciences*, Volume 19, 2023, 100623, <https://doi.org/10.1016/j.ijans.2023.100623>
- [18]. Herns, S., Panwala, R., Pfeil, A., Sardinho, M., Rossi, V., Blumenthal, J., & Hill, L., 2023, Predictors of PrEP retention in at risk patients seen at a HIV primary care clinic in San Diego. *International Journal of STD and AIDS*, 785–790, 2023 Oct;34(11):785-790, Doi: 10.1177/09564624231179276.
- [19]. Garofoli, M., Siguier, M., Robineau, O., Valette, M., Phung, B., Bachelard, A., Rioux, C., Gac, S.L., Digumber, M., Pialoux, G., Ghosn, J., Champenois, K., 2024, Incidence and factors associated with PrEP discontinuation in France. *Journal of Antimicrobial Chemotherapy*, 2024 Jul 1;79(7):1555-1563, Doi: 10.1093/jac/dkaf133.
- [20]. Shover, C. L., Shoptaw, S., Javanbakhsh, M., Lee, S. J., Bolan, R. K., Cunningham, N. J., Beymer, M., DeVost, M. A., Gorbach Pamina, M., 2020, Mind the Gaps: Prescription coverage and HIV incidence among patients receiving pre-exposure prophylaxis from a large federally qualified health center in Los Angeles, California. *PubMed Central*, 2730 - 2740. Doi: 10.1007/s10461-019-02493.

Epidemiologic Trends and Determinants of Advanced HIV Disease among People Living with HIV in Zimbabwe (2017-2024): Evidence to Inform an Optimisation Framework

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Abstract

Advanced HIV Disease (AHD) remains a leading cause of morbidity and mortality among people living with HIV (PLHIV) despite widespread antiretroviral therapy (ART) coverage. This study analysed epidemiologic trends and facility-level determinants of AHD in Zimbabwe to inform targeted programme optimisation strategies. A retrospective analysis of routine District Health Information System 2 (DHIS2) data was conducted across 16 health facilities in Harare and Mashonaland East from 2017 to 2024. AHD was defined in accordance with contemporaneous World Health Organization guidelines, and analyses included descriptive statistics, temporal trend assessment, geographic comparisons, correlation, and multivariable regression. Among 495,166 PLHIV on ART, 4,169 AHD cases were identified. AHD prevalence followed a U-shaped trend, declining from 20.31% in 2017 to 2.20% in 2020, before rising to 16.12% in 2024, reflecting programmatic shifts and COVID-19 disruptions. Rural Mashonaland East recorded significantly higher prevalence than urban Harare (16.53% vs. 9.71%, $p=0.002$). Facility-level variation was substantial (0.56%–40.23%), with district hospitals bearing a disproportionate burden ($\beta = 15.24$, $p = 0.001$). AHD was positively associated with cryptococcal meningitis ($r = 0.419$, $p = 0.003$) and mortality ($r = 0.385$, $p = 0.007$), while loss to follow-up was not strongly correlated. Despite strong retention outcomes, persistent challenges in early diagnosis and AHD identification remain. Geographic and facility-level inequities underscore the need for differentiated, equity-focused interventions. Strengthening decentralised screening, particularly for opportunistic infections such as cryptococcal disease and tuberculosis, is essential to reduce preventable mortality and improve clinical outcomes.

Keywords: Advanced HIV Disease, Epidemiology, Health Inequities, Opportunistic Infections, Program Optimization, Zimbabwe.

Introduction

Despite sub-Saharan Africa rolling out widespread antiretroviral therapy, Advanced HIV Disease (AHD) remains the foremost cause of illness and death among HIV-positive adults. According to Huerga et al. [1], many patients in Southern Africa arrive for treatment at the final stages of infection. AHD, even with treatment, still causes the occurrence of opportunistic infections and deaths [2]. HIV

service provision inequities continue to adversely affect the disease outcome in the affected population [3]. There is still inadequate explanation for the late presentation to HIV care, and this is due to a combination of structural and behavioural challenges [4]. A pertinent question in public health is what more can the health systems do to promote the early diagnosis and management of AHD to avoid avoidable suffering and death. To this end, this study seeks to assess the epidemiological

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dimensions and systemic causes of AHD in Zimbabwe. The research suggests that AHD should be viewed not merely as a clinical problem, but as an important sign of the operational capacity of health systems in relation to the accessibility of AHD services, the range and quality of services, and the overall responsiveness of health service provision.

The last two decades show a rapid growth in global HIV initiatives due to implementing antiretroviral therapy (ART), and differentiated service delivery (DSD) models. ICAP 2023 describes in many regions of Africa which have received ART, the long-term outcomes of treatment and retention and other outcomes have improved due to “patient-centered” models of care. However, in Zimbabwe Hatzold et al [5] explains that the COVID-19 pandemic caused disruptions in HIV testing and early diagnosis. Jewell et al [8] documents that in the Sub-Saharan Africa regions for the COVID-19 pandemic, the disruptions of HIV services caused late diagnosis and advanced disease progression. Moyo et al [6] advocates for the routine health information systems, including the DHIS2, which is a very important system to have to evaluate health programs and construct the necessary changes in health policy. However, the previously mentioned claims that the gaps that still exist, especially in the rural and peri-urban areas, in diagnostic, clinical and integrated management of Advanced HIV Disease (AHD) are still highly present. Therefore, the goal of this research is to develop an evidence base for an optimization framework on the identification, diagnosis, and management of AHD in Zimbabwe's national HIV program.

Research Methodology

Study Design

This study adopted a retrospective cohort method to examine the epidemiologic trends and determinants of Advanced HIV Disease (AHD) among people living with HIV (PLHIV)

in Zimbabwe. This study, for the first time, analyzed epidemiological trends and determinants of Advanced HIV Disease (AHD) in Zimbabwe. The study was based on secondary data collected through the national District Health Information System 2 (DHIS2) which is the national health and program indicators repository. The study covered an Eight-year period which was selected to demonstrate the changes that occurred both in clinical guidelines and in the programmatic responses. This approach helped to determine the effect of the COVID-19 pandemic and the post pandemic case definition modifications. The data from program reports helped to perform a comprehensive system-wide analysis of the problem without the logistical and ethical challenges of obtaining primary data in a public health study [6].

Study Sites and Sampling

The study involved 16 health care facilities from two provinces in Zimbabwe: Harare Metropolitan Province (more urban) and Mashonaland East Province (more rural) and data collection from both provinces offered a comparative perspective to determine possible geographic and structural factors impacting AHD from an AHD perspective. The facilities sampled were selected purposefully to demonstrate the national health system's tiered structure and included 12 Primary Health Care (PHC) Clinics, which are the front line for HIV testing, treatment initiation and maintenance care, as well as 4 District Hospitals, which are referral centres for complicated cases, including severe opportunistic infections. Facilities selection was done using a Probability Proportional to Size (PPS) sampling method, which increased representation of the most utilized facilities (in terms of patient volume) and minimized selection bias in the estimation of indicators at the program level [3].

Data Analysis and Statistical Approach

All data management, statistical analyses, and visualizations were completed using the Python programming language and established scientific libraries to ensure consistency and reproducibility across analyses. The pandas library was employed for data management and aggregation, and statistical testing relied on *scipy* and *statsmodels*. Visualizations were generated with *matplotlib* and *seaborn* all data management, statistical analyses, and visualizations were completed using the Python programming language and established scientific libraries to ensure consistency and reproducibility across analyses.

Results

Facility-Level Distribution of AHD Burden and Mortality (2021–2024)

Analysis conducted at the facility level showed considerable variation in the Advanced

HIV Disease (AHD) burden and in mortality outcomes at high-volume treatment sites for the period between 2021 - 2024. The differences in case burden and mortality by facility are due to variations in catchment population size, referral systems, diagnostic availability, and clinical management. Such patterns reflect the well documented inequalities in access to HIV services and the distribution of disease burden across health systems in sub-Saharan Africa [3]. The facility-level data is important for pinpointing high-burden service delivery points that need focused program enhancements and resource distribution.

Figure 1 presents the distribution of Advanced HIV Disease (AHD) cases and mortality rates across the ten highest-burden health facilities between 2021 and 2024, highlighting concentration of cases in high-volume urban referral facilities and variations in mortality outcomes across treatment sites.

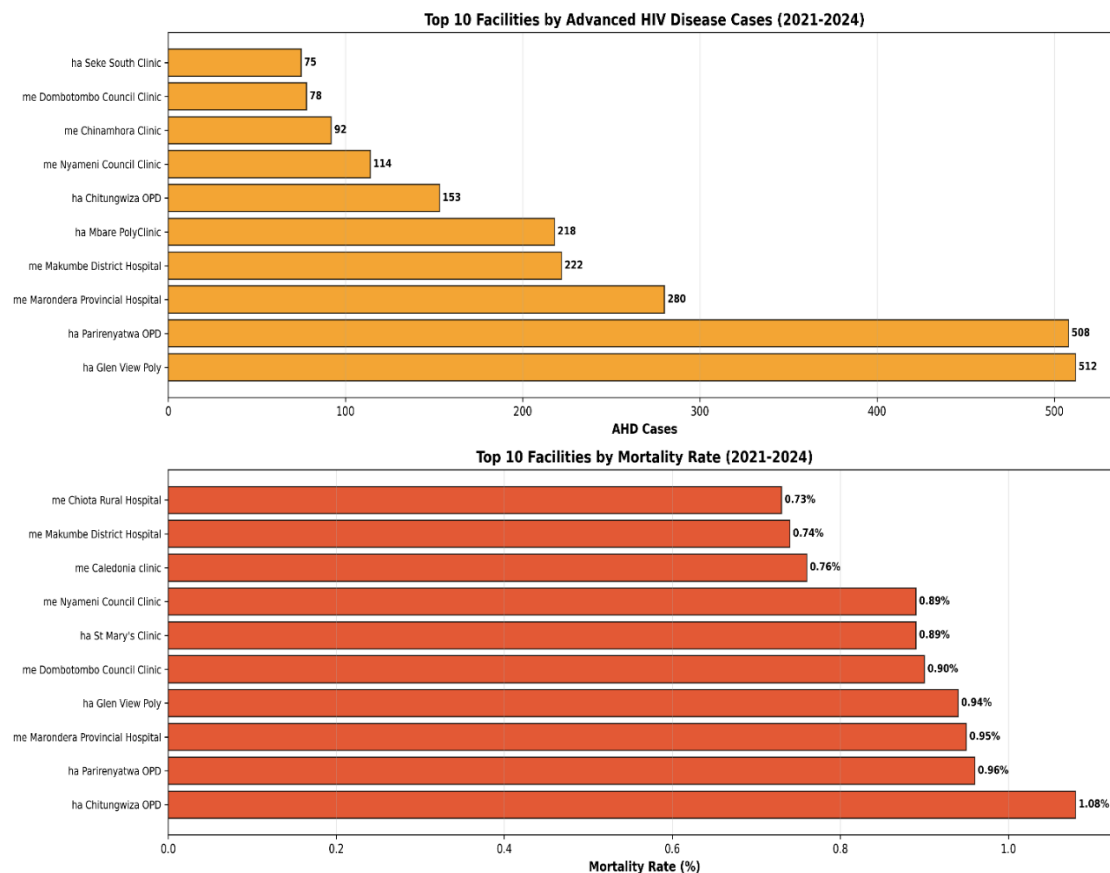


Figure 1. Top 10 Facilities by AHD Cases and Mortality Rate (2021–2024)

Figure 1 demonstrates that a notable proportion of the AHD case burden is attributable to a small number of high-volume healthcare facilities. Glen View Polyclinic is the highest reporting facility with AHD case load of 512 cases, which is closely followed by Parirenyatwa Outpatient Department, which recorded 508 cases. While Marondera Provincial Hospital has 280 cases, Makumbe District Hospital and Mbare Polyclinic have 222 and 218 cases respectively. Clinics such as Seke South and Dombotombo Council Clinic have recorded less than 80 cases. The burden of AHD cases which is concentrated on urban referral and high-density peri-urban facilities is a function of how patients are referred and diagnostics that are performed prior to patients being referred to higher levels of care [5]. The AHD case burden concentrated in urban-referral and peri-urban facilities illustrates how patients are referred and the diagnostic lag time associated with advanced care [17]. High case volumes in tertiary and referral facilities are attributed to health system organization rather than localized epidemic severity [10].

The examination of mortality rates indicated a distinct pattern from that of the case burden. Chitungwiza Hospital had recorded the most fatalities, with 1.08% followed by Parirenyatwa OPD, with 0.96% and Marondera Provincial Hospital, with 0.95%. Glen View Polyclinic had the most cases, with a mortality rate of 0.94%, which was lower than those above. Chiota Rural Hospital and Makumbe District Hospital recorded mortality rates lower than 0.75%. This data points to the fact that mortality results from a combination of factors and not just case volume, but also case severity, the availability of clinical management, and timing of the clinical presentation of infections [18].

The highlights of mortality and case burden divergences indicate potential programming. For example, a high volume of cases at a healthcare facility does not guarantee a high mortality rate. This could be a result of a more

robust healthcare facility with more effective clinical management, diagnostics, and institutional healthcare management. In contrast to that, more moderate case healthcare facilities with late presenting cases could witness higher mortality rates than the optimally specialised healthcare facilities. This would indicate the need to design differentiated service delivery models that respond more effectively to the specific needs of the individual healthcare facilities and the healthcare immediacy of the patients [6].

The research confirms that facility-level heterogeneity is a signature of AHD epidemiology. Enhancing diagnostic decentralization, workforce strengthening, and opportunistic infection screening at high-burden and high-mortality facilities will be pivotal in diminishing preventable deaths alongside an expansion of clinical outcomes within the HIV clinical care cascade at a national level [15].

Subnational Distribution of AHD Prevalence, Mortality, and TB Coinfection Burden (2021–2024)

Research shows AHD and death rates, as well as rates of opportunistic infections, are not consistent across the provinces studied. This is due to differences in the accessibility of services, how patients are referred, the geography of the population, and the time interval when people are diagnosed with HIV. An enduring aspect of the HIV epidemic in sub-Saharan Africa is the unequal HIV outcomes over different regions which demands targeted programmatic intervention [3]. Figure 2 illustrates district and provincial variations in Advanced HIV Disease (AHD) prevalence, mortality rates, and tuberculosis coinfection between 2021 and 2024, highlighting higher AHD prevalence in rural Mashonaland East than in urban Harare and substantial differences across districts.

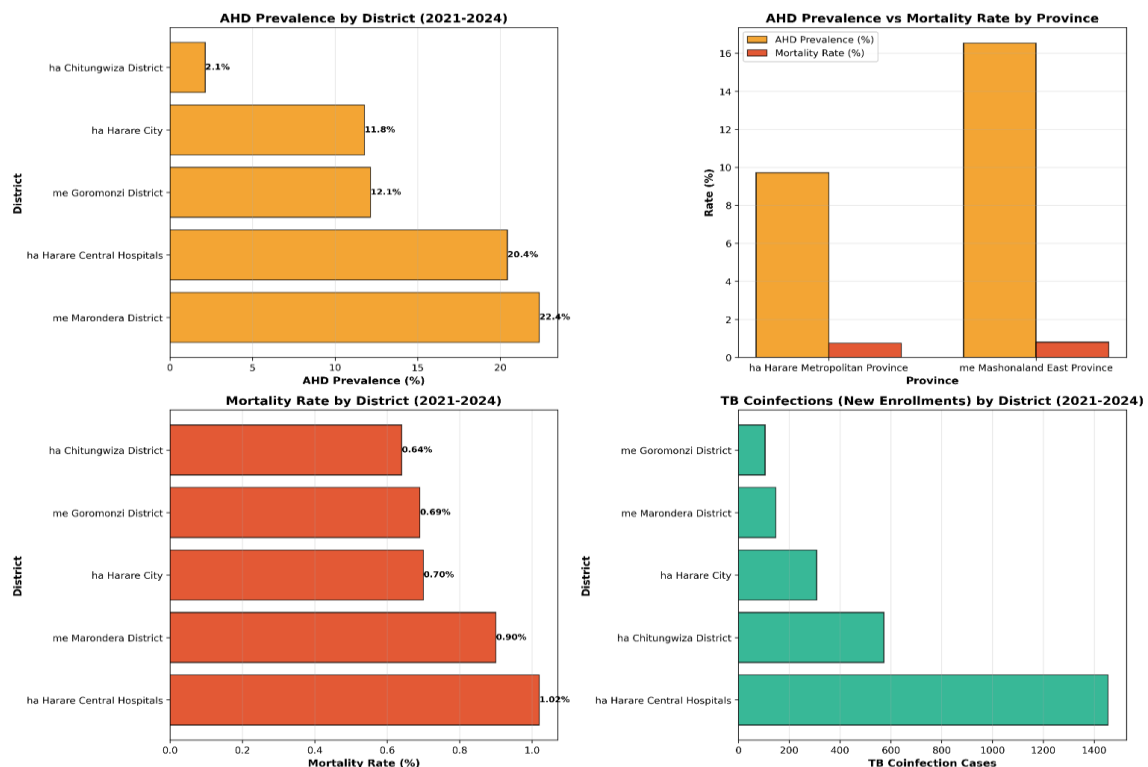


Figure 2. District and Provincial Distribution of AHD Prevalence, Mortality, and TB Coinfections (2021–2024)

Figure 2 demonstrates substantial geographic variation in the burden of Advanced HIV Disease (AHD) and associated clinical outcomes across districts and provinces between 2021 and 2024. Marondera District recorded the highest AHD prevalence (22.4%), followed by Harare Central Hospitals (20.4%), while Chitungwiza District reported the lowest prevalence (2.1%). Mortality rates were highest at Harare Central Hospitals (1.02%), reflecting the concentration of severe referral cases. Provincial comparisons indicate a higher AHD prevalence in rural Mashonaland East (16.53%)

compared with urban Harare (9.71%), although mortality differences remained relatively small. In addition, tuberculosis coinfections were disproportionately concentrated in major referral centres, particularly Harare Central Hospitals, highlighting the relationship between advanced immunosuppression and opportunistic infections in high-burden treatment facilities.

Table 1 presents a comparison of key indicators between rural and urban settings for the period 2021–2024.

Table 1. Urban-Rural Comparison of Key Indicators (2021-2024)

Setting	PLHIV on ART	AHD Prevalence (%)	Mortality (%)	LTFU (%)
Rural	69,931	16.53%	0.80%	4.51%
Urban	183,893	9.71%	0.74%	4.90%

However, there was wide variation in the prevalence of AHD across districts within the various study sites. Marondera District had the highest prevalence at 22.4%, as shown in Table 1, while Harare Central Hospitals had a prevalence of 20.4%. Moderate prevalence

levels were reported in Goromonzi and Harare City at 12.1% and 11.8%, respectively, while Chitungwiza District had the lowest prevalence at about 2.1%. These findings show a clear variation in the timing of diagnosis and linkage to care across districts. The higher prevalence

of AHD in some districts aligns with the presentation delays and diagnostic access challenges noted in Southern Africa [5].

There was also a clear rural-urban gradient in the provincial comparisons. A prevalence of AHD was about 16.5% in Mashonaland East, while in Harare Metropolitan Province, it was 9.7%. The differences in mortality between the provinces were small, with Mashonaland East having approximately 0.80% and Harare around 0.74%. This pattern indicates that while the rural population has to bear a greater disease burden at presentation, the clinical outcomes may be similar across provinces once patients enter the care system. This has also been documented in previous evaluations of regional HIV programs where there is a standardization of treatment in order to reduce the variability of outcomes after linkage to care [10].

There were significant differences in the patterns of deaths across districts. The highest death rate was recorded by Harare Central Hospital with a death rate of around 1.02%. It was closely followed by Marondera District with approximately 0.90%. Mortality rates of Harare City and Goromonzi were below 0.70%, and Chitungwiza had around 0.64%. It is possible that higher mortality rates in referrals and in high-volume facilities indicate the concentration of more severe AHD cases rather than poorer illness care. Hospitals that are referrals deal with complex cases of opportunistic infections and late presentations of the disease where advanced clinical interventions are needed [18].

There was a strong clustering of TB coinfection burden within specific districts. Over the Study period, Harare Central Hospitals had the highest TB coinfection burden with more than 1,400 counted cases. Moderate TB coinfection burden was seen in Chitungwiza and Harare City, while Marondera and Goromonzi recorded smaller figures. The high concentration of TB coinfections in high-volume referral facilities indicates both the diagnostic capacity and the referral of a body of

severely immunocompromised patients. TB continues to be a significant cause of disease and death in people with advanced HIV disease, and is closely associated with late diagnosis and the degree of immunosuppression [9].

The above-mentioned patterns in geography show how important customised HIV service delivery patterns are for each location. Rural and peri-urban regions with a greater AHD prevalence demand more robust and improved pathways for early diagnosis and linkage to care for screening and care middle for OP and CD4 opportunistic infections. Increased capacity for management of AHD (including TB and cryptococcal disease) for inpatient clinical management is also needed at high-burden referral sites. Focused geo-resource allocation is still needed to lower avoidable AHD-related deaths and enhance the equity of the country's HIV program [15].

District-Level and Facility-Level Analysis of AHD Burden

District-Level Disparities

According to this burden analysis, there are disparities at the district level that cannot be explained solely by district size or HIV case numbers. For instance, the Marondera District has been described as the most difficult district in this study, as it has the highest AHD prevalence of 22.36% (487 cases). In addition, Marondera District accounts for 13.6% of the study population, and, being predominantly rural, this suggests challenges with late presentation and links to care in Marondera. In comparison, the Harare Central Hospitals, which are tertiary referral hospitals for complex cases have a prevalence of 20.43% (661 cases); thus, this prevalence is a function of the hospital and not the local AHD burden. It is also important to point out that the Chitungwiza District, which has the highest number of patients (32.7%), AHD prevalence, 2.13% (135 cases), is very low. This shows that Chitungwiza has good AHD control with early case finding and treatment.

The significant variances in AHD prevalence across the districts e.g. Chitungwiza's 2.13% AHD prevalence compared against Marondera's 22.36% AHD prevalence highlights the potential of local data to understand access and variations in local testing/referral(s) programs to explain variations in AHD epidemiology, even under the uniformity of a single national healthcare system. The relationship of apparent patient volume, AHD prevalence, and the inverse in Chitungwiza District, indicates that this is a potential AHD low-burden district where significant service delivery, or more so than in other low-burden districts, AHD is being demonstrated. The low prevalence of AHD in Chitungwiza District is paradoxically associated with higher cryptococcal meningitis, tuberculosis, and other opportunistic infections. This apparent paradox, in relation to the high level of AHD, suggests either exceptional diagnostic vigilance at Chitungwiza sites where opportunistic infections are actively sought, or that patients are being identified and treated for

opportunistic infections before reaching the AHD threshold, demonstrating a model of success for opportunistic infections (CD4) secondary prevention.

Temporal Program Performance and Clinical Outcome Trends (2017–2024)

Facility and program performance trends from 2017 to 2024 show considerable changes in ART coverage and in the burden of Advanced HIV Disease (AHD), mortality, and opportunistic infection patterns. These metrics capture both the health system's performance and the shifting dynamics of the epidemic. Such changes are essential for evaluating the national HIV program and monitoring potential new threats [11]. Figure 3 illustrates temporal trends in ART coverage, AHD prevalence among new ART initiations, mortality, loss to follow-up, and cryptococcal meningitis cases between 2017 and 2024, highlighting improved treatment coverage alongside fluctuating burdens of advanced disease and opportunistic infections over time.

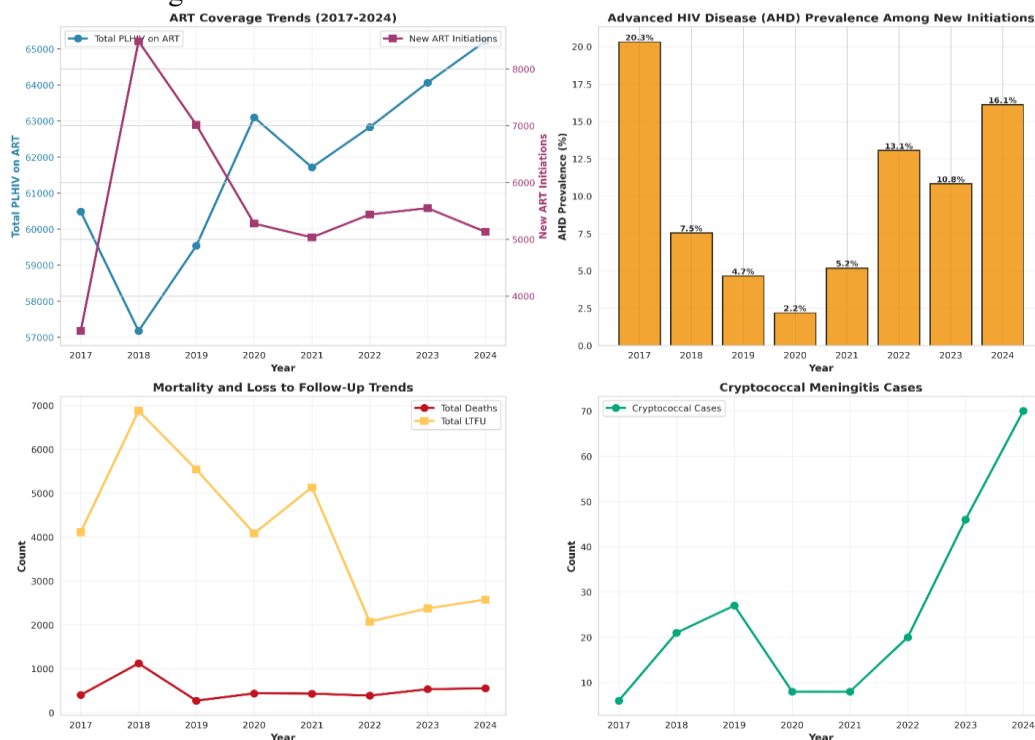


Figure 3. ART Coverage, AHD Prevalence Among New Initiations, Mortality, LTFU, and Cryptococcal Trends (2017–2024)

Figure 3 illustrates temporal trends in ART coverage, AHD prevalence among new ART initiations, mortality, loss to follow-up, and cryptococcal meningitis cases between 2017 and 2024. ART coverage steadily increased over the study period, reflecting the continued expansion of treatment programmes. However, AHD prevalence followed a U-shaped trend, declining from 20.3% in 2017 to 2.2% in 2020 before rising again to 16.1% in 2024. Mortality and loss-to-follow-up trends fluctuated but generally declined after 2021, indicating improvements in retention and treatment continuity. Conversely, cryptococcal meningitis cases increased toward the end of the study period, highlighting the persistent burden of opportunistic infections associated with late HIV diagnosis and advanced immunosuppression.

During the study period, there was a gradual expansion of ART coverage. Overall increase remained consistent despite temporary fluctuations from 2017 and 2019. New ART initiations, which peaked in 2018, plateaued at moderate levels. This phenomenon mirrors the expansion and plateauing of new enrolments as retention improves. Service reductions and new enrolments were disrupted because of COVID-19 [4].

The AHD prevalence of new ART initiations follows a U-shaped trend. Prevalence decreased from 20.3% in 2017 to 2.2% in 2020, then rose again to 16.1% by 2024. Early testing and treatment scale-up explain the initial decline. The 2020 nadir, amid COVID-19, saw substantial service disruptions. The following increase presents a situation of neglected diagnosis, missed treatment, and an infectious disease on the re-engagement of patients previously suffering advanced illness [7].

Between 2018 and 2022, there was a peak and subsequent decline in loss-to-follow-up

(LTFU) mortality. Referrals to loss to follow-up (LTFU) mortality were approximately 2,000 to 2,600 per year during that time range. Mortality rates also fluctuated, but remained consistent and steadied after 2022 [17]. There were improvements in retention, reflecting the scale-up of differentiated service delivery models in multi-month dispensing and community-based ART delivery approaches [17].

Prior to 2022, there was also a persistent retention and mortality paradox, and retention improvements were attributed to late presentation and advanced disease complications.

2024 is predicted to have approximately 70 incidences of cryptococcal meningitis. Cryptococcal disease is an indicator of late presentation/advanced immunosuppression due to HIV. HIV is an issue that also increases the prevalence of cryptococcal disease and it is anticipated that there will be an increased burden of cryptococcal disease due to the lack of early diagnosis and treatment of HIV, despite the ART advancements.

Zimbabwe's HIV program retention and ART coverage reflects the major disease burdens that advanced clinical disease provides. A greater emphasis on these advanced disease clinical burdens is needed to improve earlier diagnosis, and to additionally improve the initiatives aimed at opportunistic infection screening and advanced disease management [15].

Correlation Analysis

Figure 4 presents the correlation matrix between Advanced HIV Disease indicators and clinical outcomes, alongside a comparison of key indicators between urban and rural settings, highlighting stronger AHD prevalence in rural areas despite similar mortality rates across both settings.

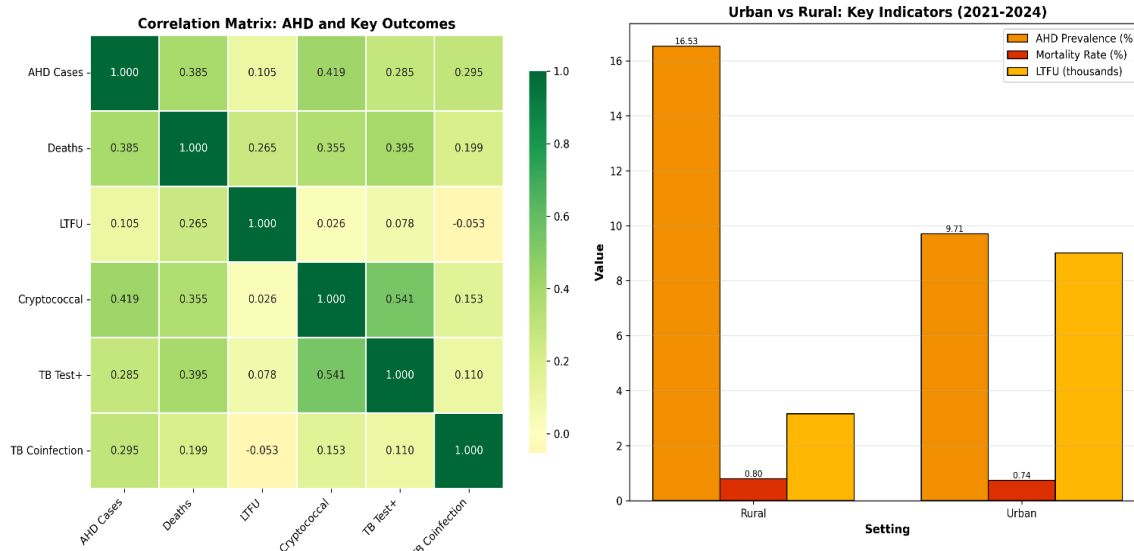


Figure 4. Correlation Analysis and Urban vs Rural: Key Indicators (2021-2024)

Figure 4 presents the correlation matrix between Advanced HIV Disease (AHD) burden and key clinical outcomes, alongside a comparison of indicators between rural and urban settings. The analysis shows moderate positive correlations between AHD cases, mortality, and opportunistic infections, particularly cryptococcal disease. Rural settings had a higher AHD prevalence (16.53%) than urban areas (9.71%), although mortality rates were similar in both settings. These patterns highlight the influence of delayed diagnosis and access barriers in rural populations rather than differences in treatment quality after patients enter the care system.

The correlation matrix shows the burden of advanced HIV disease (AHD) and clinical outcomes. There is a moderate positive relationship with AHD cases and deaths ($r = 0.385$), advanced disease burden is associated with higher mortality risk. A strong positive relationship is seen for cryptococcal infection and TB test positivity ($r = 0.541$). Implies a high-risk population of overlapping and immunosuppressed individuals. Integration of screening and management strategies for opportunistic infections is needed.

There is a clear contrast in AHD prevalence between rural areas (16.53%) and urban areas (9.71%) in the urban-rural approach. Mortality

shows little variation in both urban (0.74%) and rural (0.80%) areas. There is a higher LTFU rate in urban cohorts, likely reflecting larger treatment populations rather than poorer retention outcomes. These findings demonstrate inequities driven by higher AHD disease burden and more by delayed diagnosis and access barriers than poorer treatment quality after entering the care continuum [17].

Bivariate correlation analysis serves as an additional measure of relationships within the AHD clinical cascade. There is a statistically significant positive correlation with a value of 0.419 and a p-value of 0.003 regarding AHD cases within the facilities and cases of cryptococcal meningitis. This is a positive correlation due to biological plausibility, since cryptococcal disease occurs in severe immunosuppression ($CD4 < 100$ cells/ μ L). This relationship reinforces the WHO recommendations stating that AHD diagnoses automatically require a cryptococcal antigen test. This is a true high-yield, potentially life-saving intervention [19].

A statistically significant correlation ($p=0.041$) with a correlation coefficient of 0.295 was observed between AHD burden and TB coinfection. This relationship is weaker and may reflect variability in TB diagnostic practice, especially in the use of TB-LAM and

TB molecular testing. In advanced disease, extra-pulmonary TB may contribute to the under-detection and therefore weaken the statistical association. There is a displayed need in the AHD population for further standardized TB screening protocols [8].

There is no statistically significant association between AHD burden and loss to follow-up ($r = 0.105$, $p = 0.342$). This means that the drivers of disengagement from care is more socio-economic and behavioural than biological. Those advancing to AHD are most certainly late presenters and treatment failure patients who remain in care. This justifies the need for dual-program approaches aimed at both strengthening retention and focused clinical AHD management for high-risk patients already in treatment programs [14].

Discussion

Key Findings in Context of the National and Regional HIV Response

This comprehensive eight-year analysis reveals both the substantial progress and the persistent, There are several challenging aspects when it comes to the management of Advanced HIV Disease (AHD) within Zimbabwe's evolving HIV program. The fact that ART data from 2021–2024 shows that AHD was present in 12.82% of the cohort participants is framed regionally; there are various literature reports that document that 10–50% of people living with HIV in sub-Saharan Africa are known to start antiretroviral therapy at an advanced stage of immunosuppression [1]. The ongoing burden illustrates that although there are notable advancements in the scaling of treatment coverage, a high number of people still come into contact with the health system, only after they have suffered a high degree of immune compromise, significantly increasing their risk of morbidity and mortality. The findings of the study emphasize the fact that AHD is still a fundamental component in the fight to control HIV and it needs to be of primary focus in addition to treatment quotas.

Interpretation of Multifaceted Temporal Patterns

The U-shaped pattern in AHD prevalence between 2017 and 2024 indicates more than a simple epidemiological signal, considering evolving guidelines, health system changes, and external shocks. The 2017–2018 peak, with the larger $CD4 < 350$ cells/mm³ definition, likely depicted the historical pattern of late diagnoses and more advanced immunosuppression. The following rapid decline to the 2020 nadir reflects a complex interplay of factors, including a new and improved CD4 testing system for earlier diagnosis; mature “test and treat” policies facilitating rapid ART initiation; and likely, the significant, yet artificial, depression of new diagnoses due to the routine HIV services collapse caused by the COVID-19 pandemic [8].

An analysis of the worrying and renewed increase of the prevalence from 2021 onward, especially under the newly defined and more stringent $CD4 < 200$ criteria, requires a complicated analysis. At least three potential causes can be identified: the first being the backlog of undiagnosed disease that has progressed due to the disease-related lockdowns and is now entering the care system; the second relates to the possible diminishment of routine CD4 monitoring, as programmatic shifts focus to the viral load (VL) monitoring to assess treatment success, thereby allowing the tacit and silent immunological failing to go undetected; and the third is the revealing of deep, entrenched systemic issues, including stigma, poverty, and geographic isolation, which uninterruptedly lag the diagnosis of advanced disease in the critical and marginalized populations in the outlying areas and actively perpetuate the undiagnosed diseased pool[2]. Such an analysis as the fragile health system can be resilient to the most significant areas of shock and demonstrates the need for a system that is flexible enough to be adjustable to ensure uninterrupted service

delivery that includes both testing and treatment services in a time of need [13].

Addressing Profound Urban-Rural Disparities in AHD Burden

The analysis discovered an alarming and critically programmatic disparity, with rural settings experiencing a 70% greater burden of AHD compared to urban settings [13]. This constitutes direct epidemiological mapping of inequities in healthcare access. It highlights the structural determinants operating in rural Zimbabwe. These include elongated distances to healthcare services, unreliable transport, increased poverty that limits individuals from seeking healthcare, and an absence of healthcare personnel and diagnostic services [13]. These obstacles create a cascade of delays that hinder the initial testing, the timely linking to care, and ultimately retain individuals in a cycle of care to allow HIV to progress.

This essay aims to make sense of the paradox of the other mortality rates, considering the severity of the illness, the locations, and the other rural regions. Rural patients overcome barriers to receiving clinical care as good as urban care. This shows that the countries have established protocols for rural clinical care. However, the good outcomes for rural mortality mask an even bigger problem. Patients are diagnosed too late in rural areas. Trying to explain the urban hospitals' number of deaths shows the problem and the level of mortality that results from rural deaths. The mortality resulting from sending patients to urban hospitals is a problem originating in rural areas. The situation shows that more control is needed to improve them. Simple control over how and where to improve testing and referral infrastructure in rural areas will reduce mortality. This will improve mortality in rural areas and move toward real control of the rural areas.

The Critical and Quantifiable Link to Opportunistic Infections

The analyses demonstrate biocorrelation evidence with a statistically significant relationship between advanced immunosuppression and severe opportunistic infections (OIs) of multiple severe opportunistic infections types. The statistically significant relationship ($r=0.419$, $p=0.003$) between AHD and cryptococcal meningitis, and hence, the clinical rationale of bundled screening. The marked increase in cryptococcal meningitis cases, rising from 46 to 70 cases between 2023 and 2024, highlights a growing burden of severe opportunistic infection and underscores the potential for preventable mortality if early screening is not strengthened. This pattern reinforces the life-saving and cost-effectiveness of routine cryptococcal antigen (CrAg) screening for patients with $CD4 < 200$ cells/mm³, as recommended by WHO [11]. On the other hand, the moderate relationship with TB ($r=0.295$, $p=0.041$) confirms the opposite and more likely, a programmatic gap instead of a weak biocorrelation. The likely explanation for the weakened relationship is the poor implementation of TB screening approaches (e.g., TB-LAM or Xpert Ultra) in AHD patients which leads to under diagnosis of disseminated and extrapulmonary TB [16]. There is a clear need for not only combined screening, but also clear expectations for the standardization of sensitive TB screening, to match the high-risk TB infection at AHD.

Program Performance, Strategic Insights, and Future Direction

One of the most notable impacts of the improvements made to the patient-centered service delivery adaptations (ICAP, 2023), including multi-month dispensing (MMD) and community ART groups, to LTFU, is the decline of LTFU rates to less than 4% in the post- 2021 period. And 2021's LTFU rates of 12% show impressive growth. This is the first time any report has shown LTFU rate of less

than 4% since 2021. Nevertheless, the most important learning perspective of the study is the lack of significant relationship between LTFU and AHD. This indicates that AHD is not a disease of the lost to follow-up patients, but rather, AHD occurs substantially among retained patients. This is attributed to either a late-stage disease, or a case of clinical failure which is when patients are ART and have unsuppressed viremia and/or have receded their immune system, despite being retained [2]. Therefore, the program must change direction to incorporate the retention focus and also the AHD.

The Zimbabwe HIV response's focus on ensuring the quality of survival from simply monitoring retention illustrates the development of HIV response and its intention to reduce mortality of the most vulnerable patients and provide equal health outcomes for all.

Conclusion

This paper analyzes the expanding burden and drivers of Advanced HIV Disease (AHD) within the scope of epidemiology, specifically, the Zimbabwean national HIV programme. The overall outcome of the programme has been benefited by the increase of antiretroviral therapy and retention of patients. However, the programme continues to be affected by structural and operational challenges, which lead to the presentation of advanced stages of HIV disease. This study provides evidence to the AHD geographical inequities. The burden of AHD is disproportionately more in rural and peri-urban populations as compared to urban populations. AHD burden inequities across districts and facilities underscore that AHD outcomes are a function of the health system's operability, the availability of AHD diagnoses, and clinical management of AHD in the area. There is no doubt that a differentiated, context-specific approach is warranted, rather than the traditional homogeneous national

approach to targeting, treating, and (where possible) managing high-risk actors.

The program perspective suggests the study proposes the application of multiple components optimization approach focusing on fortifying diagnostics, clinical management, supply chain management, and community-oriented services. To mitigate the delays in clinical decision-making and facilitate early detection of immunosuppression, accessing CD4 testing at the primary health care level is vital [9]. Routine screening for opportunistic infections, particularly cryptococcal infections and TB (especially in suspected TB), should use TB-LAM technology as part of the AHD screening package. It is anticipated that the strengthening of clinical care pathways through standardisation of treatment protocols, specialised simulation-based training, and mentorship of tertiary-level specialists to district-level clinicians will enhance clinical engagement and clinical outcomes. Additionally, improved commodity forecasting, establishment of strategic buffer stocks, and integration of real time digital stock management to the health information system of the respective country will reduce stock-outs and improve supply chain management. Targeted HIV testing, peer support models, and differentiated service delivery for AHD patients, at the community level, improve late presentation, treatment adherence, and survival outcomes of AHD patients.

There are great many weaknesses in this study. The routine health facility data relies on data collection routine, therefore, it may underestimate the burden of AHD, depending on the coverage of CD4 testing. It is challenging to make direct temporal comparisons due to the disparate AHD case definitions and CD4 count thresholds across the study timeline. Nevertheless, impacted stratified effect the Analysts conducted. The Inherent study design elements will make it impossible to establish any cause and effect

relationships in AHD and the implicated factors in the AHD outcomes. The province selection, which included only two provinces, and this was methodologically justified in terms of a comparative study, will probably lower the degree of national generalisability. The absence of certain key demographic data elements such as age and sex, and key population- category data limited the analysis of subgroups that are considered to be at increased risk, and this is also a limitation.

Conflict of Interest

The author declares no conflicts of interest regarding publication of this scientific article.

Ethical Approval

Authority to use the National HIV program data was sought and granted by the Ministry of Health and Child Care of Zimbabwe. Ethical approval to conduct the research was also granted by Texilla American University.

Data Availability

Anonymised pooled data is provided by the author. The data may be made available to interested researchers through formal data access requests under the jurisdiction of Zimbabwe's Ministry of Health and Child Care.

References

- [1]. Ahmed, A., Desta, A., Gebremedhin, T., 2023, Late presentation for HIV care in sub-Saharan Africa: a systematic review and meta-analysis. *BMJ Global Health*, 8(1), e010481.
- [2]. Geng, E. H., Odeny, T. A., Lyamuya, R., Holmes, C. B., 2021, Retention in care and patient-reported reasons for undocumented transfer or stopping care among HIV-infected patients on antiretroviral therapy in Eastern Africa: Application of a sampling-based approach. *Clinical Infectious Diseases*, 72(Suppl 1), S1–S8.
- [3]. Gonese, E., Dzangare, J., Takarinda, K. C., et al., 2020, High HIV prevalence and incidence

Author Contributions

- **Sandra Chipuka:** Conceptualization, Methodology, Formal Analysis, Investigation, Data Curation, Writing-Original Draft Preparation, Writing-Review & Editing, Visualization, Project Administration.
- **Emmanuel Govha:** Writing-Review & Editing.
- **Chiedza Mupanguri:** Writing-Review & Editing.
- **Japhet Anesu Mabuku:** Data curation and analysis.A

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inequalities amongst key populations in Zimbabwe: a case for differentiated service delivery. *Journal of the International AIDS Society*, 23(Suppl 1), e25506.

- [4]. Hatzold, K., Ahmed, N., Gudukeya, S., 2022, Impact of COVID-19 on HIV service delivery: lessons from Zimbabwe. *The Lancet HIV*, 9(1), e2–e3.
- [5]. Huerga, H., Rucker, S., Cossa, L., et al., 2022, Advanced HIV disease at presentation to care in Mozambique and Zimbabwe: A cross-sectional study. *PLOS Global Public Health*, 2(1), e0000105.
- [6]. ICAP, 2023, Differentiated Service Delivery for HIV Treatment: A Toolkit for Implementation.

Columbia University Mailman School of Public Health.

- [7]. Jewell, B. L., Mudimu, E., Stover, J., et al., 2020, Potential effects of disruption to HIV programs in sub-Saharan Africa caused by COVID-19: results from multiple mathematical models. *The Lancet HIV*, 7(9), e629–e640.
- [8]. Kerkhoff, A. D., Barr, D. A., Schutz, C., et al., 2023, Disseminated tuberculosis among hospitalised HIV patients in South Africa: a common condition that can be rapidly diagnosed using urine-based assays. *Scientific Reports*, 13, 112.
- [9]. Larson, B. A., Schnippel, K., Ndibongo, B., et al., 2022, Rapid point-of-care CD4 testing at mobile units and linkage to HIV care: an evaluation of community-based mobile HIV testing in South Africa. *AIDS Research and Therapy*, 19(1), 1.
- [10]. Mee, P., Rice, B., Duda, S., et al., 2022, Advanced HIV disease in the antiretroviral therapy era: a review. *Current Opinion in HIV and AIDS*, 17(3), 145–152.
- [11]. Moyo, C., Chikwanha, T. M., Moyo, F., 2021, Use of routine health data in low- and middle-income countries: a review of current literature and future directions. *Health Policy and Planning*, 36(Supplement_1), i1–i4.
- [12]. Mukwenha, S., Dzinamarira, T., Musuka, G., 2022, Impact of multi-month dispensing on HIV treatment outcomes in Zimbabwe. *AIDS Research and Therapy*, 19(1), 55.
- [13]. Mungati, M., Dube, S., Mugurungi, O., et al., 2021, Geospatial heterogeneity of HIV and associated factors in Zimbabwe: a nationwide population-based study. *BMJ Open*, 11(12), e055312.
- [14]. Mutevedzi, P. C., Lessells, R. J., Rodger, A. J., et al., 2020, Association of age with mortality and virological and immunological response to antiretroviral therapy in rural South African adults. *PLOS ONE*, 15(7), e0234789.
- [15]. Phillips, A. N., Bansi-Matharu, L., Cambiano, V., 2023, The potential impact of emerging technologies in the management of advanced HIV disease. *Current Opinion in HIV and AIDS*, 18(2), 87–94.
- [16]. Shamu, S., Farirai, T., Slabbert, J., et al., 2021, Socio-economic and demographic factors associated with late HIV diagnosis in rural South Africa. *Southern African Journal of HIV Medicine*, 22(1), 1198.
- [17]. Takarinda, K. C., Harries, A. D., Shiraishi, R. W., et al., 2020, Gender-related differences in outcomes and attrition on antiretroviral therapy among an HIV-infected patient cohort in Zimbabwe: 2007–2010. *International Journal of Infectious Diseases*, 90, 34–41.
- [18]. Tenforde, M. W., Mokomane, M., Leeme, T., et al., 2022, Advanced HIV disease in Botswana following successful antiretroviral therapy rollout: incidence of and temporal trends in cryptococcal meningitis. *Clinical Infectious Diseases*, 74(Suppl 2), S172–S179.
- [19]. World Health Organization, 2021, Guidelines for managing advanced HIV disease and rapid initiation of antiretroviral therapy. *World Health Organization*.
<https://www.who.int/publications/i/item/9789241550062>

The Impact of Removing User Fees on Maternal and Child Health Services: A Systematic Review of Quasi-Experimental Studies

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Abstract

User fee removal is emerging as a leading strategy to expand access to financial services for maternal and child health (MCH) services. However, whether such policies improve downstream outcomes or equity remains unclear. We conducted a systematic review of quasi-experimental studies evaluating the effects of user fee removal on the MCH continuum of care, mortality outcomes, and equity, guided by PRISMA and an original conceptual framework linking financial barriers to service use, quality, system readiness, and health outcomes. We searched PubMed and Web of Science in August 2025 for studies that used experimental or quasi-experimental designs evaluating user fee removal. Of the 933 records screened, 14 studies met the inclusion criteria; all were quasi-experimental. Narrative synthesis followed SWiM (Systematic Review Without Meta-analysis) guidelines due to heterogeneity, and risk of bias was assessed using ROBINS-I. Free health care policies consistently improved access to antenatal care, facility-based delivery, and skilled birth attendance. Effects on postnatal care and caesarean section were mixed. These improvements did not correspond to significant reductions in maternal mortality, stillbirths, or neonatal mortality. Removing user fees had no immediate effect on the initiation of early antenatal care but showed long-term gains. Some policies closed equity gaps while some unintentionally widened health disparities. Removing user fees significantly increased MCH utilisation, with limited or inconsistent effects on mortality and equity. Our framework clarifies how fee removal brings both benefits and system pressures. Future research should address quality and system readiness to achieve equitable outcomes.

Keywords: Equity, Fees and Charges, Free Healthcare, Health outcomes, LMIC, Maternal and Child Health.

Introduction

User fees have shaped health financing policy in many low- and middle-income countries (LMICs), sparking decades of debate among policymakers, researchers, and practitioners. Proponents argued that charging at the point of service would generate revenue, improve efficiency, and increase the availability of essential commodities [1, 2]. Yet

strong evidence shows that direct payments burden poorer households, delay care-seeking, and worsen socioeconomic inequities, especially for maternal and child health (MCH) care, where delays heighten preventable morbidity and mortality risks [3-5].

Awareness of these inequities has shifted health financing worldwide. Researchers, NGOs, and international agencies now call for

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the removal of user fees to increase access to essential MCH services, promote continuity of care, and accelerate progress toward universal health care (UCH) and financial protection [6]. As a result, many LMICs have removed fees for pregnant women, newborns, children, or everyone. This consensus recognizes that financial barriers are a major obstacle to service use and increases maternal and neonatal disparities.

Despite widespread adoption, evidence of the effects of removing user fees for MCH services remains limited and inconsistent. The most recent systematic review [7], synthesized studies across varied designs and assessed multiple policy actions, including introducing, reducing, and removing fees. The review found generally consistent increases in facility deliveries and obstetric complication management. However, evidence on mortality, care quality, and socioeconomic inequalities was inconclusive. Most included studies from the review relied on observational designs that were either uncontrolled or poorly controlled. This limited causal inference and the ability to attribute observed changes to fee-removal policies rather than to other factors.

Existing research also often conceptualizes fee removal as simply the inverse of fee increases, assuming symmetric behavioral and health system responses. These risks overlook unintended consequences such as increased workloads, supply-side strain, or changes in provider behavior, particularly in resource-constrained settings. As a result, significant gaps persist in understanding how fee removal policies affect the full continuum of MCH care, including antenatal, intrapartum, postnatal, and newborn services, and how these reforms interact with system readiness, quality of care, and equity.

To address these limitations, we conduct the first systematic review of studies using experimental or quasi-experimental designs to evaluate the effects of removing user fees for maternal and child health (MCH) services.

Although both designs were eligible, all included studies, after screening and eligibility assessment, were quasi-experimental, yielding stronger impact estimates than traditional observational approaches and enabling clearer attribution of observed changes to policy reforms. Guided by our original conceptual framework (Figure 2), developed based on Andersen's behavioural model, Donabedian's quality framework, and the WHO health system building blocks framework [8-10], we link financial barriers to service use, quality, system readiness, and health outcomes. We assess impacts across the full MCH continuum, with particular emphasis on mortality and equity outcomes, which have been underrepresented in previous syntheses. We also include a mechanistic synthesis to clarify the pathways through which fee removal may yield both intended benefits and unintended system-level pressures, thereby providing more robust, policy-relevant evidence to inform equitable health-financing reforms and support countries' progress toward universal health coverage.

Materials and Methods

We performed a systematic review following the PRISMA best-practice guidelines [11].

Search Strategy

We searched PubMed and Web of Science on August 15th, 2025, for peer-reviewed articles on user fees and maternal and child health services. The selection of these two databases was based on preliminary scoping, which indicated that most quasi-experimental evaluations of user-fee removal policies published in economics, development, and health-systems journals were already indexed in Web of Science. Titles from EconLit and Scopus were also examined during the scoping phase, revealing substantial overlap with Web of Science and no unique quasi-experimental evaluations relevant to the research topic. Consequently, expanding the search to

additional databases was deemed unlikely to materially alter the set of eligible studies.

We operationalized different permutations of each keyword based on previously validated searches. For the User Fee keyword, we included variants such as “user charges”, “direct payment”, “user fees”, “charges and fees [Mesh]” following the reviews of [3, 12, 13]. For MCH services keywords variants, we drew on [14-16] to include “maternal and child health service”, “reproductive health service”, “child health service”, etc. We applied the title and abstract fields (PubMed) and the topic field (Web of Science) to the search. The full details of the search strategy are presented below.

We did not conduct backward or forward citation searching, nor did we include grey literature such as government reports or donor evaluations. While these methods can enhance sensitivity, they may also increase variability in study quality. To ensure methodological consistency, we limited our inclusion criteria to peer-reviewed studies indexed in the two selected databases. We acknowledge that this strategy may introduce both publication and disciplinary bias, especially considering the cross-sectoral nature of user-fee reforms. This limitation is further addressed in the Discussion section.

Pubmed Search

#1	Search: (“user fee”[Title/Abstract] OR “user fees”[Title/Abstract] OR “user-fee”[Title/Abstract] OR “user-fees”[Title/Abstract] OR “user charge”[Title/Abstract] OR “user charges”[Title/Abstract] OR “direct payment”[Title/Abstract] OR “direct payments”[Title/Abstract] OR “free healthcare”[Title/Abstract])
#2	Search: (charges and fees[MeSH Terms])
#3	Search: (“Maternal and child health service*”[Title/Abstract] OR “maternal & child health services”[Title/Abstract] OR “Maternal-Child Health Service*”[Title/Abstract] OR “Maternal Health Service*”[Title/Abstract] OR “Maternal Health”[Title/Abstract] OR “Child Health Service*”[Title/Abstract] OR “Child health”[Title/Abstract] OR “child health care”[Title/Abstract] OR “Family Planning Service*”[Title/Abstract] OR “Prenatal Care”[Title/Abstract] OR “pregnancy”[Title/Abstract] OR “perinatal care”[Title/Abstract] OR “Obstetric Delivery”[Title/Abstract] OR “Infant care”[Title/Abstract] OR “Postnatal Care”[Title/Abstract] OR “Maternal-Child Health”[Title/Abstract] OR “obstetric care”[Title/Abstract] OR “Delivery care”[Title/Abstract] OR “Newborn care”[Title/Abstract] OR “Women’s health”[Title/Abstract] OR “Women’s Health Service*”[Title/Abstract] OR “Infant health”[Title/Abstract] OR “Neonatal care”[Title/Abstract] OR “ neonatal health”[Title/Abstract] OR “Family planning”[Title/Abstract] OR “Antenatal care”[Title/Abstract] OR “Facility delivery”[Title/Abstract] OR “Skilled birth attendance”[Title/Abstract] OR “skilled attendance at birth”[Title/Abstract] OR “skilled attendance”[Title/Abstract] OR “Institutional delivery”[Title/Abstract] OR “Institutional deliveries”[Title/Abstract] OR “Postpartum care”[Title/Abstract] OR “Newborn health”[Title/Abstract] OR “maternal and neonatal health”[Title/Abstract] OR “Maternal and newborn health*”[Title/Abstract] OR “maternal and child health*”[Title/Abstract] OR “reproductive health service*”[Title/Abstract] OR “reproductive health”[Title/Abstract] OR “MCHN”[Title/Abstract] OR “MCH”[Title/Abstract])
#4	Search: #1 OR #2
#5	Search: #3 AND #4

Web of Science Search

#1	"Maternal and child health service*" OR "maternal & child health services" OR "Maternal-Child Health Service*" OR "Maternal Health Service*" OR "Maternal Health" OR "Child Health Service*" OR "Child health" OR "child health care" OR "Family Planning Service*" OR "Prenatal Care" OR "pregnancy" OR "perinatal care" OR "Obstetric Delivery" OR "Infant care" OR "Postnatal Care" OR "Maternal-Child Health" OR "obstetric care" OR "Delivery care" OR "Newborn care" OR "Women's health" OR "Women's Health Service*" OR "Infant health" OR "Neonatal care " OR " neonatal health" OR "Family planning" OR "Antenatal care" OR "Facility delivery" OR "Skilled birth attendance" OR "skilled attendance at birth" OR "skilled attendance" OR "Institutional delivery" OR "Institutional deliveries" OR "Postpartum care" OR "Newborn health" OR "maternal and neonatal health" OR "Maternal and newborn health*" OR "maternal and child health*" OR "reproductive health service*" OR "reproductive health" OR "MCHN" OR "MCH" (Topic)
#2	"user fee" OR "user fees" OR "user-fee" OR "user-fees" OR "user charge" OR "user charges" OR "direct payment" OR "direct payments" OR "free healthcare" OR "charges and fees" (Topic)
#3	Search: #1 AND #2

We obtained 933 articles from PubMed (596) and Web of Science (337). After removing duplicates (233), 700 articles were left for screening. Of the 700 articles screened, we excluded 525 because they did not cover user fee interventions, 2 were not in English, and 9 were not actual research studies. We excluded 536 articles, leaving 164 articles for retrieval. All 164 articles were retrieved for eligibility. At eligibility, upon reviewing the full text, 29 articles were excluded because they did not use a randomized-controlled trial or a quasi-experimental design. 38 articles were further excluded because the interventions did not provide free healthcare or abolish user fees. 63 articles were excluded because they did not measure at least one of the outcomes of interest (antenatal care, skilled birth attendance, facility-based delivery, caesarean section, postnatal care, mortality or equity). 20 studies that implemented multiple parallel interventions alongside user fee removal were excluded to ensure clear attribution of observed effects to the fee removal policy. These exclusions (totaling 150) resulted in 14 included quasi-experimental studies for data synthesis and analysis. The PRISMA flow diagram for this process is presented in Figure 1.

Inclusion/Exclusion Criteria

We applied a series of inclusion and exclusion criteria during the screening and eligibility stages.

Articles were included if:

1. They were peer-reviewed.
2. Written in English.
3. Used randomized-controlled trial or quasi-experimental designs.
4. Assessed effects of healthcare interventions that provide free healthcare or eliminate user fees at the point-of -care for maternal and child healthcare services.
5. They include at least one quantitative measure related to maternal and child healthcare service access and utilization, health outcomes, or equity.

Articles were excluded if:

1. They involved women and children using other healthcare services other than maternal healthcare services.
2. They focused on policies introducing, increasing, reducing user fees, or examining reduced or subsidized insurance, vouchers, or financial incentives.
3. User fee removal bundled with other major intervention components.

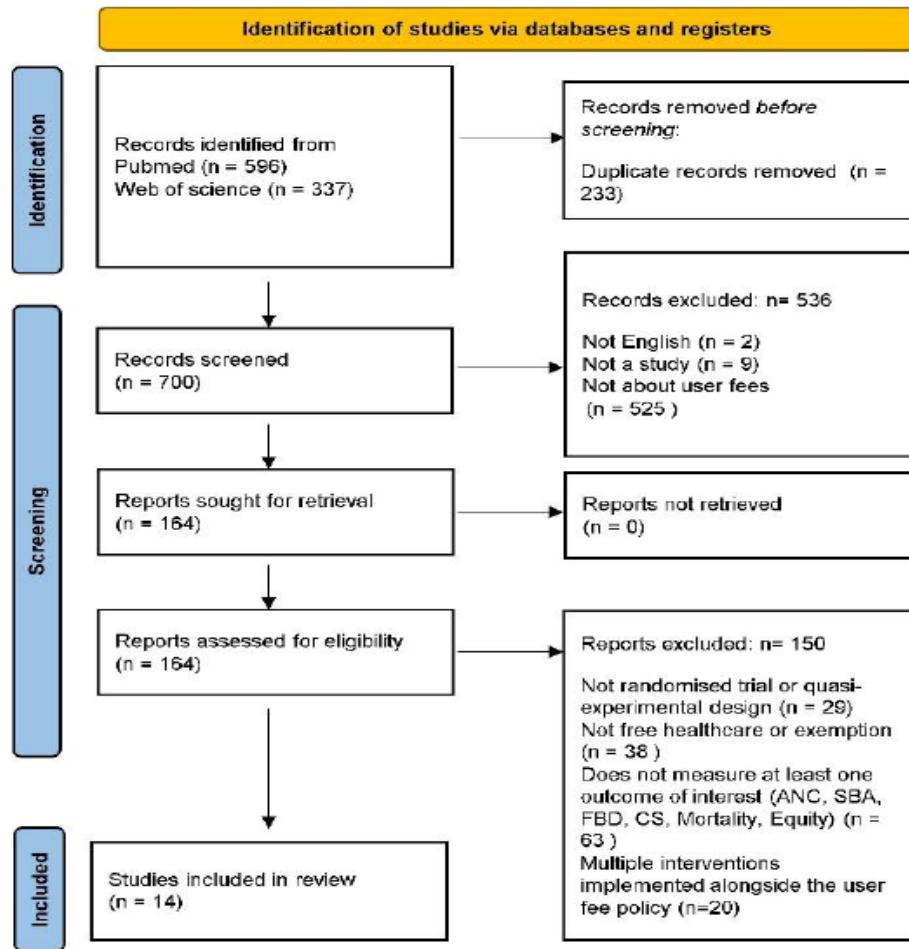


Figure 1. PRISMA Flow Diagram

Scope and Key Definitions

According to [13], user fees refer to direct payments made at the point of care when there is no prepayment or risk pooling. These fees encompass charges for consultations, medications, diagnostics, and other out-of-pocket expenses. Any policy that modifies these charges, whether by introducing, removing, or adjusting them, represents a change in the user fee regime. This review examines the removal of user fees and its effects on maternal and child health (MCH) service utilization and outcomes, with the objective of removing financial barriers for vulnerable groups. The terms “free healthcare,” “user fee removal,” and “user fee exemption” are used interchangeably to describe interventions that eliminate point-of-service payments.

Conceptual Framework

A conceptual framework was developed to examine how removing user fees through financing reforms influences maternal and child health in low- and middle-income countries (LMICs). This framework integrates established models of access, quality, and system performance, including Andersen’s behavioral model, Donabedian’s structure–process–outcome model, the WHO health system building blocks framework, Tanahashi’s effective coverage cascade, and the Three Delays model [8-10, 17, 18]. Together, these models capture both demand- and supply-side determinants and the quality of care.

Figure 2 presents the hypothesized sequence: removing user fees reduces financial barriers, thereby increasing utilisation. This increased utilisation affects two system components:

quality and capacity (processes, provider competence, workload), and referral and readiness (staffing, supplies, infrastructure). These components then mediate effects on health outcomes and equity. Solid arrows represent direct causal links between these steps, while dashed arrows show feedback loops, illustrating how perceived quality and referral effectiveness can influence future utilisation.

This framework addresses existing gaps by explicitly linking financing reforms, system readiness, and equity. Andersen's model helps explain determinants of utilisation.

Donabedian's model supports the mediation of structural and process factors. The WHO framework provides an operational definition of readiness. Tanahashi's and the Three Delays models identify bottlenecks beyond financial access. Evidence shows that fee removal increases service contact. However, it may strain system capacity and cause crowding and variable quality if structural investments do not keep pace [19]. This synthesis thus enables identification of bottlenecks in access, quality, and readiness for maternal health financing reforms in LMICs.

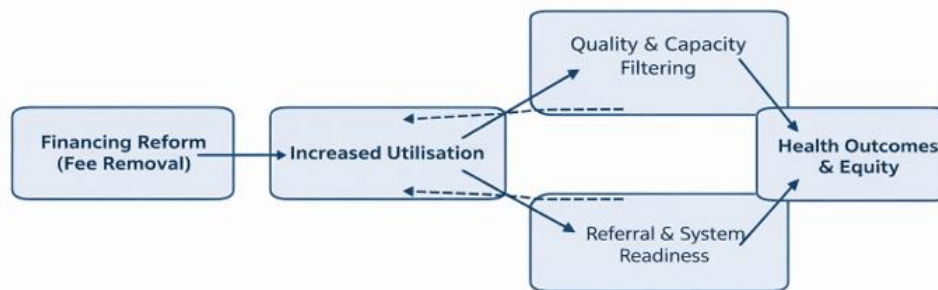


Figure 2. Conceptual Pathway Linking Fee Removal to Utilisation, Quality/System Readiness and Outcomes

Data Extraction and Synthesis

Data extraction followed a set pathway. Findings were mapped to four stages: financial protection (out-of-pocket cost protection), utilisation (healthcare use), quality or capacity (care standards or resources), and health outcomes (patient results). We extracted information on policy design, setting, population, study details, outcomes, and main findings. We noted modifiers such as distance (proximity to services), socio-economic status (income, education, occupation), and implementation fidelity (policy implementation level). Mechanisms were coded and summarized in an evidence map. Effect sizes with 95% confidence intervals or p-values were reported when available.

Results were synthesized narratively by intervention type and outcome. A meta-analysis was not conducted due to heterogeneity in definitions, follow-up periods, policy durations,

and study designs. Pooling could obscure context-specific insights. Narrative synthesis preserves interpretive depth. Future research should standardize outcome measures and use cluster-randomized trials that combine fee removal with quality interventions.

Risk of Bias Assessment (ROBINS-I)

We assessed risk of bias using the ROBINS-I tool [20]. We evaluated each study across seven domains: confounding, participant selection, intervention classification, deviations from intended interventions, missing data, outcome measurement, and selective reporting. We then compiled domain-level judgments for all 14 studies (Table 6) and used these assessments to inform the weighting of interpretations in the synthesis (see Results/Discussion).

For each difference-in-differences (DiD) study, we extracted whether the authors formally tested the parallel trends assumption,

such as through event studies with pre-treatment leads, joint F or Wald tests, or placebo/falsification timing tests, and whether pre-trends were satisfied. These diagnostics are summarized in Table 7.

During the narrative synthesis, we assigned greater weight to findings from studies assessed as having a moderate risk of bias, such as DiD studies with pre-trend tests and robustness checks, compared to those from studies with a serious risk of bias, such as single-group interrupted time series (ITS) exposed to time-varying confounding or co-interventions. This weighting is explicitly indicated in the Results, and conclusions are qualified accordingly.

Results

Study Characteristics

All 14 included quasi-experimental studies (7 Interrupted Time Series (ITS), 7 Difference-in-Differences (DiD)) were conducted in low- and middle-income countries (LMICs). Over half took place in Sub-Saharan Africa: Kenya (n=5), Zambia (n=4), and Ghana (n=2). Most studies evaluated national or subnational user-

fee removal policies for maternal and child health. Some focused on phased rollouts or sequential reforms. Data sources included routine Health Management Information Systems (HMIS), facility registers, and Demographic and Health Surveys (DHS/GDHS). ITS studies used monthly or quarterly facility data. DiD analyses relied on repeated household survey waves. Study populations included national samples of women aged 15–49 years and users of public health facilities. Several studies disaggregated results by socioeconomic or geographic subgroups. The primary outcomes assessed were service utilization measures, such as facility deliveries, antenatal care, skilled birth attendance, and postnatal care, while a smaller number of studies evaluated neonatal, infant, or maternal mortality. ITS studies applied segmented regression models, adjusting for autocorrelation and, in some cases, seasonality or control series. In contrast, DiD studies used fixed-effects or event-study models, though reporting of parallel-trends tests was inconsistent. Comprehensive details of the study characteristics appear in Table 1.

Table 1. Study Characteristics

Study (Author, Year)	Country	Design	Data source	Outcomes
Gitobu et al., (2018)	Kenya	ITS	Facility maternity & death registers	Facility-based delivery, Maternal Mortality and Neonatal Mortality
Aye et al., (2024)	Burkina Faso	ITS	HMIS + MoH annual statistical reports	Facility-based delivery
Lang'at et al., (2019)	Kenya	ITS	MoH registers (333) + DHIS2	Antenatal care, Skilled-birth attendance, Caesarean section and Stillbirth
Chitalu & Steven (2017)	Zambia	ITS	HMIS; Health Facility Census	Facility-based delivery
Orangi et al., (2021)	Kenya	ITS	Kenya HIS	Antenatal care, Facility-based delivery, Postnatal care
Demissie et al., (2020)	Ethiopia	ITS	District HIS + facility logbooks	Facility-based delivery

Owuor & Amolo (2019)	Kenya	ITS	DHIS-2 verified with facility data	Antenatal care, Skilled-birth attendance, Caesarean section, Maternal Mortality, Neonatal Mortality
McKinnon et al., (2015)	Ghana, Senegal, Sierra Leone	DiD	DHS birth histories	Facility-based delivery and Equity
Chama-Chiliba & Koch (2016)	Zambia	DiD	ZDHS 2007; Health Facility Census 2005; HMIS	Facility-based delivery
Lagarde et al., (2022)	Zambia	DiD	DHS; 2005 Health Facility Census (proximity/quality)	Facility-based delivery, Skilled-birth attendance, Caesarean section and Neonatal Mortality
Manthalu et al., (2016)	Malawi	DiD	HMIS facility annual data (MoH/CHAM)	Antenatal care, Facility-based delivery and Postnatal care
Bigool (2024)	Ghana	DiD	GDHS 2003, 2008, 2014	Antenatal care, Facility-based delivery and Skilled-birth attendance
Renard (2022)	Zambia	DiD	Zambia DHS; 2005 Health Facility Census	Facility-based delivery, Skilled-birth attendance, Postnatal care, Neonatal Mortality, Stillbirth, Infant Mortality and Equity
Oyugi et al., (2024)	Kenya	DiD	Kenya DHS 2014 (birth recode)	Facility-based delivery, Skilled-birth attendance, Caesarean section and Neonatal Mortality

Effects of User Fee Removal on Access and Utilisation of Antenatal Care (ANC) Services

Five studies evaluated the impact of removing user fees on ANC attendance. Three studies used interrupted time-series analysis, and two used difference-in-differences methods. The effects of user fee removal on ANC were heterogeneous, varying across countries, policy designs, and specific ANC indicators. Detailed results of the individual studies are presented in Table 2.

Three studies reported significant increases in ANC utilization following the removal of user fees. In Ghana, a doubly robust DiD study

by [21] found a 6.9–7.7 percentage-point increase in the probability of at least one ANC visit after the expansion of free maternal healthcare, with pre-policy dynamics near zero, supporting credible causal inference. In Malawi, user fee exemption under mission-facility Service Level Agreements (SLAs) resulted in substantial gains: the proportion of women with at least one ANC visit increased by approximately 15%, and the average number of ANC visits rose by about 12%, although early ANC initiation did not change significantly [22]. County-level evidence from Kenya [23] also demonstrated strong positive effects: the introduction of free maternity care in three counties led to a large and sustained increase in

ANC utilization, with post-policy slopes rising by 44.6 ANC visits per month ($p < 0.001$).

In contrast, national-level ITS analyses of Kenya's 2013 free maternity policy and its 2017 Linda Mama revision showed no significant effects on ANC. In public facilities, neither the level nor the trend of ANC visits reached statistical significance. For example, IRR 1.031, $p = 0.359$ for the 2013 policy; IRR 1.223, $p = 0.246$ for the 2017 policy. In private and faith-based facilities, ANC visits decreased significantly immediately after the 2013 policy

(IRR = 0.850, $p = 0.038$). This was expected, as the reform initially applied only to the public sector. The Linda Mama revision produced no measurable effect on ANC in either sector [24]. Sub-national evidence from Nyamira County found no significant immediate policy effect on ANC4. Although ANC4 showed a strong pre-policy upward trend (+10.7 per month), post-policy trajectories remained positive. However, they did not show statistically significant changes in level during the first 18 months [25].

Table 2. Direction of Effects of User Fee Removal on Utilisation of ANC Services

Study (Year)	Country	Design	ANC measure	Direction of effect
Bigool (2024)	Ghana	DiD	≥ 1 ANC	↑ sig +6.9–7.7 pp (SE 0.028–0.030)
Lang'at et al. (2019)	Kenya	ITS	≥ 1 ANC	↑ sig (trend) +44.64/month; 95% CI 20.41–68.81; $p < 0.001$
Manthalu et al. (2016)	Malawi	DiD	≥ 1 ANC	↑ sig + 15% ($p < 0.01$)
Manthalu et al. (2016)	Malawi	DiD	Average ANC visits	↑ sig +12% ($p < 0.05$)
Manthalu et al. (2016)	Malawi	DiD	Early ANC (1st trimester)	→ n.s.
Orangi et al. (2021)	Kenya	ITS	ANC visits	→ n.s. Level IRR 1.031 (0.966–1.101), $p = 0.359$; trend IRR 1.003 (0.995–1.012), $p = 0.415$
Orangi et al. (2021)	Kenya	ITS	ANC visits	↓ sig (level) Level IRR 0.850 (0.729–0.991), $p = 0.038$; trend n.s.
Orangi et al. (2021)	Kenya	ITS	ANC visits	→ n.s. Level IRR 1.223 (0.871–1.718), $p = 0.246$; trend IRR 1.002 (0.992–1.012), $p = 0.714$
Orangi et al. (2021)	Kenya	ITS	ANC visits	→ n.s. Level IRR 0.831 (0.374–1.848), $p = 0.650$; trend IRR 1.006 (0.983–1.029), $p = 0.626$
Owuor & Amolo (2019)	Kenya	ITS	ANC4	→ n.s. Immediate step: –1.233 ($p = 0.801$); month-specific levels 1–18 all n.s.; pre-trend +10.72/month; post-trend +8.49/month

Key: ↑ -increase ↓ - decrease → -no change sig-significant n.s. - no significant change PP- Percentage Points

Effects of User Fee Removal on Facility-Based Delivery (FBD)

Twelve studies from low- and middle-income countries examined facility-based delivery. Five studies used interrupted time

series analysis. Seven studies employed difference-in-differences methods (Table 3). User fee removal was consistently associated with increased facility-based delivery, but the magnitude, persistence, and nature of these

effects varied by geographic access, facility readiness, and the fidelity of policy implementation. Some settings saw immediate, strong effects, while others reported more moderate or variable changes.

These findings are reflected in several ITS analyses from Kenya and Ethiopia, which showed immediate increases. For instance, Kenya's national ITS found that the 2013 free maternity policy increased public-facility deliveries by 19.6% (IRR 1.196, $p < 0.001$) [24]. County-level ITS studies reported increases of 44-47 deliveries per month across three counties following policy implementation [23]. In Ethiopia, free delivery services led to an immediate monthly increase of 56.8 deliveries, with sustained positive trends [26].

Findings from DiD analyses also indicated strong positive effects. In Zambia, a staggered DiD event study identified an overall 13.9 percentage-point increase in institutional deliveries, although the effect decreased with greater distance and lower facility quality [27]. In Malawi, the mission-facility service-level agreement exemption policy led to an 11-15% increase in facility-based deliveries [22].

In contrast, effects were more limited where barriers remained. For example, Burkina Faso's 2016 *Gratuité* policy, evaluated through controlled ITS, did not result in significant changes in facility-based delivery. Possible reasons included prior subsidy saturation, insecurity, and reimbursement constraints [28].

Effects of User Fee Removal on Skilled Birth Attendance

Six studies in five countries examined how removing user fees affected skilled birth attendance. Four studies used difference-in-differences analysis. Two others used interrupted time series methods (Table 3). User fee removal policies increased skilled birth attendance in most contexts; however, the size and speed of these effects depended on local characteristics such as baseline access, facility quality, and population need. Some settings saw

immediate increases, while others experienced more gradual changes or muted effects.

Difference-in-differences analyses demonstrated substantial gains. In Zambia, removing delivery fees increased skilled birth attendance by 12 percentage points in rural districts and 8 percentage points in peri-urban districts ($p < 0.05$). These effects became evident from 2 to 3 years post-reform, particularly among the poorest populations and in areas with higher facility quality [27]. In Ghana, a doubly robust DiD estimated unconditional and dynamic increases in SBA of 4.6 and 4.5 percentage points, respectively, with these gains observed following the national maternal-care exemption; the timing of the emergence of effects was not explicitly stated. Conditional estimates were smaller and not statistically significant, indicating heterogeneity attributable to covariate adjustment [21]. In Kenya, a within-mother DiD using Kenya Demographic and Health Survey (KDHS) data found a 17-percentage-point increase in SBA following the 2013 free maternity policy, indicating a prompt individual-level behavioural response [29].

ITS studies also found substantial effects on skilled birth attendance. In Kenya, mean monthly SBA levels nearly doubled, rising by 47.3 cases per month after policy implementation. Improvements were sustained over 25 months [23]. In Nyamira County, the policy led to an immediate increase of 257 SBA cases per month, which persisted for 12 to 18 months and was stronger in hospitals than in primary facilities [25].

Effects of User Fee Removal on Caesarean Section Rates

Four studies examined the effects of removing user fees on caesarean section rates. Two studies used difference-in-differences, and two used interrupted time-series designs (Table 3). The main finding was that removing user fees did not consistently increase caesarean

section (CS) rates. In cases where there was an increase, the effect was not significant.

In Zambia, a long-term DiD analysis found no significant change in caesarean section rates after fee removal in rural and peri-urban areas (about +0.01 percentage points; $p>0.45$). Confidence intervals crossed zero, indicating insufficient power to detect small changes [27].

Similarly, in Kenya, county-level ITS analyses found no significant increases in caesarean section rates after policy implementation. In three counties, the Free Maternity Services policy was associated with a non-significant immediate change in level (−1.12 percentage points, 95% CI −3.94 to 1.68) and a small, non-significant upward trend (+0.14 per month) (Lang’at et al., 2019). Additionally, a within-mother DiD analysis using Kenya Demographic and Health Survey (KDHS) data identified no measurable change in caesarean section probabilities after the 2013 free maternity policy (−1.7 to −2.1 percentage points; both non-significant) [29].

An exception was observed in Nyamira County, where an ITS analysis at the county referral hospital revealed an immediate increase of 12.33 caesarean sections per month (95% CI 0.4 to 24.3; $p=0.043$). This effect lasted up to nine months and was limited to the hospital setting rather than primary care facilities [25].

Effects of User Fee Removal on Postnatal Care

Four studies examined the impact of user fee removal on postnatal care (PNC): three used difference-in-differences methods, and one used an interrupted time-series analysis (Table

3). The effects of user fee removal on PNC outcomes varied by country, sector, and policy design, with some studies reporting positive changes and others finding no significant impact.

In Malawi, removal of fees through mission-facility SLAs did not lead to a significant change in PNC use. The estimated effect was small (about +0.4%) and not statistically significant in both primary and secondary comparison groups. However, other maternal services, such as antenatal care and facility-based deliveries, did improve [22].

In Kenya, a national interrupted time-series analysis showed immediate and long-term effects. After the 2013 free maternity policy, public facilities had a 14.4% drop in PNC visits (IRR 0.856; 95% CI 0.792–0.926; $p<0.001$). There was a significant upward trend in monthly returns afterwards (+1.6% per month; IRR 1.016; $p=0.002$). The 2017 Linda Mama program led to an even bigger immediate decrease (−38.1%; IRR 0.619). This was also followed by a positive post-intervention trend (+2.3% per month). Private and faith-based facilities showed no significant changes. These findings match partial program coverage and reimbursement delays [24].

In Zambia, the difference-in-differences analysis showed a significant 7.8 percentage-point increase in early PNC checks (within 24 hours) in rural districts. Effects were non-significant in peri-urban areas and decreased with greater distance and lower facility quality. Observed increases were smaller than those for facility-based delivery, indicating supply-side constraints [30].

Table 3. Direction of Effects of User Fee Removal on MCH Utilization

Study (Year)	Country	Design	Facility-based delivery	Skilled birth attendant	Caesarean section	Postnatal care
Gitobu et al., (2018)	Kenya	ITS	↑ sig +29.5% (234,601→303,705) $p<0.001$. Trend change: ↑ post-policy slope +124.9/quarter ($p<0.01$).	N/A	N/A	N/A

Aye et al., (2024)	Burkina Faso	ITS	→ n.s. Level change: ↓ n.s -2.1 post-policy (p= 0.628). Trend change: ↓ n.s -0.10 pp/month (p=0.740)	N/A	N/A	N/A
Lang'at et al., (2019)	Kenya	ITS	↑ sig Trend change: (+44– 47/month) p<0.001 Level change: +58.5 EmONC cases/month immediately (proxy for demand) overall +97% post-policy	↑ sig Level change: +253.05 at month 1 (95% CI -101.24, 607.35) Trend change: +47.31/month (95% CI 27.88–66.73, p<0.001)	→ n.s. Level change: n.s -1.12 (95% CI -3.94, 1.68) Trend change: n.s +0.14/month (95% CI -0.15, 0.42)	N/A
Chitalu & Steven (2017)	Zambia	ITS	↑ sig Level change: +1.2 post- policy (p<0.05) Trend change: n.s	N/A	N/A	N/A
Orangi et al., (2021)	Kenya	ITS	↑ sig Level change: +19.6% public facility deliveries (IRR 1.196, 95% CI 1.113–1.286), p<0.001.	N/A	↑ sig 2013 level for CS. ↓ sig (CS trend later)	Mixed: public level ↓ then trend ↑. Private/faith- based: no significant PNC effects Level change: 2013 policy public facilities: -14.4% IRR 0.856 (95% CI 0.792–0.926) p=0.000. 2017 Linda Mama - public facilities: -38.1% IRR 0.619 (0.412–0.929) p=0.021 Trend change: 2013 policy public facilities: +1.6%/month 1.016 (1.006– 1.026) p=0.002. 2017 Linda Mama public facilities: +2.3%/month IRR 1.023 (1.011– 1.035) p=0.000

Demissie et al., (2020)	Ethiopia	ITS	↑ sig Level change: +56.8 deliveries/month ($p<0.001$). Trend change: ↑ sig +1.698/month ($p=0.009$). 36–51% relative increase by year 3	N/A	N/A	N/A
Owuor & Amolo (2019)	Kenya	ITS	↑ sig Level change: +257.4 /month (SE 66.0), $p<0.001$; Hospitals +116/month (SE 38.0), $p=0.004$; PHCF +189/month (SE 52.3), $p=0.001$ Trend change: Significant through 12–18 months depending on facility type	↑ sig Level change: (Immediate)+257.4 /month (95% CI 123.6–391.3), $p<0.001$; significant to month 12; hospitals sustained to month 18 Trend change: Pre-slope +10.1/month; post-slope +8.2/month	↑ sig Level change: Immediate +12.33 CS/month (95% CI 0.4–24.3), $p=0.043$; significant to month 9 Trend change: +0.162 (n.s.)	N/A
McKinnon et al., (2015)	Ghana/Senegal/Sierra Leone	DiD	↑ sig +5–9 pp across SES/education. Poorest: +5.4 pp (95% CI 2.1–8.8); Richest: +6.8 pp (4.0–9.7); No education: +4.6 pp (2.2–7.0); ≥Secondary: +8.6 pp (5.4–11.9)	N/A	N/A	N/A
Chama-Chiliba & Koch (2016)	Zambia	DiD	→ n.s.(public) ↑ sig (private/FBO) Public FBD: DiD –0.337 (SE 0.247), n.s.; Private/FBO: +1.575 (SE 0.671), $p<0.01$	N/A	N/A	N/A
Lagarde et al., (2022)	Zambia	DiD	↑ sig +13.9 pp overall Public facility +10.8 pp (SE 0.034, $p<0.001$)	↑ sig +12 pp (rural, 95% CI 0.07–0.16, $p<0.0001$); +8 pp (peri-urban, 0.02–0.14, $p=0.012$)	→ n.s. Rural: +0.01 pp (95% CI –0.02, 0.04, $p=0.457$); Peri-urban: +0.01 pp (95% CI –0.02, 0.04, $p=0.570$)	↑ sig +7.8 pp rural)
Manthalu et al., (2016)	Malawi	DiD	↑ sig +11% (95% CI 1–21%, $p<0.05$) vs primary control. +15% (4–26%, $p<0.01$) vs secondary control	N/A	N/A	→ n.s. No effect ($\approx$ +0.4% in log model); alternative control also n.s. SE $\approx$ 0.094 (primary); SE $\approx$ 0.099 (secondary)

Bigool (2024)	Ghana	DiD	↑ sig +10.8 pp uncond; cond n.s. +10.8 pp (unconditional); +4.8 pp (conditional, n.s.); dynamic +10.3 pp (uncond)	↑ sig Group average +4.6 pp (unconditional, p<0.05); Dynamic +4.5 pp (p<0.01); Conditional +2.9 pp (n.s.) SE ≈ 0.017–0.019	N/A	N/A
Renard, (2022)	Zambia	DiD	N/A	↑ sig +11.4 pp overall (SE 0.023, p<0.01). Phase 2 +10.4 pp (SE 0.043, p<0.05)	N/A	↑ sig (rural), mixed elsewhere +7.8 pp increase in rural districts (significant); similar magnitude in rural areas of urban districts (n.s.)
Oyugi et al., (2024)	Kenya	DiD	N/A	↑ sig +17 pp FE model, p<0.01	↓ n.s. -1.7 pp (SE 0.022) with firstborns; -2.1 pp (SE 0.030) without firstborns	N/A

Key: ↑ increase ↓ decrease → no change sig significant n.s. no significant change PP Percentage Points FBO
Faith-based organizations

Effects of User Fee Removal on Maternal Mortality

Two interrupted time-series studies assessed the impact of user-fee policies on maternal mortality. Positive effects were observed for antenatal care (ANC) visits and institutional deliveries from these studies. However, the evidence regarding maternal mortality was complex and, in some settings, counterintuitive (Table 4).

In Kenya, a large interrupted time series study across 77 public facilities reported a slight decrease in the institutional maternal mortality ratio (iMMR) from 258.3 to 237.1 per 100,000; however, this change was not statistically significant (p=0.07). Notably, stratified analyses revealed a significant decline only in rural facilities. In contrast, overall trends indicated an increase in post-policy mortality slopes (pre-trend: -1.64; post-trend: +3.49, p=0.01), which may reflect increased

caseloads and ongoing quality-of-care limitations [31].

A county-level ITS in Nyamira County, Kenya, demonstrated a more concerning trend. Specifically, the institutional maternal mortality ratio increased significantly at several post-policy time points: +301 per 100,000 at month 9 (95% CI 3–599, p=0.048), +382 at month 12 (p=0.029), and +545 at month 18 (p=0.020). Previously, pre-intervention trends showed declining mortality (-16.8/month, p=0.013), whereas post-policy slopes increased (+10.3/month) [25].

Effects of User Fee Removal on Neonatal Mortality

Four studies examined the effects of user-fee removal on newborn deaths. Of these, two used interrupted time series, while the other two used difference-in-differences. However, results show that fee removal did not reliably lower newborn deaths, as most studies reported little or no impact (Table 4).

In Kenya, two ITS studies evaluated the 2013 free maternal health policy. The first, a multi-facility ITS study, found no significant drop in neonatal deaths at health facilities, with rates moving slightly from 23.3 to 22.9 per 1,000 births ($\Delta = -0.4$; $p = 0.14$). Immediate and trend changes were not statistically significant (post-trend $p = 0.10$) (Gitobu et al., 2018). At the county level in Nyamira, the second ITS found similarly small, non-significant changes (-2.33 to -4.11 per 1,000) and no trend, even though service use increased markedly [25].

Turning to Zambia, results from two DID analyses were similar to those in Kenya. A national DHS-based DID found no average policy effect in rural or peri-urban districts, as the confidence intervals included zero. An extended event-study showed reductions in neonatal mortality only among households near higher-quality facilities, with no effect nationwide [27, 30].

However, a notable exception to these findings occurred in Kenya. A within-mother difference-in-differences analysis identified significant declines in early neonatal mortality (approximately 16.5–20.6%) and overall neonatal mortality (approximately 19–20%) following the 2013 free maternity policy ($p < 0.01$). This reduction corresponds to an estimated 4,015 neonatal deaths averted nationally [29].

Effects of User Fee Removal on Stillbirth

Two studies evaluated the effects on stillbirth (SB) using interrupted time-series and difference-in-differences analyses. User-fee removal policies did not result in significant reductions in stillbirth, and the overall evidence indicates null effects (Table 4).

In Kenya, an interrupted time-series (ITS) analysis of 90 public facilities following the June 2013 Free Maternity Services policy found no statistically significant change in stillbirth rates. The immediate level change was -2.55 per 1,000 births (95% CI: -9.87 to 4.77 ;

$p > 0.05$), and the post-policy trend remained stable ($\beta_3 = +0.08$; 95% CI: -0.45 to 0.61), despite improvements in antenatal care (ANC; care before birth), skilled birth attendance (SBA; presence of trained health professionals), and emergency obstetric and newborn care (EmONC). To provide additional context, although stillbirth rates were declining slightly prior to the policy ($\beta_1 = -0.38$; $p = 0.05$), the intervention did not accelerate this decline or alter slope trajectories [23].

Similarly, in Zambia, a large difference-in-differences analysis leveraging staggered fee removal across rural and peri-urban districts found no significant effect on stillbirth risk. Estimates derived from the Demographic and Health Survey (DHS) reproductive calendar histories indicated probability changes centered on zero, with confidence intervals that included the null. The authors explicitly reported stillbirth effects as non-significant, despite observed increases in facility utilization and other maternal health indicators [30].

Effects of User Fee Removal on Infant Mortality

Only one study employing a difference-in-differences approach assessed the effects of removing user fees on infant mortality. The findings from this study indicate that user fee removal reduces infant mortality, though average population-level effects were generally negligible (Table 4).

Turning to specific country evidence, in Zambia, a large difference-in-differences analysis [30], which leveraged staggered fee removal across rural, peri-urban, and subsequently urban districts, found no significant change in the risk of death before age one. The estimated absolute risk difference was $+0.004$ (SE 0.008; $p > 0.10$), indicating no measurable effect at either the national or district level, despite documented improvements in maternal service utilization. Furthermore, the study reported declines in newborn mortality were observed only among

households near higher-quality facilities, highlighting the importance of supply-side readiness and geographic accessibility in translating increased utilization into improved survival outcomes.

Effects of User Fee Removal on Equity

Three studies using difference-in-differences designs evaluated the effects of user-fee removal policies on equity. The evidence shows these policies consistently increased maternal health service utilization across socioeconomic groups. However, they did not consistently reduce either socioeconomic or geographic inequities. In many cases, reforms led to absolute gains for all groups, but relative disparities remained unchanged or widened (Table 4).

A multi-country analysis (Ghana, Senegal, Sierra Leone) [32] found that removing delivery fees increased facility-based delivery

by +5.4 percentage points among the poorest and +6.8 percentage points among the richest, with no significant wealth-based heterogeneity ($p=0.53$). However, there were significantly larger gains among higher-educated women (+8.6 percentage points vs +4.6 percentage points; $p=0.04$), suggesting potential education-based widening of inequality.

In Zambia, difference-in-differences analyses with event-study designs showed that utilization gains, such as a 13.9 percentage-point increase in institutional deliveries and an 11.4 percentage-point increase in skilled birth attendance, were largest for households near higher-quality facilities. In contrast, households in distant or low-quality areas benefited less. Reductions in mortality appeared only near well-equipped facilities. This highlights that geographic inequities are mainly due to service readiness rather than user fees alone [30].

Table 4. Direction of Effects of User Fee Removal on Maternal and Child Health Outcomes

Study (Year)	Country	Design	Maternal mortality	Neonatal mortality	Stillbirth	Infant mortality	Equity
Gitobu et al., (2018)	Kenya	ITS	All facilities: → n.s. MMR fell from 258.3 to 237.1 per 100,000 ($\Delta -21.2$). Pre-policy trend: -1.64 ($p=0.20$); post-policy trend: $+3.49$ ($p=0.01$). Overall $p=0.07$ for pre-post difference in MMR levels Rural facilities: ↓ sig ($p=0.02$) Level change: quarterly slopes show ↑ post-policy (3.49 , $p=0.01$)	→ n.s. 23.3→22.9 per 1,000 ($\Delta -0.4$), $p=0.14$ Level change: No significant Trend change: Pre-trend -0.09 ($p=0.24$); post-trend $+0.12$ ($p=0.10$)	N/A	N/A	N/A
Owuor & Amolo (2019)	Kenya	ITS	↑ sig Overall iMMR 9–18 month County: significant ↑ in iMMR at months 12 & 18 ($p<0.05$); CRH: level increases—e.g., +301 per 100,000 at month 9 (95% CI 3–599, $p=0.048$), +382 at month 12 ($p=0.029$), +545 at month 18 ($p=0.020$)	→ n.s. level effects -2.33 to -4.11 , ($p>0.33$) Pre-trend $+0.08$ ($p=0.565$); Post-trend -0.025 (ns)	N/A	N/A	N/A
Lang'at et al., (2019)	Kenya	ITS	N/A	N/A	→ n.s. Level change	N/A	N/A

					−2.55 (95% CI −9.87, 4.77) (p>0.05) Trend change pre = −0.38 (p=0.05); β_3 post = +0.08 (ns)		
Lagarde et al., (2022)	Zambia	DiD	N/A	→ n.s. Average policy effect (β=0.00 in rural 95% CI −0.01 to 0.02 & peri-urban −0.02 to 0.02 Pvalue: n.s	N/A	N/A	Effects stronger nearer higher-quality facilities
Renard (2022)	Zambia	DiD	N/A	→ n.s. Average effect ↓ sig reductions only for households near qualified facilities	→ n.s. stillbirth risk	→ n.s. +0.004 (absolute risk difference) SE 0.008, (p>0.10)	Newborn mortality declined near qualified facilities. Effects fade with distance to facility.
Oyugi et al., (2024)	Kenya	DiD	N/A	↓ sig 19–20% p<0.01 Early neonatal ↓ 16.5–20.6% Neonatal ↓ 19.3–20.0% (significant).	N/A	N/A	N/A
McKinnon et al., (2015)	Ghana/Senegal/Sierra Leone	DiD	N/A	N/A	N/A	N/A	Mixed: absolute FBD ↑ across SES; rich-poor gap not reduced Absolute increases per 100 births: Wealth—poorest +5.4 (95% CI 2.1–8.8), richest +6.8 (4.0–9.7), heterogeneity p=0.53;

							Assets—0 assets +8.2 (5.1–11.4) vs 3+ assets +4.4 (0.5–8.2), p=0.11; Education— none +4.6 (2.2–7.0) vs secondary+ +8.6 (5.4– 11.9), p=0.04.

Key: ↑ increase ↓ decrease → no change sig significant n.s. no significant change PP Percentage Points FBO
Faith-based organizations

Table 5. Mechanism Evidence Map

Study (country, year)	Design	Utilisation effect	Mortality/other outcomes	Mechanism domains (1–6)	Interpretation
Aye et al., 2024 (Burkina Faso)	ITS	FBD: n.s.	Mortality: not assessed	1,2,6	FBD saturated due to prior subsidy.
Bigool, 2024 (Ghana)	DiD	ANC ≥1: +6.9pp; FBD: +10.8pp; SBA: +4.6pp	Stunting: –12.3% (moderate ↓), severe n.s	2,5,6	Policy increased ANC quality/attendance; demand barriers moderated effects on severe stunting.
Chama-Chiliba & Koch, 2016 (Zambia)	DiD	No mean ↑ in public FBD; ↑ deliveries at faith-based	N/A	3,5,6	Cost shifting & indirect costs; redistribution to FBO; implementation & demand barriers.
Chitalu & Steven, 2017 (Zambia)	ITS	Immediate FBD +1.2pp; no sustained trend	N/A	1,6	Short-term response without capacity/funding to sustain.
Demissie et al., 2020 (Ethiopia)	ITS	FBD ↑ (44–51% by 2–3 years)	N/A	1,6,2	Gradual capacity/process improvements needed for sustained effect.
Gitobu et al., 2018 (Kenya)	ITS	FBD +29.5%	MMR ↓ n.s; NMR ↓ n.s	1,3,4	Volume ↑ without commensurate EmONC/referral capacity limited mortality impact.
Lang’at et al., 2019 (Kenya)	ITS	ANC, SBA, live births ↑; CS, stillbirth →	Stillbirth: →	2,3,6	Process/throughput gains not matched by advanced obstetric capacity.
Orangi et al., 2021 (Kenya)	ITS	2013 FMP: public deliveries +19.6%, CS +28.9%; 2017 LM mixed; PNC level ↓ then trend ↑	N/A	3,6,2	Policy transitions disrupted PNC; redistribution across sectors; incentive/contracting issues.

Owuor & Amolo, 2019 (Kenya)	ITS	SBA ↑ (long-term); CS ↑ (medium-term)	Institutional MMR ↑; NMR →	1,4,2	More severe cases reached hospitals; referral/critical-care constraints increased in-facility MMR.
Oyugi et al., 2024 (Kenya)	DiD	SBA ↑ 17pp; public facility birth ↑ 5.8pp	Early NMR ↓ 17–21%; NMR ↓ 19–20%	2	Suggests improved intrapartum/immediate neonatal care in some contexts.
Renard, 2022 (Zambia)	DiD	FBD +43%; SBA +36%	Infant mortality: avg —; death at birth ↓ near qualified facilities; stunting ↓ 8%	1,2,5	Benefits concentrated where proximity/capacity higher; equity by distance remains.
Lagarde et al., 2022 (Zambia)	DiD	Institutional/assisted delivery ↑ (10–15pp); CS N/A	Neonatal mortality →	1,2,5	Utilisation ↑, outcome static; capacity/quality constraints and distance gradients.
Manthalu et al., 2016 (Malawi)	DiD	ANC ≥1 +15%; avg ANC +12%; FBD +11%; early ANC/PNC N/A	N/A	2,5,6	Non-price barriers and continuity gaps constrained early ANC and PNC.
McKinnon et al., 2015 (Ghana, Senegal, Sierra Leone)	DiD	FBD ↑ across wealth/education; richest/educated gained more	Neonatal mortality →	5,1	Distributional improvements uneven; capacity/proximity advantages for better-off.

Key: ↑ increase ↓ decrease → no change sig-significant n.s. no significant change PP Percentage Points.

Mechanism domains: 1) Supply-side capacity readiness 2) Quality-of-care processes 3) Provider incentives/workload 4)

Referral system 5) Demand-side accessibility beyond fees 6) Implementation fidelity.

Mechanism Evidence Map

Study-level mechanisms were mapped against the conceptual pathway and summarized in Table 5.

Risk/ Quality Assessment

We found that the methodological quality of studies varied substantially. Four studies were judged to have an overall moderate risk of bias, primarily those employing difference-in-differences with strong diagnostics (parallel trends check, event-study plots and placebo tests). These studies typically adjusted for key confounders and used non-equivalent controls or fixed-effects models to mitigate bias. For example [21], in Ghana

leveraged rich covariate sets and municipal or regional fixed effects.

Conversely, 10 studies were rated as having a serious risk of bias, largely due to design limitations and contextual challenges. Studies relying on uncontrolled interrupted time series were particularly vulnerable to residual confounding and concurrent policy changes. In fragile settings such as Burkina Faso, deviations from intended interventions were common, driven by health system shocks including strikes, insecurity, and COVID-19 disruptions. These factors contributed to elevated risk in studies like [28]. Table 6 below presents the full details of the Risk of bias assessment.

Table 6. ROBINS-I Summary Judgements

Study	Design	Confounding	Selection of participants	Classification of interventions	Deviations from intended interventions	Missing data	Measurement of outcomes	Selection of reported result	Overall ROBINS-I	Key notes
Aye et al., 2024 (Burkina Faso)	ITS	Serious	Low	Low	Low	Moderate	Moderate	Moderate	Serious	ITS: potential history/co-intervention bias; seasonality/auto-correlation often addressed but residual confounding likely.
Bigool, 2024 (Ghana)	DiD	Moderate	Low	Low	Low	Low	Moderate	Moderate	Moderate	Augmented DiD / FE improves control for time-invariant confounding; still subject to time-varying unmeasured confounding.
Chama-Chiliba & Koch, 2016 (Zambia)	DiD	Moderate	Low	Low	Low	Low	Moderate	Moderate	Moderate	DiD: assumes parallel trends; some studies test/event-study; residual confounding possible. No mortality outcomes in study.
Chitalu & Steven, 2017 (Zambia)	ITS	Serious	Low	Low	Low	Moderate	Moderate	Moderate	Serious	ITS: potential history/co-intervention bias; seasonality/auto-correlation often addressed but residual confounding likely. No mortality outcomes in study.
Demissie et al., 2020 (Ethiopia)	ITS	Serious	Low	Low	Low	Moderate	Moderate	Moderate	Serious	ITS: potential history/co-intervention bias;

										seasonality/auto-correlation often addressed but residual confounding likely. No mortality outcomes in study.
Gitobu et al., 2018 (Kenya)	ITS	Serious	Moderate	Low	Low	Moderate	Low	Low	Serious	ITS : potential history/co-intervention bias; seasonality/auto-correlation often addressed but residual confounding likely. Single-county hospital; selection & data completeness concerns. Mortality measurement may be underpowered/subject to misclassification.
Lang'at et al., 2019 (Kenya)	ITS	Serious	Low	Low	Low	Moderate	Low	Low	Serious	ITS : potential history/co-intervention bias; seasonality/auto-correlation often addressed but residual confounding likely.
Orangi et al., 2021 (Kenya)	ITS	Serious	Low	Low	Low	Moderate	Low	Moderate	Serious	ITS : potential history/co-intervention bias; seasonality/auto-correlation often addressed but residual confounding likely. No mortality outcomes in study.

Owuor & Amolo, 2019 (Kenya)	ITS	Serious	Moderate	Low	Low	Low	Low	Serious	Moderate	Serious	Moderate	ITS: potential history/co-intervention bias; seasonality/auto-correlation often addressed but residual confounding likely. Single-county hospital; selection & data completeness concerns. Mortality measurement may be underpowered/subject to misclassification.
Oyugi et al., 2024 (Kenya)	DiD	Moderate	Low	Low	Low	Low	Low	Moderate	Moderate	Moderate	Moderate	Augmented DiD / FE improves control for time-invariant confounding; still subject to time-varying unmeasured confounding.
Renard, 2022 (Zambia)	DiD	Moderate	Low	Low	Low	Low	Low	Serious	Moderate	Serious	Moderate	DiD: assumes parallel trends; some studies test/event-study; residual confounding possible. Mortality measurement may be underpowered/subject to misclassification.
Lagarde et al., 2022 (Zambia)	DiD	Moderate	Low	Low	Low	Low	Low	Serious	Moderate	Serious	Moderate	DiD: assumes parallel trends; some studies test/event-study; residual confounding possible. Mortality measurement

											may be underpowered/subject to misclassification.
Manthalu et al., 2016 (Malawi)	DiD	Moderate	Low	Low	Low	Low	Low	Moderate	Moderate	Moderate	DiD: assumes parallel trends; some studies test/event-study; residual confounding possible. No mortality outcomes in study.
McKinnon et al., 2015 (Ghana, Senegal, Sierra Leone)	DiD	Moderate	Low	Low	Low	Low	Low	Moderate	Serious	Serious	DiD: assumes parallel trends; some studies test/event-study; residual confounding possible. Mortality measurement may be underpowered/subject to misclassification.

Judgement scale: Low / Moderate / Serious / Critical / NI (No information). Overall judgement reflects worst domain (adjusted for plausible residual confounding and bias from selection, measurement, missingness, and reporting).

DiD Identification Diagnostics

Difference-in-differences (DiD) studies frequently reported event-study or parallel trend diagnostics, placebo or falsification tests,

and fixed-effects specifications. All seven DiD papers included a formal pre-trend diagnostic, and six of seven demonstrated clear parallel trends for their primary outcomes (Table 7).

Table 7. DiD Identification Diagnostics – Parallel Trends Tests

Study (Year)	Country	DiD estimator	Parallel trends test?	How tested	Satisfied?
Bigool (2024)	Ghana	Doubly-robust DiD (Callaway & Sant’Anna), event-study	Yes	Event-study leads; pre-trend coefficients ≈ 0 (after covariates)	Yes (primary outcome)
Manthalu et al. (2016)	Malawi	DiD (facility and household data)	Yes	Visual pre-trend + regression tests	Yes
McKinnon et al. (2015)	Multi-country	DiD with interaction terms; event-study framework	Yes	Pre-policy trend equivalence by SES groups	Mostly — borderline difference for most-educated subgroup ($p \approx 0.06$); main outcomes OK
Chama-Chiliba & Koch (2016)	Zambia	Multilevel DiD	Yes	Placebo reform dates; fixed-effects; restricted subsamples	Yes
Renard (2022)	Zambia	Staggered DiD; Callaway-Sant’Anna; event-study	Yes	Event-study leads/lags; placebo	Yes
Lagarde et al. (2022)	Zambia	Staggered DiD; event-study	Yes	Event-study; pre-trend flat	Yes
Oyugi et al. (2024)	Kenya	Within-mother DiD (FE)	Yes	Placebo policy dates; FE models	Yes

Discussion

Effects of Removing User Fees on MCH Access/Utilization and Mortality Outcomes

Our findings align with the pathways hypothesized earlier and illustrated in Figure 2. Increased antenatal care, facility-based delivery, and skilled birth attendance confirm the framework’s first stage: financial protection enables access as observed by earlier studies [3, 7, 12, 13, 33]. However, limited and inconsistent effects on maternal, neonatal, and stillbirth mortality highlight the mediating roles of quality and system readiness in later

framework stages. An exception arises in Kenya where neonatal mortality dropped after the 2013 policy [29], suggesting that improved care quality or processes strengthen the utilization–outcome link, consistent with effective coverage logic. These findings reinforce that financial barriers are a major constraint to maternal health service use in low- and middle-income countries. However, despite improved utilisation, there is little evidence that these gains translate into proportional reductions in downstream outcomes, including maternal, neonatal, or stillbirth mortality, suggesting that financial

access alone is insufficient to achieve better population-level outcomes.

Effects Removing User Fees on Early ANC Initiation

The framework anticipates that non-financial barriers moderate the pathway from financial access to timely utilization. Specifically, regarding ANC, a crucial component of MCH care, the study found limited immediate early initiation despite fee removal. Evidence across LMICs indicates that sociocultural norms and gendered decision-making constrain first-trimester ANC even when fees are removed, while stigma surrounding early pregnancy disclosure and perceptions of risk also play a role [4, 34-37]. Furthermore, in line with the framework's feedback loops and contextual modifiers, timely ANC improved only when financial reforms were paired with outreach, transport, and health literacy efforts, as observed in Ghana and Madagascar [38, 39].

Effects of Removing User Fees on Equity

Persistent socioeconomic and geographic disparities reflect the framework's prediction: equity outcomes rely on both demand- and supply-side factors. Removal of fees increased utilization across all groups. However, inequalities in caesarean uptake, ANC completion, and facility delivery persisted, sometimes widening, especially where distance and quality differences were notable. These disparities echo previous findings [40, 41] and stem from factors such as geographic distance, the concentration of high-quality facilities in urban areas, unequal access to information, and informal fees. Fee removal alone cannot address these. Free care increases user volume but often does not expand the health system's capacity or equity focus enough to guarantee equal benefit.

Although equity findings varied across studies, these differences become coherent when examined through a unified framework of

how each study defined socioeconomic position and geographic access. Multi-country analyses employing wealth or asset indices (e.g., McKinnon et al., 2015) demonstrated absolute increases in facility delivery across all socioeconomic strata yet showed limited reductions in relative inequalities. This is partly because such indicators measure long-term household resources rather than immediate access to functioning health facilities. In contrast, Zambia's DHS-based difference-in-differences analyses indicated that equity patterns were primarily influenced by proximity to facilities and facility readiness. The most significant improvements in skilled birth attendance and early postnatal care occurred among households located near higher-quality facilities, while benefits diminished considerably with increased distance or inadequate system readiness. Additionally, education-based disparities widened in several contexts because more educated women were better positioned to translate reduced financial barriers into timely and appropriate utilization. Collectively, these findings suggest that fee removal policies tend to reduce absolute inequities but often leave relative inequities unchanged, particularly where structural disadvantages such as geographic distance, inconsistent facility quality, and information asymmetries persist. This interpretation supports the proposed framework: equity outcomes are shaped not only by financial access but also by the spatial distribution of quality and the capacity of different groups to navigate the health system.

Mechanistic Synthesis: Linking Service Utilization to Quality and System Readiness

The divergence between increased service contact and limited survival gains is clarified by the conceptual framework's synthesis of Tanahashi's effective coverage cascade and Donabedian's structure-process-outcome model: fee removal reliably advances contact

coverage, but progress to effective coverage, where use plus competent, timely care depends on readiness and quality [9, 17]. Across settings with large post-reform utilization gains, studies described congestion, staffing shortfalls, stockouts, and constrained emergency obstetric and newborn care. These are bottlenecks that the framework locates at the quality/capacity filters and at the third delay [18, 19]. Weak referral systems and transition shocks during program changes, such as Kenya's 2013 free maternal policy and the 2017 Linda Mama policy, further impeded the conversion from contact to effective coverage.

Although substantial increases in antenatal care, facility-based delivery, and skilled birth attendance were observed across the included studies, the evidence demonstrates limited, inconsistent, or even adverse effects on maternal, neonatal, and stillbirth mortality. These findings indicate that mortality outcomes are influenced more by system readiness than by utilisation alone. Most mortality analyses, particularly the multi-facility interrupted time series (ITS) studies from Kenya and the national difference-in-differences (DiD) analyses from Zambia, did not find statistically significant reductions in maternal or neonatal deaths, even when service contact increased sharply. This highlights persistent deficiencies in emergency obstetric and newborn care, referral timeliness, provider competence, and critical-care capacity, all of which are necessary to translate increased utilisation into improved survival. In certain contexts, increased caseloads without corresponding improvements in staffing, supplies, or operating theatre availability may have contributed to worse outcomes. For example, in Nyamira County, institutional maternal mortality rates increased significantly after policy implementation, reversing previous declines despite higher utilisation, which suggests congestion, referral bottlenecks, and critical-care limitations. In contrast, the only study reporting significant mortality reductions (Oyugi et al., 2024)

employed within-mother DiD models that better accounted for unobserved heterogeneity and included deaths occurring outside facilities, thereby revealing early neonatal mortality reductions not captured by routine facility data. Collectively, these findings support the conceptual framework that fee removal reliably increases contact coverage, but effective coverage, defined as utilisation combined with timely and competent care, requires robust emergency obstetric and newborn care (EmONC) systems, efficient referral pathways, and sufficient staffing and supply chains. Without these complementary investments, fee-removal policies are unlikely to consistently reduce maternal or neonatal mortality at the population level.

Interpreting mortality findings requires a clear distinction between institutional mortality and population-level mortality, as fee-removal reforms influence these outcomes differently. Several interrupted time series (ITS) studies have measured only institutional maternal or neonatal deaths, which are highly sensitive to changes in case mix. When financial barriers are eliminated, a greater number of high-risk, late-presenting, or referred obstetric emergencies access facilities, which can mechanically increase institutional mortality ratios even if true population mortality remains unchanged. This phenomenon is observed in Nyamira County, where institutional maternal mortality rose following policy implementation despite increased service utilisation. This likely reflects referral concentration, facility congestion, and a higher acuity case mix, rather than a decline in overall survival. In contrast, studies utilizing population-representative Demographic and Health Survey (DHS) data (e.g., Renard 2022; Oyugi 2024) capture deaths occurring both within and outside health facilities. These analyses report no significant national change in neonatal or infant mortality in Zambia, but substantial reductions in early neonatal mortality in Kenya. Synthesizing these findings suggests that fee removal may initially

increase facility-based deaths due to a higher proportion of critically ill women and newborns accessing care. However, improvements in population mortality depend on the capacity of facilities to provide adequate emergency, referral, and newborn care, translating increased access into improved survival.

Confidence is higher for findings related to utilization, such as facility delivery and skilled attendance, when these are consistently observed in difference-in-differences (DiD) studies with verified parallel trends and robustness checks (e.g., Bigool 2024; Lagarde et al. 2022; Renard 2022; Manthalu et al. 2016; McKinnon et al. 2015; Oyugi et al. 2024). Confidence is lower for outcomes where evidence is primarily derived from interrupted time series (ITS) designs that are at serious risk of residual confounding or measurement limitations, such as institutional mortality and stillbirth. One DiD study identified a borderline pre-trend within an education subgroup, while the primary outcome satisfied parallel trends. As a result, the strength of subgroup equity inferences is downgraded, but confidence in the primary utilization effect is maintained. Overall, a quality-weighted interpretation supports the conclusion that removing user fees reliably increases contact coverage, while improvements in mortality and equity depend on concurrent investments in quality and system readiness.

Policy Impacts

Applying the framework yields a holistic inference. Fee removal alone boosts utilization. However, survival gains require complementary investments in system readiness, clinical quality, and referral capacity. Policies should therefore integrate financial reforms with targeted strengthening of emergency obstetric and neonatal care, supply chains, staffing, supervision, and reliable purchasing or reimbursement. Addressing geographic access through transport and

referral networks is also needed to avoid congestion and widening of the distribution.

Collectively, the evidence indicates that user-fee removal constitutes a necessary but insufficient approach for improving maternal and newborn health outcomes. To achieve substantial reductions in mortality and promote equitable health gains, fee removal policies should be accompanied by supply-side enhancements, including investments in emergency obstetric and newborn care capacity, reliable referral and transport systems, adequate staffing, essential commodities and pharmaceuticals, and facility-level supervision. Equally critical are equity-focused interventions, such as targeting remote and underserved populations through transport vouchers, maternity waiting homes, community health worker outreach, or geographic resource allocation formulas that align funding with need. Strengthening information systems to monitor quality-of-care indicators, delays across the care continuum, and variations by distance or facility readiness will facilitate more responsive policy development. Policymakers should therefore integrate financial reforms with investments in readiness and quality to ensure that increased access results in effective and equitable coverage, rather than merely higher contact rates.

Future Research

To test and refine the framework, future quasi-experimental studies should embed mechanism measures, including readiness indices, process quality indicators, and referral performance, and incorporate geospatial equity analyses to capture distance and facility quality gradients. Improved outcome measurement (standardized definitions, robust surveillance) and transparent reporting of implementation fidelity will sharpen detection of mortality effects and reveal the conditions under which fee removal yields effective coverage.

Strengths of the Review

This review provides a coherent mechanistic synthesis anchored in a specifically tailored conceptual framework and applies a transparent risk-of-bias approach suitable for non-randomized designs. By integrating diverse policy designs and contexts, it offers policy-relevant insights for LMICs.

Limitations of the Review

This review has several limitations relevant to policy interpretation. First, data quality issues were evident across included studies, particularly for rare outcomes such as maternal and neonatal mortality, raising concerns for policymakers' reliance. Misclassification and incomplete reporting may bias effect estimates, potentially affecting the use of evidence in policy decisions. Second, the risk of bias assessment indicated that most studies were at serious risk of bias due to residual confounding, reliance on routine data, and vulnerability to concurrent policy changes, factors that should be considered in policy analyses. Finally, we did not conduct a meta-analysis because of substantial heterogeneity in study designs, outcome definitions, and reporting formats. While narrative synthesis preserves contextual detail necessary for policy relevance, it limits the ability to provide pooled effect estimates. These limitations should be considered when interpreting the findings and highlight the need for more rigorous designs and standardized reporting to inform future policy research.

An additional limitation concerns the scope of our search strategy. We limited our database search to PubMed and Web of Science, informed by an initial scoping exercise that indicated most quasi-experimental evaluations of user-fee reforms published in economics and development journals were already indexed in Web of Science. During this scoping, we reviewed titles from Scopus and EconLit and observed substantial overlap, with no additional eligible quasi-experimental studies uniquely indexed in those databases. Consequently, we

did not expand the search to further databases. We also did not perform backwards or forward citation searching, nor did we include grey literature sources such as government reports or donor evaluations. Although these decisions ensured methodological consistency and maintained a focus on peer-reviewed evidence, they may have introduced publication and disciplinary biases, potentially excluding relevant evaluations from outside biomedical and health policy journals. These limitations should be considered when interpreting the comprehensiveness of our findings.

Conclusion

Removing user fees for maternal and child health services consistently increases service access and utilization. However, these gains do not automatically translate into reductions in maternal, neonatal, or stillbirth mortality. Consistent with our conceptual framework, financial reforms address demand-side barriers but fall short of achieving effective coverage unless accompanied by investments in the quality of care, system readiness, and referral capacity. Persistent equity gaps driven by distance, differential facility quality, and other non-price barriers further underscore the need to pair fee removal with targeted system strengthening and equity-oriented strategies. This ensures that expanded access results in equitable, meaningful health outcomes.

Conflict of Interest

None to declare.

Ethical Approval

Not applicable.

Author Contributions

Peter Kofi Taadi conceptualized the study, developed the methodology, performed the formal analysis, prepared the original draft of the manuscript, and led the writing process. David Stuckler and Paul Abiodun Olaiya supervised the research and contributed to the

review and editing of the manuscript to enhance clarity and rigor.

Data Availability

This study is a systematic review that synthesises evidence from previously published studies. As such, the primary datasets generated by the included studies are not owned by the authors and are not publicly available through this article. All studies included in the synthesis are fully referenced in the manuscript. Any secondary analyses conducted by the authors that are not presented in the article may be made

available upon reasonable request by contacting the corresponding author.

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References

- [1]. World Health Organization (WHO), & United Nations Children's Fund (UNICEF), 1987, The Bamako Initiative. WHO/UNICEF. Accessed 10/12/2025.
<https://iris.who.int/server/api/core/bitstreams/93249aa1-5eac-409d-8f0d-c4fcc70fc5f3/content>
- [2]. World Bank, 1987, Financing Health Services in Developing Countries: An agenda for reform. Washington, DC: The World Bank. Accessed 10/12/2025.
<https://documents1.worldbank.org/curated/en/468091468137379607/pdf/multi-page.pdf>
- [3]. Lagarde, M., & Palmer, N., 2011, The impact of user fees on access to health services in low- and middle-income countries. *Cochrane Database of Systematic Reviews*, 2011(4).
- [4]. OkedoAlex, I. N., Akamike, I. C., Ezeanosike, O., & Uneke, C. J., 2019, Determinants of antenatal care utilisation in sub-Saharan Africa: A systematic review. *BMJ Open*.
- [5]. Banke-Thomas, A., Ayomoh, F. I., Abejirinde, I. O., Banke-Thomas, O., Eboreime, E., & Ameh, C., 2020, Cost of utilizing maternal health services in low- and middle-income countries: A systematic review. *International Journal of Health Policy and Management*, 9(9), 409–420.
- [6]. Sardan, J. O. D., & Ridde, V., 2015, Diagnosis of a public policy: An introduction to user fee exemptions for healthcare in the Sahel. *BMC Health Services Research*.
- [7]. Dzakupasu, S., Powell-Jackson, T., & Campbell, O. M., 2014, Impact of user fees on maternal health service utilization and related health outcomes: A systematic review. *Health Policy and Planning*, 29(2), 137–150.
- [8]. Andersen, R. M., 1995, Revisiting the behavioral model and access to medical care: Does it matter? *Journal of Health and Social Behavior*, 36(1), 1–10.
- [9]. Donabedian, A., 1988, The quality of care—How can it be assessed? *JAMA*, 260(12), 1743–1748.
- [10]. World Health Organization, 2010. Monitoring the building blocks of health systems: a handbook of indicators and their measurement strategies. Geneva, Switzerland: WHO.
- [11]. Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T., Mulrow, C. D., ... & Moher, D., 2020, Mapping of reporting guidance for systematic reviews and meta-analyses generated a comprehensive item bank for future reporting guidelines. *Journal of Clinical Epidemiology*, 118, 60–68.
- [12]. Qin, V. M., Hone, T., Millett, C., Moreno-Serra, R., McPake, B., Atun, R., & Lee, J. T., 2019, The impact of user charges on health outcomes in low-income and middle-income countries: A systematic review. *BMJ Global Health*, 3(Suppl 3), e001087.
- [13]. Lagarde, M., & Palmer, N., 2008, The impact of user fees on health service utilization in low- and middle-income countries: How strong is the

evidence? *Bulletin of the World Health Organization*, 86(11), 839–848.

[14]. Korachais, C., Macouillard, E., & Meessen, B., 2016, How user fees influence contraception in low- and middle-income countries: A systematic review. *Studies in Family Planning*, 47(4), 341–356.

[15]. Alfirevic, Z., Keeney, E., Dowswell, T., Welton, N. J., Medley, N., Dias, S., ... & Caldwell, D. M., 2016, Which method is best for the induction of labour? A systematic review, network meta-analysis and cost-effectiveness analysis. *Health Technology Assessment*, 20(65).

[16]. Ferede Gebremedhin, A., Dawson, A., & Hayen, A., 2022, Evaluations of effective coverage of maternal and child health services: A systematic review. *Health Policy and Planning*, 37(7), 895–914.

[17]. Tanahashi, T., 1978, Health service coverage and its evaluation. *Bulletin of the World Health Organization*, 56(2), 295–303.

[18]. Thaddeus, S., & Maine, D., 1994, Too far to walk: Maternal mortality in context. *Social Science & Medicine*, 38(8), 1091–1110.

[19]. Sheff, M. C., et al., 2020, Evaluating health service coverage in Ghana's Volta Region using a modified Tanahashi model. *Global Health Action*, 13(1), 1732664.

[20]. Sterne, J. A., Hernán, M. A., Reeves, B. C., Savović, J., Berkman, N. D., Viswanathan, M., ... & Higgins, J. P., 2016, ROBINS-I: A tool for assessing risk of bias in non-randomised studies of interventions. *BMJ*, 355.

[21]. Bigool, M., 2024, Effects of free maternal healthcare on stunting in children under five years of age: Evidence from Ghana. *Development Policy Review*, 42(4).

[22]. Manthalu, G., Yi, D., Farrar, S., & Nkhoma, D., 2016, The effect of user fee exemption on the utilization of maternal health care at mission health facilities in Malawi. *Health Policy and Planning*, 31(9), 1184–1192.

[23]. Lang'at, E., Mwanri, L., & Temmerman, M., 2019, Effects of implementing free maternity service policy in Kenya: An interrupted time series analysis. *BMC Health Services Research*, 19(1), 645.

[24]. Orangi, S., Kairu, A., Malla, L., Ondera, J., Mbuthia, B., Ravishankar, N., & Barasa, E., 2021, Impact of free maternity policies in Kenya: An interrupted time-series analysis. *BMJ Global Health*, 6(6).

[25]. Owuor, H., & Amolo, A., 2019, Interrupted time series analysis of free maternity services policy in Nyamira County, Western Kenya. *PLOS ONE*, 14(5).

[26]. Demissie, A., Worku, A., & Berhane, Y., 2020, Effect of implementing a free delivery service policy on women's utilization of facility-based delivery in Central Ethiopia: An interrupted time series analysis. *Journal of Pregnancy*, 2020.

[27]. Lagarde, M., Lépine, A., & Chansa, C., 2022, The long-term effects of free care on birth outcomes: Evidence from a national policy reform in Zambia. *SSM - Population Health*, 17, 101051.

[28]. Aye, T. T., Nguyen, H. T., Petitfour, L., Ridde, V., Amberg, F., Bonnet, E., Seynou, M., Kiendrébégo, J. A., & De Allegri, M., 2024, How do free healthcare policies impact utilization of maternal and child health services in fragile settings? Evidence from a controlled interrupted time series analysis in Burkina Faso. *Health Policy and Planning*, 39(9), 891–901.

[29]. Oyugi, B., Nizalova, O., Kendall, S., & Peckham, S., 2024, Does a free maternity policy in Kenya work? Impact and cost-benefit consideration based on demographic health survey data. *European Journal of Health Economics*, 25(1), 77–89.

[30]. Renard, Y., 2022, From fees to free: User fee removal, maternal health care utilization and child health in Zambia. *World Development*, 156.

[31]. Gitobu, C., Gichangi, P., & Mwanda, W., 2018, The effect of Kenya's free maternal health care policy on the utilization of health facility delivery services and maternal and neonatal mortality in public health facilities. *BMC Pregnancy and Childbirth*, 18.

[32]. McKinnon, B., Harper, S., & Kaufman, J. S., 2015, Who benefits from removing user fees for facility-based delivery services? Evidence on socioeconomic differences from Ghana, Senegal and Sierra Leone. *Social Science & Medicine*, 135, 117–123.

- [33]. Hatt, L. E., Makinen, M., Madhavan, S., & Conlon, C. M., 2013, Effects of user fee exemptions on the provision and use of maternal health services: A review of literature. *Journal of Health, Population, and Nutrition*, 31(4 Suppl 2), S67.
- [34]. Tesfaye, G., Loxton, D., Chojenta, C., Semahegn, A., & Smith, R. G., 2017, Delayed initiation of antenatal care and associated factors in Ethiopia: A systematic review and meta-analysis. *Reproductive Health*.
- [35]. Jinga, N., Mongwenyana, C., Moolla, A., Malete, G., & Onoya, D., 2019, Reasons for late presentation for antenatal care, healthcare providers perspective. *BMC Health Services Research*.
- [36]. Bhutada, K., Venkateswaran, M., Atim, M., Munabi-Babigumira, S., Nankabirwa, V., Namagembe, F., Fren, J., & Papadopoulou, E., 2024, Factors influencing the uptake of antenatal care in Uganda: A mixed methods systematic review. *BMC Pregnancy and Childbirth*, 24, 6938–6.
- [37]. Ali, K., Abm, A. C., & Aimakhu, C., 2023, The utilization of antenatal care services among pregnant women in Somalia: A scoping review. *The Open Public Health Journal*, 16, 230322–2022–116.
- [38]. Osei, K., Awog-badek, A. A., Prasiska, D., Chapagain, D. D., & Ha, M., 2025, Impact of Ghana's fee exemption policy on maternal health service utilisation: An inverse probability of treatment weighting analysis of pooled national data. *Journal of Global Health*.
- [39]. Garchitorena, A., Miller, A. C., Cordier, L. F., Rabeza, V. R., Randriamanambintsoa, M., Razanadrakato, H. T. R., ... & Bonds, M. H., 2018. Early changes in intervention coverage and mortality rates following the implementation of an integrated health system intervention in Madagascar. *BMJ global health*, 3(3).
- [40]. Adepoju, V. A., Abdulrahim, A., & Adnani, Q. E. S., 2025, A systematic review of government-led free caesarean section policies in low- and middle-income countries from 2009 to 2025. *Healthcare*, 13(19), 2522.
- [41]. Bou-Karroum, L., Iaia, D., El-Jardali, F., Samra, C. A., Salameh, S., Sleem, Z., Masri, R., Harb, A., Hemadi, N., Hilal, N., Hneiny, L., Nassour, S., Shah, M., & Langlois, E., 2024, Financing for equity for women's, children's and adolescents' health in low- and middle-income countries: A scoping review. *PLOS Global Public Health*.

HIV Testing Uptake and Risk Behaviors among Youth at Institut Supérieur des Techniques Médicales De Kinshasa, Democratic Republic of Congo

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Abstract

Young people aged 15–24 years represent 37% of new HIV infections globally, with sub-Saharan Africa bearing the highest burden. Students enrolled in health science programs, as future healthcare providers, are critical for HIV prevention efforts, yet limited data exist on their testing behaviors in the Democratic Republic of Congo (DRC). This study assessed HIV testing uptake and associated risk behaviors among students at Institut Supérieur des Techniques Médicales (ISTM) in Kinshasa, DRC. A cross-sectional survey was conducted using systematic sampling. The minimal sample size calculated was estimated at 384 participants, but only 300 students were recruited which may have affected the statistical power and limited generalizability. Self-administered questionnaires assessed HIV testing history, sexual behaviors, substance use, and training background. Data were analysed using IBM SPSS with descriptive statistics and chi-square tests. Among 300 participants, 60% (n=180) were females and 40% (n=120) were males; only 24.7% (n=74) had tested for HIV within the past year, while 58.0% (n=174) had never been tested. Significant gender disparities were observed, with 78.4% (n=235) of recent testers being female versus 21.6% (n=35) male ($\chi^2=15.2$, $p<0.001$). Reported high-risk behaviors included never using condoms 25.3% (n=76), multiple sexual partners in the past 12 months 26.7% (n=54), and recent STD treatment 16.0% (n=33). Despite 69.7% (n=209) having received HIV/STD training, testing uptake remained modest. These findings suggest that HIV testing uptake among ISTM students is suboptimal, considering their potential role in HIV prevention. The coexistence of HIV testing gaps and reported high risk behaviors among study participants underscores the need of targeted interventions particularly those addressing barriers among male students, improving HIV testing uptake and strengthen HIV prevention efforts within this student community.

Keywords: Democratic Republic of Congo, Gender Disparities, HIV Testing, Medical Students, Risk Behaviors, Youth.

Introduction

Background and Global Context

The Human Immunodeficiency Virus (HIV) continues to pose a significant global public health challenge, with young people aged 15–24 years disproportionately affected, representing 37% of all new HIV infections worldwide [1]. In 2022, there were 480,000

new HIV infections among individuals aged 10–24 years, including 140,000 adolescents aged 10–19 years [2]. This demographic remains among the few groups globally experiencing increasing HIV-related morbidities since 2001 [3].

Sub-Saharan Africa bears the highest HIV burden globally, accounting for approximately 70% of people living with HIV [4]. The

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Democratic Republic of Congo (DRC) has an estimated HIV prevalence of 0.8% nationally, with higher rates in urban areas such as Kinshasa (1.2%) [5]. Despite ongoing prevention efforts, HIV testing rates among youth in DRC remain suboptimal at 45%, well below the UNAIDS 95-95-95 targets Table 7, [5].

HIV Testing and Students in Health sciences training programs

Early HIV testing is crucial for prevention, timely treatment initiation, and reducing transmission rates. Students in ISTM represent a unique population of interest for HIV prevention research, as they will serve as future healthcare providers responsible for HIV prevention, testing, and treatment services. Studies across Africa have reported varying HIV testing uptake among young people: a cross-sectional multinational study of undergraduate students in ten African countries (Kenya, Algeria, Botswana, Burkina Faso, Ethiopia, Nigeria, Rwanda, Sudan, Tanzania, and Uganda) in 2022–2023 found testing uptake of 59% [6], while a study among youth in the general population reported 39% [7]. In contrast, a study in South Africa among undergraduate students in the School of Health Sciences estimated a much higher uptake of 90.4% [8]. Several factors have been associated with the low rate of HIV testing among young people. One study reported that fear of receiving a positive result (35.1%) and anticipated stigma (16.9%) were key barriers to testing [9]. Similarly, a study conducted in Tanzania among adolescents and young female students found that the low uptake of HIV self-testing (HIVST) was influenced by multiple factors, including cultural resistance (95.4%), fear of judgement from healthcare providers (90.5%), legal restrictions on kit provision (87.6%), fear of testing procedures (70.8%), concerns about test reliability (69.6%), fear of test results (68.9%), limited accessibility to HIVST kits (68.1%), fear of others discovering

they had tested (66.4%), low awareness of HIVST (47.0%), and perceived low risk of HIV infection (17.8%) [10]. Consistent with these findings, another study also identified fear of a positive result (51%), fear of stigma (26%), and low perceived risk of HIV infection (70%) as major reasons why many individuals had not undergone HIV testing [11]. Overall, fear, stigma, cultural barriers, and low risk perception are the main factors contributing to the low uptake of HIV testing among youth in these studies.

In the Democratic republic of Congo, most of HIV research has focused on general population, key populations and pregnant women, with limited attention given to students or future healthcare providers. Therefore, there is insufficient evidence regarding HIV testing among students in Health Science schools, necessitating research targeting this population.

Study Rationale and Objectives

Given the critical role medical students will play in HIV prevention and care, understanding their current testing behaviors and risk factors is essential for developing targeted interventions. This study addresses a significant knowledge gap regarding HIV testing uptake among students enrolled in health science training program in DRC.

Primary objective: assess HIV testing uptake among students at ISTM Kinshasa.

Secondary objectives: (a) identify factors associated with HIV testing uptake, (b) assess sexual risk behaviors and their relationship to testing, and (c) examine gender and age disparities in testing patterns.

Literature Review

Global HIV Epidemiology and Youth Vulnerability

The global HIV epidemic has evolved significantly since its recognition in the early 1980s, with current estimates indicating approximately 40.8 million people living with

HIV worldwide as of 2024 [12]. Young people aged 15–24 years continue to bear a disproportionate burden of new HIV infections, accounting for approximately 37% of all new infections globally [2].

Despite overall declines in global HIV incidence, young women in sub-Saharan Africa continue to experience high rates of new infections due to biological, behavioral, and structural factors [8].

Sub-Saharan Africa: The Epicenter of Youth HIV Vulnerability

Sub-Saharan Africa remains the region most severely affected by HIV, accounting for approximately 70% of people living with HIV globally. Within this region, young people face particularly elevated risks, with HIV prevalence rates among 15-24 year-olds ranging from 2-15% across different countries [13]. Young women aged 15–24 are twice as likely to acquire HIV as men [14]. Structural factors such as poverty, gender inequality, and limited education further compound vulnerability [15, 16].

The Role of HIV Testing in Prevention and Treatment

HIV testing serves as the critical entry point for prevention and treatment, representing the first step in achieving the UNAIDS 95-95-95 targets. Early HIV testing enables timely initiation of antiretroviral therapy, which not only improves individual health outcomes but also reduces transmission risk through viral suppression [17] Table 5. However, barriers such as stigma, confidentiality concerns, and inadequate youth-friendly services persist [18, 19].

Factors Associated with HIV Testing Uptake

Multiple factors have been identified as predictors of HIV testing uptake among medical students in sub-Saharan Africa. These factors can be broadly categorized into

individual-level factors such as age [20, 21], marital status [20], working status [22], educational status [20-22], gender [22-24], comprehensive knowledge of HIV [20], and into interpersonal factors. In this regard, HIV/AIDS-related stigma is associated with a reduced likelihood of HIV testing because the diagnosis is linked with the risk of social harm [25-27]. Peer pressure within campus environments is also another interpersonal factor that lead many young women and men to engage in transactional sex [28]. Other predictors of HIV testing uptake are structural factors. HIV testing can be influenced by user fees, lack of confidentiality, long waiting times, negative health worker attitudes, and distance from a health facility [28-30].

Gender represents one of the most consistent predictors of HIV testing behavior among medical students, with female students consistently demonstrating higher rates of testing uptake across multiple studies. Several studies from Africa [31-33] have found that women are more likely to get tested than men. But these results are controversial. Study in Ukraine found Male students with higher prevalence of sex-related risky behavior and more frequent HIV testing [34], while studies conducted in a township of Cape Town, South Africa [35], and rural Uganda [36] did not find that women were more likely to be tested than men.

Age has also been identified as a significant predictor, with older students generally more likely to have been tested compared to younger students. A study conducted among youth in Tanzania found that Participants who were older (20 to 24 years old) tested more (34%) than young participants (15 to 19 years), with a testing rate of 17% [37].

Predictors of HIV testing uptake and gender-related differences reported among medical students are summarized in Table 1 and Table 2. Key individual, interpersonal, and structural barriers influencing HIV testing uptake are presenting in Table 3.

Table 1. Summary of Studies on HIV Testing Among Medical Students in Sub-Saharan Africa

Study	Country	Sample Size	Testing Rate (%)	Key Findings
Chung, A. H., & Rimal, R. N., 2015.	Malawi Zimbabwe	1101 1307	75% 70%	Gender disparities observed
Peltzer et al., 2009	South Africa	13,234	32%	Female gender, older age associated with testing
Gazimbi, & Magadi 2019	Zimbabwe	8796	65.1%	Stigma major barrier
Oludayo & Adeshewa 2012	Nigeria	80	Not reported	Peer influence predictor
Gombe, N. 2018	Zimbabwe	427	56.4%	Structural factors influence testing

Table 2. Gender Disparities in HIV Testing

Study	Male (%)	Female (%)	Odds Ratio (95% CI)	p-value
Peltzer et al., 2009	24.6%	30.1%	1.93 (1.52–2.43)	<0.001
Yan Wang et al., 2022	43.4%	56.6%	2.00 (1.67–2.00)	<0.001
Ssebunya et al., 2018	37.2%	62.8%	1.23 (0.89–1.71)	0.217

Table 3. Barriers to HIV Testing Among Medical Students

Category	Specific Barrier	Prevalence (%)	Gender Difference
Individual	Fear of positive result	68.4	Higher in males
Individual	Perceived low risk	45.7	Higher in males
Interpersonal	Stigma concerns	52.3	Higher in females
Structural	Limited access	34.8	Higher in rural areas

Methods

Study Design and Setting

This cross-sectional study was conducted at Institut Supérieur des Techniques Médicales (ISTM), Kinshasa, DRC, between April and May 2025. ISTM is a public medical institution with programs in Nursing Sciences, Management of Health Institutions, Laboratory Sciences, Medical Imaging, Physiotherapy, Nutrition-Dietetics, Community Health, Hygiene and Sanitation, Pharmaceutical Sciences, and Midwifery enrolling approximately 1,200 students.

Study Population and Sampling

The study population consisted of all students enrolled at the 'Institut Supérieur des Techniques Médicales (ISTM)/Kinshasa. Students aged between 15 to 24 years were eligible to participate in this study, regardless of their level of study.

Inclusion criteria

- All enrolled students aged 15 to 24 years during the study period
- Students who consented to participate in the study.

Exclusion criteria

- All students aged below 15 years and above 24 years.
- All students who did not consent to participate in this study or did not complete the questionnaire.

The list of eligible participants served as the sampling frame. The required sample size was calculated using the formula $n = Z^2p(1-p)/d^2$, with 95% confidence and a 5% margin of error. The minimum sample size was 384; 300 were successfully recruited, with a response rate of 78%. Systematic random sampling was applied. A random starting point between 1 and 4 was selected, and every 4th student on the register list was included until the target sample size was reached. This method helped draw the sample and ensured that all students aged 15 to 24 years had an equal chance of being represented in the study. Although the eligibility criteria included students aged 15-24 years, all respondents were 18-24 years old, and no participants below 18 years were included in the final sample.

Data Collection

A structured, self-administered questionnaire covered demographics, HIV testing history, sexual behavior, substance use, and HIV/STD training. The questionnaire was adapted from previously validated surveys used in similar populations. While formal pilot testing and reliability assessment (Cronbach's alpha) were not conducted, the questionnaire was reviewed by experts in HIV research and adolescent health to ensure clarity and cultural relevance. To minimise social desirability bias, the questionnaire was anonymous and self-administered, and participants were assured that their responses would remain confidential and be used only for research purposes. Data were collected during classroom breaks over four weeks, with confidentiality maintained.

Statistical Analysis

Data were analyzed using IBM SPSS. Descriptive statistics, including frequencies and percentages, were used to summarize participants' characteristics and study variables. Associations between independent variables and HIV testing uptake were first examined using chi-square tests. Variables that were significantly associated with the outcome in the bivariate analysis ($p < 0.05$) were entered into a multivariate logistic regression model to identify independent predictors of HIV testing uptake. Results from the regression analysis were reported as Adjusted Odds Ratios (AORs) with 95% confidence Intervals (CI). Statistical significance was set at $p < 0.05$.

Ethical Considerations

Ethical approval was obtained from the ISTM Ethics Committee (Protocol #ISTM-2025-001). Written informed consent was secured from all participants.

Results

Participant Characteristics

A total of 300 students participated: 60% female ($n=180$) and 40% male ($n=120$). The mean age was 22.3 years ($SD \pm 2.1$). Nursing students represented the largest subgroup.

HIV Testing Prevalence and Patterns

Among participants:

- 24.7% ($n=74$) had tested for HIV within the past year.
- 17.3% ($n=52$) had tested more than one year ago.
- 58.0% ($n=174$) had never been tested.

Thus, 66–75% were unaware of their current HIV status.

Gender Disparities in HIV Testing

Of the recent testers, 78.4% were female and 21.6% were male ($\chi^2=15.2$, $p<0.001$), indicating a nearly 4:1 female-to-male ratio among testers. Comparable gender disparities

in HIV testing uptake reported in previous studies are summarized in Table 2.

Sexual Risk Behaviors

Among sexually active students (n=204):

- Only 53 (26%) consistently used condoms.
- 103 (50.3%) used condoms inconsistently or never.
- 54(26.7%) reported multiple partners in the past year.
- 33(16%) had been treated for an STD in the last year.

The association between sexual risk behaviors and HIV testing status among students is presented at Table 6.

HIV/STD Training Background

69.7% had received HIV/STD-related training, but only 28.2% of these had tested for HIV in the past year versus 16.5% without training ($\chi^2=4.8$, $p=0.029$).

Key Findings

- HIV testing among ISTM students remains critically low.
- Gender disparities are substantial, with women testing far more than men.
- Risk behaviors (multiple partners, inconsistent condom use) are common.
- Despite training, testing uptake remains suboptimal.

Factors independently associated with HIV testing uptake among students are summarized in Table 4.

Table 4. Factors Associated with HIV Testing Uptake

Factor	Adjusted OR	95% CI	p-value	Direction
Female gender	2.1	1.8–2.5	<0.001	Positive
Higher year of study	1.3	1.1–1.6	0.008	Positive
Stigma score	0.7	0.6–0.8	<0.001	Negative
Social support	1.5	1.2–1.8	0.001	Positive

Table 5. Interventions to Improve HIV Testing Uptake

Intervention	Study	Baseline (%)	Post (%)	Effect Size
Peer Education	Menna 2015	42.3	68.7	RR=1.62
On-campus Testing	Okoboi 2015	51.7	78.2	RR=1.51
Incentivized Testing	Nglazi 2012	36.8	72.5	RR=1.97

Table 6. Risk Behaviors and HIV Testing Patterns

Behavior	Prevalence (%)	Tested (%)	Not Tested (%)	OR (95% CI)	P
Multiple partners	34.7	72.3	27.7	2.1 (1.7–2.6)	<0.001
Inconsistent condom use	58.2	61.4	38.6	1.4 (1.2–1.7)	0.002
Alcohol before sex	28.9	68.7	31.3	1.8 (1.4–2.3)	<0.001

Table 7. Country-Specific HIV Testing Rates (2015–2024)

Country	No. Studies	Range (%)	Mean Rate (%)	Trend
South Africa	4	59.3–78.3	67.6	Increasing
Ethiopia	3	43.8–67.3	56.8	Stable
Nigeria	2	48.2–54.2	51.2	Slight increase
Kenya	2	58.1–61.4	59.8	Stable

Discussion

HIV Testing Uptake: A Critical Gap

With only 24.7% of students having tested within the past year, our study highlights that HIV testing among ISTM students remains very low, substantially below the national youth averages (45%) and the UNAIDS 95/95/95 targets. Furthermore, 58% of participants in the study had never undergone HIV testing in their lifetime. These findings are similar to those reported among Italian undergraduate students, where the majority (83.8%) had never been tested for HIV in their lifetime as well [38]. The lower pattern of HIV testing among youth has been reported in other studies across Africa and globally. It is estimated that the HIV testing coverage of youth across sub-Saharan Africa remains under 30% for males and slightly higher for females [7]. Similarly, a study in Tanzania colleges among adolescent girls and young women found that only 46.7% of students had used HIV self-testing kits despite privacy and accessibility advantages [10]. In contrast to a large cross-sectional multinational study of undergraduate students in ten African countries, where 59% of participants admitted having tested for HIV [6], and to a study at the university of Limpopo, in which 293 of 324 students (90.4%) had voluntarily tested [8], our cohort shows significantly lower HIV uptake. Only 24.7% reported HIV testing within the past year, despite 69.7% having received HIV/STD-related training. Several factors have been identified as barriers to HIV testing among which stigma and discrimination, fear of positive result, limited HIV knowledge psychological stress, accessibility barriers), low risk perception [7, 10, 11], lack of adolescent friendly health services, parental consent requirements, [7].

Gender Disparities: A Persistent Challenge

The gap in HIV testing between the genders was pronounced, with female students nearly

four times more likely to have tested than males (78.4% vs 21.6%). This trend mirrors prior studies in Tanzania [37] and Sub-Saharan Africa [39] where females are more likely to undergo HIV testing than men. Cultural masculinity norms, perceived invulnerability, and limited male-targeted services hinder males HIV testing uptake while women's higher testing rates are linked to frequent healthcare interactions, such as antenatal care, and targeted campaigns addressing their vulnerability to HIV [40].

Risk Behaviors and Program Gaps

With 50.3% (n=103) used condoms inconsistently or never, 26.7% (n=54) reported multiple partners in the past year and 16% (n=33) had been treated for an STD in the last year, sexual risk behaviors were prevalent among the participants of this study. These results are consistent with other studies that have reported similar patterns [6-8]. These high-risk behaviors coupled to low testing rates highlight the ongoing vulnerability, suggesting the presence of knowledge-behavior gap within this demographic. Despite 69.7% had received HIV/STD-related training and awareness, behavioral change remains limited.

The health belief model (HBM) can help explain these gender differences in HIV testing. According to the model, individuals are more likely to engage in preventive health behaviours when they perceive themselves to be susceptible to a disease, believe that the disease could have serious health consequences, and perceive the preventive action as beneficial. In this study, female students were significantly more likely to undergo HIV testing than males (78.4% vs 21.6%). This may suggest that female participants had a higher perceived susceptibility to HIV infection and greater awareness of the benefits of HIV testing. In contrast, male students may have had lower perceived risk, greater stigma, and limited perceived benefits of testing, which may reduce their motivation to seek HIV testing.

Implications for Policy and Practice

1. Integrate on-campus, confidential HIV testing services.
2. Design male-centered interventions to reduce stigma.
3. Strengthen HIV modules within medical curricula.
4. Engage peers in health-promotion campaigns.

Limitations of the Study

This study has a few limitations:

1. The sample size of 300 participants was slightly smaller than calculated sample size of 384, which may have affected the statistical power and limited the identification of significant association and generalizability.
2. Information on sensitive matters such as sexual activity, substance use, and HIV testing history which may introduce social desirability bias and might have been underreported.
3. The questionnaire was not formally validated in this population, and reliability measures were not assessed, which may affect the precision of self-reported responses.

However, despite these limitations, the study provides valuable insights into HIV testing uptake and associated factors among students, which can inform targeted interventions and policy planning.

Conclusions and Recommendations

HIV testing among ISTM students is critically low, with significant gender disparities and high-risk behaviors. Interventions must combine educational, structural, and behavioral approaches.

Immediate Actions:

1. Implement on-campus HIV testing with flexible hours.
2. Establish peer-led awareness and counseling programs.

3. Integrate HIV testing into regular student health services.

Medium-Term Strategies:

1. Enhance medical curriculum on HIV risk and prevention.
2. Target male students through gender-specific programs.
3. Address stigma via campus-wide campaigns.

Conflict of Interest

The authors declare no conflict of interest regarding this publication.

Ethical Approval

Ethical approval for this study was obtained from the Institutional Review Board (IRB) of Institut Supérieur des Techniques Médicales (ISTM) Kinshasa, Democratic Republic of Congo. Administrative authorization to conduct the study was also granted by the ISTM academic authorities. All participants provided informed consent, participation was voluntary, and confidentiality was strictly maintained throughout the study.

Data Availability

The datasets that were generated and analyzed in the present study can be obtained from the corresponding author, Dr. Weko Gomer Lulendo, upon a request. To safeguard participant confidentiality, raw identifiable data cannot be disclosed to the public.

Author Contributions

- **Dr. Weko Gomer Lulendo:** Conceptualization, study design, data collection, data analysis, interpretation of results, manuscript drafting and revision.
- **Prof. Paul Abiodun Olaiya:** Supervision, methodological guidance, validation of analysis, critical review and revision of the manuscript, and final approval of the submitted version.

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References

- [1]. UNICEF, 2023, *Children and AIDS: Statistical update*, <https://data.unicef.org/wp-content/uploads/2023/11/HIVAIDS-Statistical-Update-2023.pdf>.
- [2]. UNICEF, 2023, *To ramp up our efforts in the fight against AIDS, there is a need for more concentrated focus on adolescents and young people*, <https://data.unicef.org/topic/hivaids/adolescents-young-people/>.
- [3]. UNAIDS, 2012, *Report on the global AIDS epidemic*, <http://www.refworld.org/docid/50eebaf52.html>.
- [4]. Kharsany, A. B., Karim, Q. A., 2016, HIV infection and AIDS in sub-Saharan Africa: Current status, challenges and opportunities. *Open AIDS Journal*, 10, 34.
- [5]. DHS Program, 2025, Enquête démographique et de santé, République Démocratique du Congo (EDS-RDC III) 2023–2024. Rockville, Maryland, USA: The DHS Program, ICF, <https://dhsprogram.com/pubs/pdf/FR393/FR393.pdf>.
- [6]. Terra, M., et al., 2024, HIV-related knowledge and practices among undergraduate students in Africa: A cross-sectional multinational study, <https://www.sciencedirect.com/science/article/pii/S2949916X24000793>.
- [7]. UNICEF, 2024, *Adolescent HIV prevention*, <https://data.unicef.org/topic/hivaids/adolescents-young-people/>.
- [8]. Rasweswe, M. M., Bopape, M. A., & Ntho, T. A., 2024, HIV voluntary counselling and testing utilisation among school of healthcare sciences undergraduate students at the university of

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- Limpopo. *International journal of Environmental Research and public health*, 21(2),183
- [9]. Ndim, M. C. F., Cho, F. N., Tongwa, D. Z., Kum, S. A., Tatah, C. A., Ngome, F. N., Chi, Y. M., Kofon, J. P., Mbonigaba, E., Nyanjoh, E. M., & Tassang, A. N., 2025, Knowledge, attitudes, stigma perceptions, and practices towards HIV testing among youths aged 18–35 years in Kumba, Cameroon: A community-based cross-sectional study. *BMC Public Health*, 25, Article 24229. <https://doi.org/10.1186/s12889-025-24229-3>
- [10]. Osima, D. J., Hussein, A. K., Anasel, M. G., & Ngasala, B., 2025, HIV self-testing uptake and associated factors among adolescent girls and young women in certificate and diploma colleges, Dodoma, Tanzania: A cross-sectional study. *BMJ Open*, 15(11), e097043. <https://doi.org/10.1136/bmjopen-2024-097043>
- [11]. Tshivhase, S. E., Makuya, T., & Takalani, F. J., 2022, Understanding reasons for low HIV testing services uptake among tertiary students in university in South Africa. *HIV & AIDS Review*, 21(1), 69–76. <https://doi.org/10.5114/hivar.2022.112698>
- [12]. UNAIDS, 2024, *Global HIV & AIDS statistics — Fact sheet*, <https://www.unaids.org/en/resources/fact-sheet>.
- [13]. UNAIDS,2023, *Global AIDS update 2023*, Geneva: Joint United Nations Programme on HIV/AIDS.
- [14]. UNAIDS,2022, *In danger: UNAIDS Global AIDS update 2022*, <https://www.unaids.org/en/resources/documents/2022/in-danger-global-aids-update>.
- [15]. Topazian, H. M., et al., 2021, Variations in HIV risk by young women’s age and partner age-disparity in rural South Africa (HPTN 068) ,

<https://pmc.ncbi.nlm.nih.gov/articles/PMC7722780/>.

- [16]. Underwood, C., et al., 2011, Structural determinants of adolescent girls' vulnerability to HIV: Views from community members in Botswana, Malawi, and Mozambique, <https://www.sciencedirect.com/science/article/abs/pii/S0277953611003339>.
- [17]. National Institutes of Health, 2015, Consolidated guidelines on HIV testing services: 5Cs—Consent, confidentiality, counselling, correct results, and connection. <https://www.ncbi.nlm.nih.gov/books/NBK316039/>.
- [18]. Alhasawi, A., Grover, S. B., Sadek, A., Ashoor, I., Alkhabbaz, I., & Almasri, S., 2019, Assessing HIV/AIDS knowledge, awareness, and attitudes among senior high school students in Kuwait. *Medical Principles and Practice*, 28(5), 470–476, <https://doi.org/10.1159/000500307>
- [19]. Ssebunya, R. N., Wanyenze, R. K., Namale, L., Lukolyo, H., Kisitu, G. P., Nahirya-Ntege, P., et al., 2018, Prevalence and correlates of HIV testing among adolescents 10–19 years in a post-conflict pastoralist community of Karamoja region, Uganda. *BMC Public Health*, 18(1), 1–8, <https://doi.org/10.1186/s12889-018-5544-0>.
- [20]. Adugna, D. G., & Worku, M. G., 2022, HIV testing and associated factors among men (15–64 years) in Eastern Africa: A multilevel analysis using the recent demographic and health survey. *BMC Public Health*, 22(1), 1–9.
- [21]. Asresie, M. B., Worku, G. T., & Bekele, Y. A., 2023, HIV testing uptake among Ethiopian rural men: Evidence from 2016 Ethiopian Demography and Health Survey data. *HIV/AIDS – Research and Palliative Care*, 15, 225–234.
- [22]. Nkambule, B. S., et al., 2023, Factors associated with HIV-positive status awareness among adults with long-term HIV infection in four countries in the East and Southern Africa region: A multilevel approach. *PLOS Global Public Health*, 3(12), e0002692.
- [23]. Zegeye, B., et al., 2023, HIV testing among women of reproductive age in 28 sub-Saharan African countries: A multilevel modelling.

International Health, <https://doi.org/10.1093/inthealth/ihad031>.

- [24]. Alem, A. Z., et al., 2022, Determinants of HIV voluntary counselling and testing: A multilevel modelling of the Ethiopian Demographic and Health Survey. *BMC Women's Health*, 22(1), 1–10.
- [25]. Fleming, P. J., Rosen, J. G., Wong, V. J., & Carrasco, M. A., 2019, Shedding light on an HIV blind spot: Factors associated with men's HIV testing in five African countries. *Global Public Health*, 14(9), 1241–1251.
- [26]. Chung, A. H., & Rimal, R. N., 2015, Applying choice architecture principles to understand HIV testing: Findings from Malawi and Zimbabwe. *AIDS Education and Prevention*, 27(4), 362–372.
- [27]. Gazimbi, M. M., & Magadi, M. A., 2019, Individual- and community-level determinants of antenatal HIV testing in Zimbabwe. *Journal of Biosocial Science*, 51(2), 203–224.
- [28]. Oludayo, T., & Adeshewa, J. A., 2012, Transactional sex and the “aristo” phenomenon in Nigerian universities. *Human Affairs*, 22(2), 239–255, <https://doi.org/10.2478/s13374-012-0020-5>.
- [29]. Tafuma, T. A., Mahachi, N., Dziwa, C., Moga, T., Baloyi, P., & Muyambo, G., et al., 2018, Barriers to HIV service utilisation by people living with HIV in two provinces of Zimbabwe: Results from 2016 baseline assessment. *South African Journal of HIV Medicine*, 19(1), 1–6.
- [30]. Gombe, N., 2018, Barriers to HIV testing among adolescents and young adults in Harare City, Zimbabwe. *Texila International Journal of Public Health*, 6(2), 62–68.
- [31]. Peltzer, K., Matseke, G., Mzolo, T., & Majaja, M., 2009, Determinants of knowledge of HIV status in South Africa: Results from a population-based survey. *BMC Public Health*, 9, 174, <https://doi.org/10.1186/1471-2458-9-174>.
- [32]. Weiser, S., Heisler, M., Leiter, K., Percy-de Korte, F., Tlou, S., DeMonner, S., Phaladze, N., Bangsberg, D., & Iacopino, V., 2006, Routine HIV testing in Botswana: A population-based study on attitudes, practices, and human rights concerns. *PLoS Medicine*, 3(7), e261, <https://doi.org/10.1371/journal.pmed.0030261>.

- [33]. Cockcroft, A., Andersson, N., Milne, D., Mokoena, T., & Masisi, M., 2007, Community views about routine HIV testing and antiretroviral treatment in Botswana: Signs of progress from a cross-sectional study. *BMC International Health and Human Rights*, 7, 5, <https://doi.org/10.1186/1472-698X-7-5>.
- [34]. Chernyshov, P. V., 2020, Risk factors for HIV transmission and HIV testing among medical students, <https://pubmed.ncbi.nlm.nih.gov/32650844/>
- [35]. Kalichman, S. C., & Simbayi, L. C., 2003, HIV testing attitudes, AIDS stigma, and voluntary HIV counselling and testing in a Black township in Cape Town, South Africa. *Sexually Transmitted Infections*, 79(6), 442–447.
- [36]. Nyblade, L., Menken, J., Wawer, M., Sewankambo, N., Serwadda, D., Makumbi, F., Lutalo, T., & Gray, R., 2001, Population-based HIV testing and counselling in rural Uganda: Participation and risk characteristics. *Journal of Acquired Immune Deficiency Syndromes*, 28(5), 463–470. *
- [37]. Wang, Y., Chen, Y., Li, Q., Mmbaga, E. J., Chang, J., Kahesa, C., Mbatia, G., & Wang, J., 2022, Factors associated with HIV testing among youth in Tanzania based on the 2016–2017 Tanzania HIV Impact Survey (THIS). *BMC Public Health*, 22, 2426. <https://doi.org/10.1186/s12889-022-14691-3>.
- [38]. Licata, F., Angelillo, S., Nobile, C. G. A., Di Gennaro, G., Bianco, A., 2020, Understanding individual barriers to HIV testing among undergraduate university students: Results from a cross-sectional study in Italy. *Front. Med.* 9:882125. doi: 10.3389/fmed.2022.882125. [DOI] [PMC free article] [PubMed] [Google Scholar]
- [39]. Bekele, Y. A., Fekadu, G. A., 2020, Factors associated with HIV testing among young females; further analysis of the 2016 Ethiopian demographic and health survey data. *PLoS ONE*. 15(2):e0228783. <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0228783>. <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0228783.%20Return%20to%20ref%204%20in%20article> Article CAS PubMed PubMed Central Google Scholar
- [40]. Yohana, B. S., Massito, J., & Moshi, A., 2025, Unpacking the drivers of HIV testing uptake among adolescents and adults in twelve sub-Saharan African countries using Population HIV Impact Assessment data. *Discover Public Health*, 22, Article 776. <https://doi.org/10.1186/s12982-025-01124-1>

Trends and Determinants of Postnatal Care Utilization in South-West Nigeria Using NDHS Data (2013-2024)

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Abstract

Despite readily available information on national-level analyses of Postnatal care utilization, there is a paucity of studies on subnational evidence on postnatal care uptake. This study addresses this gap by examining trend PNC uptake across the South-West states in Nigeria using pooled NDHS data from 2013 to 2024. A secondary analysis of pooled data from the Nigeria Demographic and Health Surveys (NDHS) conducted in 2013, 2018, and 2024 with a final unweighted sample size of 5,514. The study outcome variable is the postnatal care utilization within seven days of delivery among women of reproductive age. Sampling weight was applied to estimates while multivariable multilevel logistic regression models were fitted to examine determinants of PNC uptake. Majority of the study respondent resided in urban area (72.1%), with secondary education being the highest maternal level of education (51.7%). The proportion of PNC uptake dropped drastically from 48.9% in 2013 to 23.9% in 2018 and 22.7% in 2024. Maternal level of education (Tertiary education: AOR=2.26; 95% CI=1.64-3.13) significantly increased the likelihood of PNC utilization among women of reproductive age. Findings revealed a disturbing downward slope in PNC utilization especially in 2024 which call for urgent response in programme design and implementation. Efforts should be reinforced in ensuring female education as a critical step to reduce neonatal and maternal mortality.

Keywords: Education, Maternal health, Nigeria, Postnatal care, Utilization, Determinants

Introduction

Postnatal care (PNC) has been proven to be a cost-effective method for lowering avoidable neonatal and maternal mortality [1, 2]. It is a critical component of the continuum of maternal, newborn, and child health, encompassing care provided to the mother and newborn immediately after birth and during the

first six weeks postpartum. This period is associated with the highest risk of maternal and neonatal morbidity and mortality, with a substantial proportion of maternal deaths and nearly half of neonatal deaths occurring within the first week after delivery [3]. One in every 24 newborns dies within the first 28 days of life, which indicates that a newborn in Nigeria has 13 times higher risk of dying in the neonatal

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period compared with newborns in developing countries [4]. Effective postnatal care provides opportunities for early detection and management of complications, promotion of healthy behaviours such as exclusive breastfeeding, and counselling on family planning, among others.

Despite its recognized importance, postnatal care utilization remains suboptimal in many low- and middle-income countries (LMICs), particularly in sub-Saharan Africa and South Asia [5]. Evidence from Demographic and Health Surveys (DHS) indicates that while antenatal care and skilled birth attendance have improved over time, coverage of timely and adequate postnatal care lags behind, especially for women who deliver at home or in lower-level facilities [6]. Though maternal health indicators have improved during the previous ten years in Nigeria [7, 8], the country still contributes considerably to the worldwide neonatal mortality rate.

In Nigeria, there are significant regional and state-level inequalities. Usually, the South-West geopolitical zone outperforms other areas [9], however, there are state-level differences. Ondo State, for example, has introduced interventions such as free maternity healthcare policies and community-based programs [10-12], which may affect postnatal care use and newborn outcomes.

Although national-level studies of postnatal care utilization and neonatal mortality abound, there is no available data on how postnatal care utilization has changed across South-West Nigeria over time and what explains the differences. Understanding patterns and determinants of postnatal care utilization is essential for improving maternal and neonatal health outcomes.

Methods

Study Design

A cross-sectional study, using pooled data from the Nigeria Demographic and Health

Surveys (NDHS) conducted in 2013, 2018, and 2024. The NDHS employs a nationally representative, stratified two-stage cluster sampling design. Of the six geopolitical zones in the country, this present study focused on data from the South-West geopolitical zone consisting of six states: Ondo, Ekiti, Lagos, Ogun, Osun, and Oyo.

Study Population

The study population comprised recent live births to women of reproductive age who resided in any of the six (6) states in the South-West region of Nigeria. The analysis was based on records from the Children's Recode (KR) file of the 2013, 2018, and 2024 Nigeria Demographic and Health Surveys (NDHS), which contains birth-level information linked to maternal characteristics and postnatal care utilization. Those with missing data on PNC utilization after birth were excluded from the present study.

Data Source and Management

Data from the Children Recode file (KR) of three waves – 2013, 2018, and 2024 – of the Nigeria Demographic and Health Survey were merged and analysed for this study. The KR dataset contains individual records of under-five children across the 36 states of the country. Of the 93,189 records that were obtained in the merged dataset, 5,514 were used for the final analysis after excluding children from states outside the South-West geopolitical zones ($n=45,831$), those with missing data on mother's postnatal care utilization ($n=37,435$), and those whose postnatal care uptake was after seven (7) days ($n=4,408$).

Study Variables

Outcome Variable

The outcome variable is postnatal care (PNC) utilization by mothers of the under-five children after birth, defined as receipt of a postnatal check for the mother and/or newborn

within the recommended postnatal period (7 days).

Explanatory Variables

The main explanatory variable for this study is the geographical location (rural/urban). Other covariates that were considered in this study include socio-demographic characteristics of the child such as sex, multiple birth (i.e singleton/multiple), ever/currently breastfeeding etc. In addition, maternal health factors, including maternal education, household wealth index, among other factors, were considered as covariates in the analysis.

Data Analysis

Sampling weights and survey design effects were applied to ensure representativeness of the participants. Descriptive statistics using mean, standard deviation, frequency and percentages were used to estimate postnatal care utilization for each state and survey year. Trends in postnatal care utilisation from 2013 to 2024

were examined and assessed graphically using a multiple bar chart. Postnatal care utilisation was originally dichotomised in the dataset as 1 – “Baby had postnatal check within 7 days” and 0 otherwise, and was used to fit the regression models. Multivariable multilevel logistic regression models were used to examine predictors of postnatal care utilization, considering the hierarchical/complex nature of the Demographic and Health Survey data. First, univariable multilevel logistic models were fitted to identify factors that independently predict the outcome. Consequently, factors from the univariable models that were statistically significant ($p\text{-value} < 0.05$) were included in the multivariable (adjusted) model. Data cleaning and analysis were conducted using Stata v.16.

Results

Socio-demographic Characteristics of the Study Population (DHS 2013-2024)

Table 1. Weighted and Unweighted Distribution of Socio-demographic Characteristics (DHS 2013-2024)

	Unweighted count (%)	Weighted count (%)
State	N=5,514	N=6,574
Oyo	1168(21.2)	1711(26.0)
Osun	829(15.0)	772(11.7)
Ekiti	667(12.1)	328(5.0)
Ondo	737(13.4)	618(9.4)
Lagos	1228(22.3)	2029(30.9)
Ogun	885(16.0)	1116(17.0)
Year		
2013	2178(39.5)	2485(37.8)
2018	2038(37.0)	2656(40.4)
2024	1298(23.5)	1433(21.8)
Sex of child		
Male	2866(52.0)	3422(52.1)
Female	2648(48.0)	3152(47.9)
Multiple birth		
Singleton	5356(97.2)	6399(97.4)
2nd of multiple	155(2.7)	169(2.6)
3rd of multiple	3(0.1)	6(0.1)
Ever breastfed		
Never	178(3.2)	208(3.2)

Ever/currently breastfeeding	5336(96.8)	6366(96.8)
Place of residence		
Urban	3975(72.1)	5075(77.2)
Rural	1539(27.9)	1499(22.8)
Wealth index		
Poor	622(11.3)	641(9.7)
Middle	837(15.2)	839(12.8)
Rich	4055(73.5)	5094(77.5)
Maternal Highest educational level		
None	585(10.6)	664(10.1)
Primary	1029(18.7)	1214(18.5)
Secondary	2849(51.7)	3429(52.2)
Higher	1051(19.1)	1268(19.3)

As shown in Table 1 above, a total weighted sample of 6,574 under-five children from the different South-West states were recruited into the study. Specifically, majority of them were from Lagos 2029(30.9%) and Oyo state 1711(26.0%), with the least 328(5.0%) from Ekiti state. Also, there was a higher proportion of males (52.1%) compared to females (47.9%) in the study. A vast majority of the children were of single birth 6399(97.4%), leaving only 2.6% as multiple births (i.e., second or third of

multiple births). In addition, most of the children had ever or were currently breastfeeding (96.8%) and resided in an urban area (77.2%). Regarding the maternal highest level of education, the majority of the mothers had a secondary level of education (52.2%), relatively higher than those with higher (19.3%) and primary (18.5%) education.

Trend of Postnatal Care Utilization in South-West, Nigeria

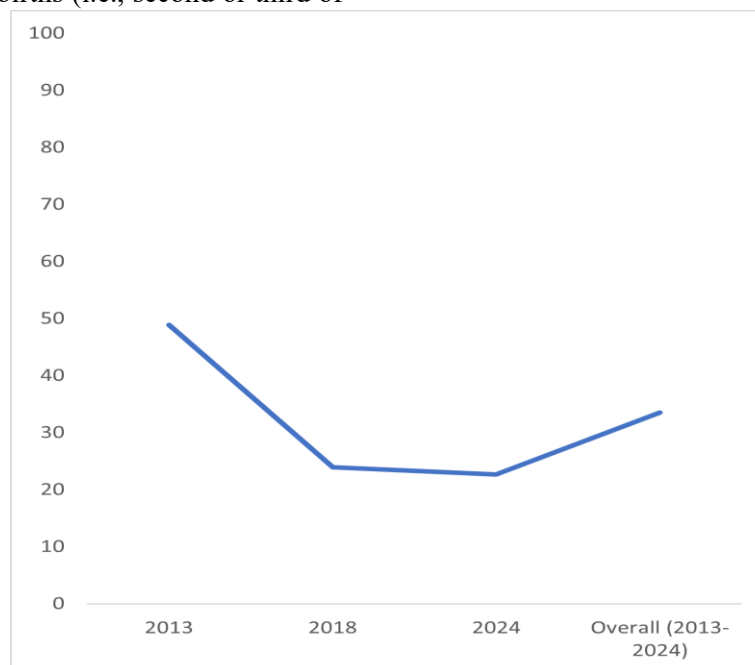


Figure 1. Trend of Postnatal Care Utilization in South-West, Nigeria (2013-2024)

Findings from this study, as depicted in figure 1 reveals a consistent decline in postnatal

care utilization among recent live births of women of reproductive age in Nigeria over the

study period (2013-2024). As displayed in figure1, the proportion of children who received postnatal care after birth was highest in 2013 (48.9%) followed by significant decline to 23.9% in 2018 and further reduction to

22.7% in 2024, indicating a sustained downward trend over time.

Postnatal Care Utilization Predictors

Table 2. Predictors of Postnatal Care Utilization in South-West Nigeria (DHS 2013-2024)

South-West Nigeria				
	OR (95% CI)	p-value	AOR (95% CI)	p-value
Gender				
Male	Ref			
Female	0.99(0.87-1.13)	0.940		
Birth type				
Singleton	Ref			
2nd of multiple	1.02(0.69-1.49)	0.907		
3rd of multiple	2.55(0.18-35.71)	0.486		
Breastfeed				
Ever	Ref		Ref	
Never	0.24(0.14-0.38)	<0.001	0.23(0.14-0.38)	<0.001
Residence				
Urban	Ref		Ref	
Rural	0.58(0.47-0.72)	<0.001	0.81(0.63-1.05)	0.123
Wealth index				
Poor	Ref		Ref	
Middle	1.85(1.36-2.53)	<0.001	1.44(1.04-1.99)	0.025
Rich	2.75(2.06-3.68)	<0.001	1.70(1.23-2.37)	0.001
Maternal education				
No formal	Ref		Ref	
Primary	2.25(1.68-3.01)	<0.001	1.87(1.38-2.53)	<0.001
Secondary	2.05(1.56-2.69)	<0.001	1.83(1.37-2.45)	<0.001
Higher	2.62(1.94-3.54)	<0.001	2.26(1.64-3.13)	<0.001
Year				
2013	Ref		Ref	
2018	0.24(0.19-0.30)	<0.001	0.24(0.19-0.31)	<0.001
2024	0.21(0.17-0.26)	<0.001	0.22(0.18-0.27)	<0.001
State				
Oyo	Ref		Ref	
Osun	1.62(1.20-2.19)	0.002	1.19(0.88-1.62)	0.240
Ekiti	1.13(0.81-1.56)	0.454	1.12(0.81-1.55)	0.473
Ondo	0.94(0.69-1.26)	0.694	1.06(0.77-1.44)	0.712
Lagos	2.83(2.15-3.72)	<0.001	1.31(0.99-1.74)	0.054
Ogun	0.93(0.70-1.24)	0.654	0.61(0.45-0.83)	0.002

The major determinants of postnatal care utilization in South-West Nigeria identified include Child breastfeeding status, household wealth index, maternal education attainment, as well as child's state of residence.

As presented in Table 2, children who were never breastfed had an 79% lower likelihood of receiving postnatal care after birth (AOR=0.23; 95% CI=0.14-0.39; p-value<0.001). Similarly, children from the 2018 DHS survey (AOR=0.25; 95% CI=0.19-0.31; p-value<0.001) and those from the most recent 2024 survey (AOR=0.22; 95% CI=0.18-0.27; p-value<0.001) were remarkably less likely to receive postnatal care uptake.

On the contrary, the household wealth index, maternal education, and state of residence were significant predictors for Postnatal care utilization. Specifically, children from the middle wealth quantile were 1.44 more likely to receive postnatal care compared to those in the poor households (95% CI=1.04-1.99; p-value=0.025). While those from the rich households had higher odds (AOR=1.70; 95% CI=1.23-2.37; p-value=0.001). Likewise, maternal education had a positive association with PNC utilization. Mothers with primary education (AOR=1.87; 95% CI=1.38-2.53; p-value<0.001), secondary education (AOR=1.83; 95% CI=1.37-2.45; p-value<0.001), and tertiary education (AOR=2.26; 95% CI=1.64-3.13; p-value<0.001) were more likely to utilize postnatal care for their children compared to those with no formal education.

In term of geographical variation, children residing in Ogun state had significantly lower odds of receiving postnatal care (AOR=0.61; 95% CI=0.45-0.83; p-value<0.001), compared to those in Oyo state.

Discussion

This study investigated the prevalence of postnatal care utilisation in the South-West Geopolitical zone in Nigeria using data from

the 2013, 2018, and 2024 waves of the DHS survey.

Regional and Temporal Changes in Uptake of Postnatal Care

The observed strong association between postnatal care uptake across all survey waves and state of residence highlight the need of subnational context in maternal and newborn health service utilization. While Lagos State recorded the highest postnatal care uptake in 2013, subsequent survey waves revealed a shift in peak to Ekiti and Ondo States in 2018, followed by a significant decline across all South-West states by 2024. Given the critical function of postnatal care in early detection and prompt treatment of neonatal complications—which contribute substantially to under-five mortality—the decline noted in most recent survey wave (2024) is very disturbing. The reduction in PNC uptake might represent general institutional related issues, including health system disruptions, competing healthcare priorities, or diminished accessibility to essential health services [13-15]. Comparable changes in maternal and child health service use have been recorded in low- and middle-income nations during times of health system stress [16, 17], highlighting the need for resilient and sustainable postnatal care delivery systems.

Determinants of Postnatal Care Uptake

Additionally, this study identified the major determinants of postnatal care uptake, including maternal education, household wealth index, place of residence, and breastfeeding status. The observed positive wealth index and postnatal care utilization dose-response relationship points to socioeconomic disparities in access to maternal and neonatal health services even within middle and rich wealth index. Similar findings have been documented in previous studies in Nigeria, when women from wealthier households and those with higher education

attainment were more likely to utilize postnatal care services [18].

Another notable determinant of postnatal uptake was maternal education; which is consistent with existing documented evidence that educated women are more likely to notice danger signs, seek prompt treatment, and navigate healthcare systems effectively [19-21]. Conversely, reduced postnatal care utilization among rural people highlights continuing geographical obstacles/barriers including long distance to services and limited availability of skilled health providers [22].

Overall, the results of this study indicate that improving postnatal care uptake in the South-West requires more than just expanding the postnatal care service coverage. Targeted efforts to address socioeconomic inequalities, promote exclusive breastfeeding practices, and ensure the quality, accessibility and continuity of postnatal service are vital for improving the maternal and neonatal health outcomes.

Conclusion

This study provides strong evidence of considerable subnational diversity in postnatal care uptake across the six states in the South-West Geopolitical Zone of Nigeria. Though zonal maternal and child health indicators are relatively good, there is a worrisome decline in the postnatal care in 2024. These findings spotlight the fragility of recent gains in maternal and newborn health and highlight the need for sustained, context-specific

interventions to strengthen PNC uptake and provision.

Conflict of Interest

The authors declare there is no conflict of interest.

Ethical Approval

This study is based on secondary analysis of NDHS data. Therefore, it leveraged on the NHREC clearance for conduct of the 3 NDHS in the country.

Data Availability

The data is publicly available on the DHS portal (<https://dhsprogram.com/>).

Author Contributions

- **Adeyinka Odejimi:** Conceptualization of paper, manuscript drafting, data analysis, and interpretation.
- **Tolulope O. Afolaranmi:** Manuscript review, analysis interpretation, supervision.
- **Samson. O. Bamiwuye:** Data analysis.
- **Gabriel D. Ogunde:** Analysis and interpretation review.

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References

- [1]. Tiruneh, G. T., Shiferaw, C. B., Worku, A., 2019, Effectiveness and cost-effectiveness of home-based postpartum care on neonatal mortality and exclusive breastfeeding practice in low- and middle-income countries: a systematic review and meta-analysis. *BMC Pregnancy Childbirth*, 19(1), 507, <https://doi.org/10.1186/s12884-019-2651-6>
- [2]. Ariff, S., Jiwani, U., Rizvi, A., Muhammad, S., Hussain, A., Ahmed, I., Hussain, M., Usman, M.,

- Iqbal, J., Memon, Z., Soofi, S. B., Bhutta, Z. A., 2024, Effect of maternal and newborn care service package on perinatal and newborn mortality: a cluster randomized clinical trial. *JAMA Netw Open*, 7(2), e2356609, <https://doi.org/10.1001/jamanetworkopen.2023.56609>
- [3]. Dol, J., Hughes, B., Bonet, M., Dorey, R., Dorling, J., Grant, A., Langlois, E. V., Monaghan, J., Ollivier, R., Parker, R., Roos, N., Scott, H., Shin, H. D., Curran, J., 2022, Timing of maternal

- mortality and severe morbidity during the postpartum period: a systematic review. *JBISynth*, 20(9), 2119–2194, <https://doi.org/10.11124/JBIES-20-00578>
- [4]. United Nations Inter-agency Group for Child Mortality Estimation (UN IGME), 2024, Levels and trends in child mortality: report 2024. *United Nations Children's Fund*, <https://childmortality.org/>
- [5]. Baten, A., Biswas, R. K., Kendal, E., Bhowmik, J., 2025, Utilization of maternal healthcare services in low- and middle-income countries: a systematic review and meta-analysis. *Syst Rev*, 14(1), 88, <https://doi.org/10.1186/s13643-025-02832-0>
- [6]. Morakinyo, O. M., Fagbamigbe, A. F., 2017, Neonatal, infant and under-five mortalities in Nigeria: an examination of trends and drivers (2003–2013). *PLoS One*, 12(8), e0182990, <https://doi.org/10.1371/journal.pone.0182990>
- [7]. Adeyinka, D. A., Muhajarine, N., 2024, Geographic inequities in neonatal survival in Nigeria: a cross-sectional evidence from spatial and artificial neural network analyses. *Journal of Biosocial Science*, 56(5), 896–919, <https://doi.org/10.1017/S0021932024000282>
- [8]. Agiri, U. A., Paul, O., Adjugh, J., Ndubuisi-Igwilo, O., 2023, Relationship between socio-demographic characteristics and the pattern of birth preparedness and complication readiness among pregnant women attending the antenatal clinic in UPTH. *Nigerian Journal of Medicine*, 32(5), 480–486, https://doi.org/10.4103/NJM.NJM_136_23
- [9]. Ajayi, A. I., Akpan, W., 2017, Who benefits from free institutional delivery? Evidence from a cross-sectional survey of North Central and Southwestern Nigeria. *BMC Health Serv Res*, 17, 620, <https://doi.org/10.1186/s12913-017-2560-1>
- [10]. Oyeneyin, L., van den Akker, T., Durojaiye, O., 2019, Confidential enquiries into maternal deaths in Ondo State, Nigeria – a comparative analysis. *BMC Pregnancy Childbirth*, 19, 514, <https://doi.org/10.1186/s12884-019-2659-y>
- [11]. Ajayi, A. I., Akpan, W., 2020, Maternal health care services utilisation in the context of 'Abiye' (safe motherhood) programme in Ondo State, Nigeria. *BMC Public Health*, 20(1), 362, <https://doi.org/10.1186/s12889-020-08512-z>
- [12]. Uzuegbu, C. N., Nnama-Okechukwu, C. U., Udeze, O. N., 2024, Access to maternal and child health care services in primary health care centers in Nigeria: perspectives from primary health care nurses. *J Hum Rights Soc Work*, 9, 606–614, <https://doi.org/10.1007/s41134-024-00320-4>
- [13]. Dzinamarira, T., Moyo, E., Pierre, G., Mpabuka, E., Kahere, M., Tungwarara, N., Chitungo, I., Murewanhema, G., Musuka, G., 2023, Postnatal care services availability and utilization during the COVID-19 era in sub-Saharan Africa: a rapid review. *Women Birth*, 36(3), 295–299, <https://doi.org/10.1016/j.wombi.2022.10.002>
- [14]. Akaba, G. O., Dirisu, O., Okunade, K. S., Adams, E., Ohioghame, J., Obikeze, O. O., Izuka, E., Sulieman, M., Edeh, M., 2022, Barriers and facilitators of access to maternal, newborn and child health services during the first wave of the COVID-19 pandemic in Nigeria: findings from a qualitative study. *BMC Health Serv Res*, 22, 611, <https://doi.org/10.1186/s12913-022-07996-2>
- [15]. Aranda, Z., Binde, T., Tashman, K., Tadikonda, A., Mawindo, B., Maweu, D., Boley, E. J., Mphande, I., Dumbuya, I., Montaña, M., Clisbee, M., Mvula, M. G., Ndayizigiye, M., Casella, J. B., Varney, P. F., Anyango, S., Grépin, K. A., Law, M. R., Mugunga, J. C., Hedt-Gauthier, B., 2021, Disruptions in maternal health service use during the COVID-19 pandemic in 2020: experiences from 37 health facilities in low- and middle-income countries. *BMJ Glob Health*, 7(1), e007247, <https://doi.org/10.1136/bmjgh-2021-007247>
- [16]. Ahmed, T., Robertson, T., Vergeer, P., Hansen, P. M., Peters, M. A., Ofosu, A. A., Mwansambo, C., Nzelu, C., Wesseh, C. S., Smart, F., Alfred, J. P., Diabate, M., Baye, M., Yansane, M. L., Wendrad, N., Mohamud, N. A., Mbaka, P., Yuma, S., Ndiaye, Y., Sadat, H., Uddin, H., Kiarie, H., Tsihory, R., Mwinnyaa, G., de Dieu Rusatira, J., Amor Fernandez, P., Muhoza, P., Baral, P., Drouard, S., Hashemi, T., Friedman, J., Shapira, G., 2022, Healthcare utilization and maternal and child mortality during the COVID-19 pandemic in 18 low- and middle-income countries: an interrupted time-series analysis with mathematical modeling of

administrative data. *PLoS Med*, 19(8), e1004070, <https://doi.org/10.1371/journal.pmed.1004070>

[17]. Adebawale, A. S., Fagbamigbe, A. F., Akinyemi, J. O., 2021, Regional differences in maternal healthcare utilization in Nigeria: a multilevel analysis. *BMC Health Serv Res*, 21, 111, <https://doi.org/10.1186/s12913-020-05700-w>

[18]. Amwonya, D., Kigosa, N., Kizza, J., 2022, Female education and maternal health care utilization: evidence from Uganda. *Reprod Health*, 19, 142, <https://doi.org/10.1186/s12978-022-01432-8>

[19]. Hassen, S. S., Lelisho, M. E., 2022, Determining factors associated with the prevalence of knowledge, attitude, and practice in seeking skilled maternal healthcare services among women in a remote area of Gesha district. *BMC Health Serv Res*, 22, 1318, <https://doi.org/10.1186/s12913-022-08710-y>

[20]. Gesese, S. S., Mersha, E. A., Balcha, W. F., 2023, Knowledge of danger signs of pregnancy and health-seeking action among pregnant women: a health facility-based cross-sectional study. *Ann Med Surg (Lond)*, 85, 1722–1730, <https://doi.org/10.1097/MS9.0000000000000610>

[21]. Ntoimo, L. F. C., Okonofua, F. E., Igboin, B., Ekwo, C., Imongan, W., Yaya, S., 2019, Why rural women do not use primary health centres for pregnancy care: evidence from a qualitative study in Nigeria. *BMC Pregnancy Childbirth*, 19, 277, <https://doi.org/10.1186/s12884-019-2433-1>

[22]. Solanke, B. L., Rahman, S. A., 2018, Multilevel analysis of factors associated with assistance during delivery in rural Nigeria: implications for reducing rural-urban inequity in skilled care at delivery. *BMC Pregnancy Childbirth*, 18, 438, <https://doi.org/10.1186/s12884-018-2074-9>

Family Functioning and its Association with Alcohol Use Disorder among Adolescents in Southwestern Uganda: A Cross-Sectional Study

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Abstract

This study investigates the association between family functioning and the severity of alcohol use disorders (AUD) among adolescents in Southwestern Uganda. Focusing on dimensions such as family cohesion, adaptability, communication, and satisfaction, the research explores how familial relationships and sociodemographic factors influence adolescent alcohol use. A cross-sectional study was conducted from September to December 2019 in Ibanda District, involving 308 adolescents aged 10 to 19 years. Participants were selected through multistage sampling, and data were collected using the Alcohol Use Disorders Identification Test (AUDIT) and the Family Adaptability and Cohesion Evaluation Scale IV (FACES IV). Ordered logistic regression was used to assess predictors of AUD severity. The findings revealed that 21.1% of participants were classified as hazardous drinkers, 9.1% as harmful drinkers, and 9.7% as dependent drinkers. Higher levels of family cohesion were associated with increased odds of more severe AUD classification (OR = 1.14, $p < 0.001$), suggesting possible enabling or permissive dynamics in certain family contexts. In contrast, higher levels of adaptability (OR = 0.79, $p < 0.001$) and satisfaction (OR = 0.82, $p = 0.003$) were protective against severe alcohol use. Additionally, lower household income, non-nuclear living arrangements, and unstable family structures were significantly associated with greater AUD severity. These findings underscore the critical role of family dynamics and socioeconomic conditions in shaping adolescent alcohol use behaviours. The study highlights the need for family-centred and context-sensitive interventions that strengthen adaptability and satisfaction within the family unit, while also addressing underlying structural vulnerabilities.

Keywords: Adolescents, Alcohol Use Disorder, Family Functioning, Southwestern Uganda.

Introduction

Alcohol use among adolescents has emerged as a significant public health concern worldwide, with urgency in regions like Southwestern Uganda. The World Health Organization (WHO) reports that harmful

alcohol consumption accounts for 5.3% of all deaths globally and constitutes a considerable portion of morbidity among youth [1]. The early onset of alcohol use in adolescents is closely linked to a myriad of mental health disorders, which may subsequently compromise long-term health outcomes [2-8].

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Adolescence, a pivotal developmental phase marked by exploration, identity formation, and heightened risk-taking behaviors, is particularly susceptible to the influences of alcohol and other psychoactive substances [9]. Within this context, alcohol stands out as the most widely consumed psychoactive substance among adolescents, contributing substantially to the global burden of disease and injury [1]. In Uganda, recent epidemiological studies reveal that the prevalence of alcohol use among adolescents ranges from 20% to 35%, with higher rates documented in rural and peri-urban areas [10]. In light of such an alarming trend, there is a need for an understanding of the factors that shape adolescent alcohol use, particularly the role of family functioning.

Evidence has demonstrated that family plays a major role in shaping adolescents' health behaviors, including Alcohol use [11]. According to the family systems theory, the family is viewed as an interdependent system in which any interactions and changes among family members not only influence the balance of the whole system but also significantly impact the behavior of each member [12]. For families to effectively support children's developmental needs, they must first achieve optimal family functioning. Family functioning refers to the family's ability to manage everyday life and cope effectively with problems and changes, including effective emotional bonding among family members, family communication, and the management of external events [13-14].

According to the Circumplex Model of the family system, family functioning encompasses four dimensions: cohesion, adaptability, communication, and satisfaction, which are essential for adolescent stability [15]. Family cohesion is defined as the emotional bonding among family members, while family adaptability is the ability of a family to adapt to problems arising from family circumstances and developmental stages [15].

Research consistently indicates that these dimensions are intricately linked to adolescent health behaviors, including substance use [16-18]. Poor family relationships, characterized by parental neglect, inter-parental conflict, and inconsistent disciplinary practices, have been associated with elevated rates of adolescent substance use, including alcohol [19, 20]. Conversely, robust family bonds and effective communication have been identified as protective factors that can mitigate the risk of substance abuse among young people [21, 22].

Dysfunctional family environments, typified by inadequate communication, lack of emotional support, and insufficient parental supervision, are associated with poor mental health among family members [23, 24] and have been shown to correlate with an increased risk of alcohol and substance abuse among adolescents [20, 21, 25]. Much of the existing literature in Uganda and elsewhere has concentrated on factors such as peer pressure, economic hardship, or the school environment, thereby leaving a significant gap in our understanding of family-level dynamics [2, 26-27], and particularly family functioning dimensions. This study seeks to fill the existing gaps by providing empirical evidence on the association between family functioning dimensions and alcohol use disorder among adolescents in Southwestern Uganda. Understanding these dynamics is essential for developing targeted interventions that address the root causes of adolescent alcohol use and to promote healthier family environments.

Family Functioning and Adolescent Alcohol Use Disorder

The findings of the present study are echoed by multiple international studies. For instance, a curvilinear relationship has been demonstrated between family adaptability/cohesion and adolescent externalizing behaviours, including substance use [15]. Adolescents in families that were either too rigid or overly enmeshed were more

likely to engage in alcohol-related risk behaviours, illustrating the complexity and potential non-linearity in family influences. Further support of this it was established that low family functioning, as measured by poor communication and low satisfaction, significantly increased alcohol consumption among university students in Spain [28]. These findings support the argument that dysfunctional family dynamics continue to affect drinking behaviour even into young adulthood, suggesting enduring developmental impacts. A study among the youth in Bhutan identified both social and familial predictors of alcohol misuse, including limited parental oversight and normalized family drinking patterns [29]. These findings suggest that in collectivist or close-knit societies, high levels of perceived cohesion might mask permissive attitudes toward alcohol, aligning with the counterintuitive result in our study that higher cohesion was associated with more severe AUD categories.

Studies from low- and middle-income countries provide further context. In a community-based study carried out in Ethiopia, it was found that low income, rural residency, and poor family relationships significantly predicted alcohol use disorders [30]. Their findings reinforce the importance of socioeconomic and environmental stressors as critical moderators of adolescent health behaviours. Moreover, in sub-Saharan African urban settings, unstable family structures and absent parental figures are associated with increased substance abuse among youth [31]. The research highlighted the importance of family presence and structure, not just emotional bonds, in buffering adolescents from risky behaviours.

Beyond family factors, sociodemographic characteristics such as low household income, poor educational attainment, and limited parental supervision repeatedly emerge as consistent predictors of adolescent alcohol use across contexts [14, 32]. These variables often

compound the effects of dysfunctional family environments, creating a multi-layered risk profile for vulnerable adolescents.

Together, these studies underscore the multifactorial and systemic nature of adolescent alcohol misuse. They also validate the use of comprehensive family functioning tools such as FACES IV [14], which assess not only emotional closeness and flexibility but also communication quality and satisfaction, dimensions shown to predict AUD severity across multiple contexts. The present study thus builds upon this literature by examining how family functioning and sociodemographic characteristics jointly influence the severity (not merely presence) of alcohol use disorders among adolescents in Uganda, using both validated psychometric scales and robust statistical models. It contributes to the growing body of evidence advocating for family-centred interventions in addressing adolescent substance use in sub-Saharan Africa.

Materials and Methods

Study Design and Setting

This study employed a cross-sectional design conducted between September and December 2019 in Ibanda District, located in Southwestern Uganda. The district is characterized by a mixture of rural and peri-urban communities and a high concentration of adolescents, making it a suitable location for examining youth behavioral health outcomes. The study sought to investigate the association between family functioning and alcohol use disorders (AUD) among adolescents in this socioeconomically diverse setting.

Study Population and Sampling Procedure

The study population comprised adolescents aged 10 to 19 years. A total sample size of 308 participants was determined using Cochran's formula, assuming a 50% prevalence, a 95% confidence

level, and a 5% margin of error. A multistage sampling method was applied. First, sub-counties were randomly selected, followed by random selection of households with eligible adolescents.

Data Collection Tools and Measures

Alcohol Use Disorder was assessed using the Alcohol Use Disorder Identification Test (AUDIT) developed by the World Health Organization [33]. This study adopted the Alcohol Use Disorder classification, which categorizes adolescents into four distinct levels: no disorder, hazardous use, harmful use, and dependent use. Family Functioning was assessed using the Family Adaptability and Cohesion Evaluation Scale IV (FACES IV), a validated tool that measures four core domains relevant to this study: family cohesion, flexibility, communication, and satisfaction [14]. Higher balanced scores indicate healthier family functioning, while unbalanced scores suggest dysfunction [14]. Sociodemographic information was also collected using a structured questionnaire adapted to the Ugandan context.

Data Management and Analysis

All data were entered and cleaned using EpiData and exported to Stata for analysis. Descriptive statistics were first conducted to summarize participant characteristics, including means, standard deviations, and frequency distributions. To examine preliminary associations between key study variables and alcohol use disorder (AUD) severity, bivariate analyses were conducted. AUD severity was operationalized using the Alcohol Use Disorders variable, a four-level ordinal variable representing categories of alcohol use: no disorder, hazardous use, harmful use, and dependence. For categorical sociodemographic variables, Pearson's Chi-square tests were used to assess group differences across AUD categories. For continuous variables, one-way analysis of

variance (ANOVA) and Kruskal–Wallis rank tests were used to compare family functioning subdomains across AUD severity categories.

In the multivariable analysis, an ordered logistic regression model was fitted to examine the relationship between family functioning dimensions and the severity of AUD. The ordinal dependent variable was Alcohol Use Disorder, and the key predictors included cohesion, adaptability, communication, and satisfaction, adjusted for age, sex, income, education, and family structure. This model was appropriate for analyzing the ordered nature of AUD severity categories. To assess potential multicollinearity among independent variables, Variance Inflation Factors (VIFs) were calculated. Results indicated that communication (VIF = 6.41) and satisfaction (VIF = 6.38) showed moderate multicollinearity, but all other variables had acceptable VIFs below 3. The overall mean VIF of 2.62 indicated that the model was sufficiently robust, and no variables were excluded from the multivariate analysis due to multicollinearity concerns. Model diagnostics were conducted to assess goodness of fit. The ordered logistic regression model yielded a log-likelihood of -181.59, a likelihood ratio chi-squared statistic of 314.11 ($p < 0.001$), and a pseudo- R^2 of 0.464, indicating a well-fitting model that explains a substantial portion of the variability in AUD severity among adolescents.

Results

A total of 308 adolescents participated in the study, and their responses were analyzed to identify patterns and associations that may inform future interventions and policy.

Descriptive Statistics

The study sample comprised 308 adolescents with a mean age of 15.42 years (SD = 2.17), ranging from 11 to 19 years, as reflected in Table 1. In terms of

socioeconomic background, the mean household income level was 2.74 (SD = 0.87) on a 5-point scale, indicating that most participants came from lower to middle-income households. Education level, rated on a 3-point scale, had a mean of 1.29 (SD = 0.47), suggesting that most participants were still in the early stages of formal education, likely in primary or early secondary school.

The mean score for family structure was 2.29 (SD = 1.78), indicating broad variation in family configurations, including single-parent households, extended families, and child-headed households. Living arrangements, measured on a 5-point scale, had a mean of 2.18 (SD = 0.66), indicating that while many adolescents resided with their biological parents, a substantial proportion lived with

other guardians or in alternate arrangements. Regarding relationship status, nearly all adolescents reported being single (mean = 1.01, SD = 0.08), which is consistent with their age profile.

The average number of children per household was 5.24 (SD = 1.33), with most families having between 4 and 7 children. This finding underscores the relatively large household sizes typical in the study setting, which may influence resource distribution and parenting dynamics. In terms of family functioning, the participants reported moderate to high scores on several domains: cohesion (mean = 25.44, SD = 4.30), adaptability (mean = 20.11, SD = 6.88), communication (mean = 14.79, SD = 5.53), and satisfaction (mean = 14.91, SD = 5.56).

Table 1. Descriptive Results

Variable	Obs	Mean	Std. Dev.	Min	Max
Age	308	15.42	2.17	11	19
Income	308	2.74	0.87	1	5
Education	308	1.29	0.47	1	3
Family Structure	308	2.29	1.78	1	6
Cohesion	308	25.44	4.30	10	34
Adaptability	308	20.11	6.88	7	38
Communication	308	14.79	5.53	5	25
Satisfaction	308	14.91	5.56	5	25
Living arrangement	308	2.18	0.66	1	5
Relationship status	308	1.01	0.08	1	2
Number of children	308	5.24	1.33	3	7

Family Functioning by AUD Category

Bivariate analysis revealed clear and statistically significant differences in family functioning scores across levels of alcohol use disorder (AUD) severity (Table 2). Adolescents with no AUD reported the lowest average score in family cohesion (mean = 24.52, SD = 4.87), while those classified under hazardous (mean = 27.05, SD = 2.56), harmful (mean = 26.39, SD = 3.72), and dependent (mean = 26.80, SD = 2.02) drinking categories showed higher cohesion scores. This pattern may reflect a possible misperception of

cohesion among adolescents with AUD, where close-knit family relationships could be enabling or permissive toward risky alcohol consumption.

In contrast, adaptability scores were significantly higher among adolescents with no AUD (mean = 24.74, SD = 4.36) and substantially lower among those in the hazardous (mean = 13.43, SD = 3.79), harmful (mean = 12.54, SD = 2.35), and dependent (mean = 13.43, SD = 2.18) categories. This indicates that families of adolescents with more severe AUD tend to be less flexible and

may struggle to adapt to challenges, potentially contributing to the escalation of alcohol-related problems.

Similarly, communication and satisfaction scores showed a declining trend with increasing levels of AUD severity. Adolescents with no disorder reported higher communication (mean = 18.22, SD = 4.03) and satisfaction (mean = 18.45, SD = 3.91) scores than their peers in the hazardous, harmful, or dependent groups, whose mean scores ranged from 9.03 to 9.94 for both domains. These findings suggest that deficiencies in effective communication and relational satisfaction within the family may

exacerbate the risk and progression of alcohol use disorders.

Overall, the bivariate results emphasize the critical role that various dimensions of family functioning play in shaping the severity of adolescent alcohol use. Specifically, while higher cohesion may appear protective, its elevated levels among adolescents with AUD may reflect complex or enabling dynamics. Meanwhile, adaptability, communication, and satisfaction emerge as clear protective factors, underscoring the need for family-based interventions that strengthen these components.

Table 2. Mean (Standard Deviation) of Family Functioning Dimensions by Alcohol Use Disorder (AUD) Category

AUD Severity	Cohesion Mean (SD)	Adaptability Mean (SD)	Communication Mean (SD)	Satisfaction Mean (SD)
No Disorder	24.52 (4.87)	24.74 (4.36)	18.22 (4.03)	18.45 (3.91)
Hazardous	27.05 (2.56)	13.43 (3.79)	9.92 (2.87)	9.94 (2.44)
Harmful	26.39 (3.72)	12.54 (2.35)	9.46 (1.53)	9.07 (2.05)
Dependent	26.80 (2.02)	13.43 (2.18)	9.03 (3.21)	9.27 (3.43)

Ordered Logistic Regression Results

To further explore the relationships between family functioning, sociodemographic factors, and AUD severity, an ordered logistic regression analysis was conducted. The results are summarized in Table 3, which presents the odds ratios (OR) for each predictor variable.

Regression Analysis

The multivariable ordered logistic regression model revealed several important associations between family functioning dimensions, sociodemographic factors, and the severity of Alcohol Use Disorders (AUD) among adolescents. Family Cohesion was significantly associated with increased odds of being in a more severe AUD category (OR = 1.14, $p < 0.001$). This seemingly

counterintuitive finding suggests that, in some family contexts, strong cohesion may reflect enmeshment or permissive environments that inadvertently facilitate risky drinking behaviours.

In contrast, Family Adaptability showed a strong protective effect (OR = 0.79, $p < 0.001$), indicating that adolescents from flexible and resilient family systems are less likely to develop more severe forms of AUD. Family Satisfaction also emerged as a significant protective factor (OR = 0.81, $p = 0.003$), highlighting the buffering role of positive family relationships. Communication did not show a statistically significant relationship with AUD severity (OR = 0.95, $p = 0.496$), suggesting that while communication remains a vital component of family dynamics, it may

not have a direct measurable influence on the severity of adolescent alcohol use.

Among sociodemographic variables, lower household income was significantly associated with higher AUD severity (OR = 0.66, $p=0.012$). This finding reflects the influence of economic stress on adolescent behavior and outcomes. Family Structure was marginally significant (OR = 0.85, $p=0.055$), indicating a potential trend where less stable family setups are linked to greater alcohol problems. Other variables such as age, sex, education, living arrangement, relationship status, and number

of children in the family were not significantly associated with AUD severity. These findings underscore the critical role of family functioning and economic context in shaping adolescent alcohol-related outcomes. The overall model demonstrated satisfactory explanatory power, with a log-likelihood of -207.74 and a likelihood ratio chi-square statistic of 187.72 ($df=12$, $p<0.001$). The pseudo R^2 value of 0.3113 indicates that approximately 31.1% of the variability in AUD severity is explained by the predictors included in the model.

Table 3. Logistic Regression Results Predicting Probability of AUD

Predictor Variable	Unadjusted OR	95% CI	p-value	Adjusted OR	95% CI	p-value
Cohesion	1.1	1.06 – 1.14	<0.001	1.15	1.09 – 1.21	<0.001
Adaptability	0.78	0.75 – 0.82	<0.001	0.78	0.73 – 0.84	<0.001
Communication	0.92	0.87 – 0.98	0.009	0.94	0.86 – 1.03	0.171
Satisfaction	0.8	0.75 – 0.85	<0.001	0.78	0.72 – 0.85	<0.001
Age	0.94	0.85 – 1.03	0.185	0.91	0.80 – 1.03	0.136
Sex (1=Male)	0.89	0.53 – 1.48	0.643	0.92	0.49 – 1.74	0.799
Income	0.67	0.50 – 0.88	0.005	0.7	0.51 – 0.96	0.028
Education	0.72	0.44 – 1.18	0.192	0.74	0.42 – 1.28	0.274
Family Structure	0.79	0.68 – 0.92	0.002	0.83	0.69 – 0.99	0.04
Living Arrangement	0.9	0.60 – 1.34	0.602	1	0.63 – 1.60	0.998
Relationship Status	1.05	0.60 – 1.85	0.867	1.16	0.61 – 2.20	0.651
Number of Children in Family	1.02	0.87 – 1.20	0.768	1.03	0.86 – 1.24	0.725
N= 308						
Log Likelihood = -207.74						
LR $\chi^2(9)$ = 187.72, $p < 0.001$						
Pseudo R^2 = 0.3113						

Discussion

This study examined the associations between family functioning, sociodemographic factors, and the severity of Alcohol Use Disorders (AUD) among adolescents in Uganda. Drawing on a cross-sectional sample of 308 adolescents aged 10–19 years, the results provide nuanced insights into how family dynamics and socioeconomic contexts shape the severity and progression of adolescent alcohol use. The findings reinforce a growing consensus in the literature that indicates adolescent alcohol use as not solely an individual behavioral issue, but rather a family and community-level concern influenced by structural, relational, and contextual determinants [19, 21].

The study revealed a substantial prevalence of alcohol-related problems among adolescents, with 21.1% categorized as hazardous drinkers, 9.1% as harmful drinkers, and 9.7% as dependent drinkers. Comparable findings have been documented across sub-Saharan Africa, including studies in Ethiopia [30] and Nigeria [34], where adolescent alcohol use was strongly linked to familial instability and economic hardship. Together, these findings underscore that adolescent drinking patterns in low- and middle-income contexts are often shaped by both household vulnerability and community norms surrounding alcohol.

The relationship between family functioning and AUD severity in this study was complex and multidimensional. Higher levels of family cohesion were associated with increased odds of being in a more severe AUD category. While cohesion is traditionally viewed as protective, this counterintuitive result may reflect dynamics of enmeshment or permissive family norms, where close familial bonds inadvertently enable or normalize alcohol consumption. Similar interpretations have been advanced, indicating that excessive cohesion, without boundaries or adaptability, can foster environments where risky

behaviours are tolerated or reinforced [15, 16, 29]. In such families, adolescents may perceive alcohol use as an acceptable coping mechanism or social norm.

Conversely, adaptability and family satisfaction emerged as significant protective factors against severe AUD. Families characterized by flexibility, effective problem-solving, and emotional balance were less likely to have adolescents with higher AUD severity. These findings are consistent with studies which emphasized that adaptability, being the ability to adjust to changing family demands, is central to preventing maladaptive coping behaviors such as substance use [14, 35]. Similarly, emotional satisfaction within families has been identified as a key buffer against adolescent substance misuse [19]. Positive family interactions were also found buffer against adolescent substance use. Studies found out that adolescents who feel emotionally supported and satisfied within their families may develop stronger resilience and lower susceptibility to peer or social pressures to consume alcohol [34, 36–39].

Interestingly, communication did not emerge as a significant predictor of AUD severity in the adjusted model. This may suggest that communication, while important, is not sufficient in isolation. Rather, its protective potential may depend on its integration within an adaptive and supportive family system. As observed in their Kenyan family therapy intervention, improvements in family communication had the greatest impact when accompanied by broader improvements in cohesion and adaptability [21].

Beyond family functioning, sociodemographic variables such as household income, family structure, living arrangement, and number of children significantly influenced AUD severity. Adolescents from lower-income households and unstable family structures were more likely to experience severe forms of alcohol use, echoing prior findings that economic vulnerability and

instability amplify the risk of substance use [30, 32]. Moreover, adolescents from large families or non-traditional living arrangements (such as living with extended relatives or guardians) demonstrated higher odds of severe AUD. This may reflect both resource constraints and reduced parental supervision, consistent with youth populations in eastern Africa [18, 31].

In contrast, age and sex were not significant predictors in the final model, suggesting that, in this Ugandan context, family and socioeconomic variables exert greater explanatory power than individual demographic factors. This aligns with findings in a Ugandan study, which found that psychosocial and structural variables, rather than age or gender, better explained patterns of alcohol use among school children [2].

Conclusion

This study reinforces the pivotal role of family functioning and socioeconomic conditions in shaping the severity of adolescent alcohol use disorders in Uganda. The findings carry critical implications for the design of interventions targeting adolescent alcohol use. Family-based prevention and therapy programs should focus not only on improving communication but also on strengthening adaptability and satisfaction within families. As such, structured family interventions can effectively enhance family functioning and reduce adolescent risk behaviours in African contexts [20]. Additionally, interventions should address the socioeconomic dimensions of alcohol use, recognizing that poverty, overcrowding, and unstable family structures compound the risk of substance misuse. By integrating family, economic, and social perspectives, Uganda and similar contexts can move toward more sustainable, evidence-based interventions for reducing adolescent alcohol-related harm.

Conflict of Interest

The authors declare no conflict of interest.

Ethical Approval

Ethical approval was obtained from the Mbarara University Research Ethics Committee [Ref No. MUST-2023-1267], and was registered with the Uganda National Council for Science and Technology [Ref No. SS 5106]. Permission to conduct the study was acquired from the Health Department of Isingiro District Local Government. Before data collection began, written informed consent was obtained from participants who were informed of study objectives, procedures, possible risks, benefits, voluntary participation, and their right to withdraw from the study at any time without any penalty. All interviews were conducted in private settings. No personally identifiable information was recorded, and participant responses were kept anonymous. Data were securely stored in password-protected files, only accessible to members of the research team.

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Authors' Contribution

Conceptualization: Novatus Nyemara, Aloysius Rukundo, Elialilia S Okello. Data collection and analysis: Novatus Nyemara, Aloysius Rukundo, Elialilia S Okello. Methodology: Nyemara Novatus, Richard Merkel. Writing original draft, review & editing of the final manuscript: Novatus Nyemara, Aloysius Rukundo, Elialilia, S Okello, and Richard Merkel.

Data Availability

All data generated and analyzed during this study will be made available to appropriate academic parties on request from the authors.

References

- [1]. World Health Organization, 2023, Global Status Report on Alcohol and Health 2023. Geneva: WHO.
- [2]. Nalugya, J. S., Nakasujja, N., Engebretsen, I. M., Abbo, C., Tumwine, J. K., Musisi, S., Babirye, J. N., Mpungu, E. N., and Ndeezi, G., 2024, Prevalence and psycho-social factors associated with alcohol use among primary school-going children aged 6 to 13 years in Mbale district, Uganda: a cross-sectional study. *BMC pediatrics*, 24(1), p.782. <https://doi.org/10.1186/s12887-024-05260-6>
- [3]. Sjödin, L., Raninen, J., and Larm, P., 2024, Early drinking onset and subsequent alcohol use in late adolescence: A longitudinal study of drinking patterns. *Journal of Adolescent Health*, 74(6), pp.1225-1230. <https://doi.org/10.1016/j.jadohealth.2024.02.014>
- [4]. Tackaberry-Giddens, L., Henderson, J., and Hawke, L. D., 2023, Early alcohol onset: clinical and demographic characteristics of service-seeking youth. *Journal of the Canadian Academy of Child and Adolescent Psychiatry*, 32(3), p.150. <https://pubmed.ncbi.nlm.nih.gov/37534111/>
- [5]. Sellers, C. M., McRoy, R. G., and O'Brien, K. H. M., 2019, Substance use and suicidal ideation among child welfare involved adolescents: A longitudinal examination. *Addictive behaviors*, 93, pp.39-45. <https://doi.org/10.1016/j.addbeh.2019.01.021>
- [6]. Newton-Howes, G., Cook, S., Martin, G., Foulds, J. A., and Boden, J. M., 2019, Comparison of age of first drink and age of first intoxication as predictors of substance use and mental health

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- problems in adulthood. *Drug and alcohol dependence*, 194, pp.238-243. <https://doi.org/10.1016/j.drugalcdep.2018.10.012>
- [7]. DeWit, D. J., Adlaf, E. M., Offord, D. R., and Ogborne, A. C., 2000, Age at First Alcohol Use: A Risk Factor for the Development of Alcohol Disorders. *American Journal of Psychiatry*, 157(5):745–50. <https://doi.org/10.1176/appi.ajp.157.5.745> PMID:10784467
 - [8]. Grant, B. F., and Dawson, D. A., 1997, Age at onset of alcohol use and its association with DSM-IV alcohol abuse and dependence: results from the National Longitudinal Alcohol Epidemiologic Survey. *Journal of Substance Abuse*, 9, 103–110.
 - [9]. Crone, E. A., and van Duijvenvoorde, A. C., 2021, Multiple pathways of risk taking in adolescence. *Developmental Review*, 62, 100996. <https://doi.org/10.1016/j.dr.2021.100996>
 - [10]. Uganda Bureau of Statistics (UBOS). 2022, Uganda National Adolescent Health Survey Report. *Kampala: UBOS*.
 - [11]. Umberson, D., and Thomeer, M. B., 2020, Family matters: Research on family ties and health, 2010 to 2020. *Journal of Marriage and Family*, 82(1), pp.404-419. <https://doi.org/10.1111/jomf.12640>
 - [12]. Katafiasz, H., 2019, Bowen Family Systems Therapy with Families. In *Encyclopedia of Couple and Family Therapy* (pp. 325-331). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-15877-8_1147-1.
 - [13]. Holtom-Viesel, A., and Allan, S., 2014, A systematic review of the literature on family functioning across all eating disorder diagnoses in comparison to control families. *Clinical psychology*

- review, 34(1), pp.29-43.
<https://doi.org/10.1016/j.cpr.2013.10.005>.
- [14]. Olson, D., 2011, FACES IV and the circumplex model: Validation study. *Journal of marital and family therapy*, 37(1), pp.64-80.
<https://doi.org/10.1111/j.1752-0606.2009.00175.x>
- [15]. Joh, J. Y., Kim, S., Park, J., and Kim, Y. P., 2013, Relationship between family adaptability, cohesion and adolescent problem behaviors: curvilinearity of circumplex model. *Korean J Fam Med*; 34(3):169–77.
<https://doi.org/10.4082/kjfm.2013.34.3.169>.
- [16]. Gikandi, A. W., Egunjobi, J. P. P., and Muriithi, J. K. P., 2021, Influence of Family Cohesion on Substance Use Disorders among the Youth in Selected Rehabilitation Centres in Nairobi County, Kenya.
<https://doi.org/10.47772/IJRISS.2021.5816>
- [17]. Rukundo, A., Ayebare, D. S., Kibanja, G., and Steffens, K., 2020, Family Factors Associated with Consumption of Spirits: A Comparative Gender-Based Study of Ugandan Students in Public Secondary Schools. *Education Research International*, 2020(1), p.5432545.
<https://doi.org/10.1155/2020/5432545>
- [18]. Kivuva, S. N., and Muasa, W. P., 2023, Role of family functioning in substance addiction among emerging adults in Ongata Rongai Sub county in Kajiado county, Kenya. *International Journal of Research and Innovation in Social Science*, 7(9), pp.1941-1950.
<https://doi.org/10.47772/IJRISS.2023.71057>
- [19]. Cavanaugh, C. E., Andrade, F. C. D., George, S., and Wurth, M., 2020, Family functioning and substance use among African adolescents: A systematic review. *Substance Use & Misuse*, 55(4), 625–640.
<https://doi.org/10.1080/10826084.2019.1686043>
- [20]. Lander, L., Howsare, J., and Byrne, M., 2013, The impact of substance use disorders on families and children: From theory to practice. *Social Work in Public Health*, 28(3–4), 194–205.
<https://doi.org/10.1080/19371918.2013.759005>
- [21]. Puffer, E. S., Friis Healy, E., Green, E. P. M., Giusto, A. N., Kaiser, B., Patel, P., and Ayuku, D., 2020, Family functioning and mental health changes following a family therapy intervention in Kenya: A pilot trial. *Journal of Child and Family Studies*, 29(12), 3493-3508.
<https://doi.org/10.1007/s10826-020-01816-z>
- [22]. Opara, I., Lardier Jr, D. T., Reid, R. J., and Garcia-Reid, P., 2019, “It all starts with the parents”: A qualitative study on protective factors for drug-use prevention among Black and Hispanic girls. *Affilia*, 34(2), pp.199-218.
<https://doi.org/10.1177/0886109918822543>
- [23]. Wiggins, J. L., Mitchell, C., Hyde, L. W., and Monk, C. S., 2015, Identifying early pathways of risk and resilience: The codevelopment of internalizing and externalizing symptoms and the role of harsh parenting. *Development and psychopathology*, 27(4pt1), pp.1295-1312.
<https://doi.org/10.1017/S0954579414001412>
- [24]. Yap, M. B. H., Pilkington, P. D., Ryan, S. M., and Jorm, A. F., 2014, Parental factors associated with depression and anxiety in young people: A systematic review and meta-analysis. *Journal of affective disorders*, 156, pp.8-23.
<https://doi.org/10.1016/j.jad.2013.11.007>
- [25]. Skylstad, V., Nalugya, J. S., Skar, A. M. S., Opesen, C., Ndeezi, G., Okello, E. S., Moland, K. M., Engebretsen, I. M. S., and Tumwine, J. K., 2022, ‘As soon as they can hold a glass, they begin taking alcohol’: a qualitative study on early childhood substance use in Mbale District, Uganda. *BMC public health*, 22(1), p.812.
<https://doi.org/10.1186/s12889-022-13140-w>.
- [26]. Ali, T., and Worku, T., 2020, Current alcohol consumption and associated factors among school adolescents and youths in Ethiopia: a systematic review and meta-analysis. *SAGE Open Medicine*, 8, p.2050312120974154.
<https://doi.org/10.1177/2050312120974154>
- [27]. Biramo, Y. B., and Philipos, G., 2016, Peer pressure and alcohol use among undergraduate students of Wolaita Sodo University. *International Journal of Sciences: Basic and Applied Research*, 29(1), pp.212-223.
<https://doi.org/10.24085/jsaa.v12i2.4524>
- [28]. Romero-Rodríguez, E., Ortega, E., and Rivera, F., 2022, Family functionality and alcohol consumption among university students: A cross-

- sectional study using the Family APGAR questionnaire. *International Journal of Environmental Research and Public Health*, 19(4), 2321. <https://doi.org/10.3390/ijerph19042321>
- [29]. Dorji, T., Tshering, T., and Wangdi, K., 2020, Factors associated with alcohol use and hazardous drinking among youth in Bhutan: A cross-sectional study. *BMC Public Health*, 20(1), 1441. <https://doi.org/10.1186/s12889-020-09531-1>
- [30]. Demilew, D., Yeneabat, T., and Assefa, N., 2021, Assessment of alcohol use disorder and associated factors among people in Ethiopia: A community-based cross-sectional study. *Substance Abuse Treatment, Prevention, and Policy*, 16(1), 1-10. <https://doi.org/10.1186/s13011-021-00381-7>
- [31]. Chege, A., and Kathungu, B., 2021, Does Family Structure Predispose Youth to Drug Use: The Case of Kajiado County, Kenya. *African Journal of Alcohol and Drug Abuse (AJADA)*, pp.68-80.
- [32]. Reisdorfer, E., Büchele, F., and Pasa, M. B., 2012, Prevalence and associated factors with alcohol use disorders among adults in a southern Brazilian city. *Revista de Saúde Pública*, 46(6), 1049–1056. <https://doi.org/10.1590/S0034-89102012005000078>
- [33]. Babor, T. F., Higgins-Biddle, J. C., Saunders, J. B., and Monteiro, M. G., 2001, The alcohol use disorders identification test.
- [34]. Kemjika, O. G., and Ojiugo, A. B., 2015, Influence of family dysfunction on drug abuse of adolescent students of unity schools in south-south zone Nigeria. *European Journal of Psychological Research Vol*, 2(2) ISSN 2057-4794
- [35]. Lin, C. Y., and Yi, C. C., 2019, Family functioning and adolescent problem behaviors: Moderating roles of birth order and gender. *Journal of Family Issues*, 40(5), 587–611, <https://doi.org/10.1177/0192513X18810980>
- [36]. Gebremariam, K. T., and Sandhu, T., 2020, Family environment and substance use among university students. *International Journal of Scientific & Technology Research*, 9(2), pp.1530-1535. <https://doi.org/10.1186/s13011-018-0150-9>
- [37]. Wahab, S., Baharom, M. A., Abd Rahman, F. N., Wahab, K. A., Zulkifly, M. A., Azmi, A. D. and Ahmad, N., 2021, The relationship of lifetime substance-use disorder with family functioning, childhood victimisation, and depression, among juvenile offenders in Malaysia. *Addictive behaviors reports*, 14, p.100359. <https://doi.org/10.1016/j.abrep.2021.100359>
- [38]. LaFreniere, L. S., Newman, M. G., and Graham, J. W., 2021, Parental support and monitoring influences on adolescent alcohol use: A peer selection mediation model. *Mental health and addiction research*, 6(2), pp.10-15761. <https://doi.org/10.15761/mhar.1000202>
- [39]. Kelly, A. B., O'Flaherty, M., Toumbourou, J. W., Connor, J. P., Hemphill, S. A., and Catalano, R. F., 2011, Gender differences in the impact of families on alcohol use: A lagged longitudinal study of early adolescents. *Addiction*, 106(8), pp.1427-1436. <https://doi.org/10.1111/j.1360-0443.2011.03435.x>

Community Health Workers' Integration Models and Health System Integration Effectiveness for Universal Health Coverage in Sub-Saharan Africa: A Systematic Review

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Abstract

In sub-Saharan Africa (SSA), evidence suggests that many low and middle-income countries face severe shortages and uneven distribution of health workers, medicines and infrastructure, resulting in poor quality services and serious gaps in coverage for essential health care. In addressing the human resources gaps of trained health professionals, Community Health Workers (CHWs) were recruited and integrated in the health system and they are increasingly regarded as central actors in achieving Universal Health Coverage (UHC) and strengthening primary health care (PHC) in SSA. Evidence from existing studies shows that community health workers have the greatest impact when they are well integrated across the main health system building blocks. Estimates of Community Health Worker (CHW) density vary widely across Sub-Saharan Africa, ranging from about 11.2 to 59.5 CHWs for every 10,000 people. These differences depend largely on how many hours CHWs work and the scope of services they provide. However, integration models differ widely across nations with mixed outcomes in service provision, equity, and sustainability. Three models of integration dominated: government-driven, hybrid, and Non-Governmental Organisation-driven (NGO). Government-driven models have 40% higher levels of sustainability than donor-based models and cost-effectiveness ratios of \$1.20 per capita per annum, for example in Ethiopia and Ghana, among others. Successful CHW integration is context-dependent model selection, with no single model likely to be optimal for every situation; success depends on close adaptation to the local health system and community context.

Keywords: Community Health Workers, Health System Strengthening, Integration Models, Sub-Saharan Africa, Universal Health Coverage.

Introduction

The World Health Organization (WHO) African Region bears a disproportionate share of the global shortage, with low densities of doctors, nurses and midwives and severe maldistribution between and within countries in many countries, with rural, remote and underserved areas facing the greatest shortages. WHO estimates a projected shortfall of 18 million health workers by 2030, mostly in low- and lower-middle-income countries [2] and emphasizes that health systems can only

function well when they have sufficient, well-trained and equitably distributed health workers, who are competent, responsive, motivated and productive [39]. Since the Alma-Ata Declaration of 1978, which emphasized 'Health for All' through community participation, CHW programs have evolved from vertical, disease-specific interventions to integrated, comprehensive community health systems. Also, the 2018 Astana Declaration reaffirmed the centrality of primary health care (PHC) and explicitly recognized CHWs as an essential health workforce [1]. Community

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Health Workers (CHWs) have emerged as a cornerstone of primary health care delivery in Sub-Saharan Africa, bridging the gap between formal health systems and underserved communities. In Sub-Saharan Africa, where health workforce shortages are most acute with only 2.3 health workers per 1,000 population compared to the World Health Organization (WHO) minimum of 4.45 CHWs provide critical services including maternal and child health, infectious disease management, health promotion, and increasingly, non-communicable disease screening [2].

The WHO adopted a global strategy on human resources for health, aimed at ensuring universal access to health workers and improving their performance, quality, and impact on health systems, which specifically recognises CHWs as an important component of the health workforce. The strategy emphasizes the need for countries to develop comprehensive policies for CHW programs, including training, supervision, and integration with health systems [2].

Integration requires harmonizing CHW roles and competencies with service delivery models and ensuring they are supported by the broader system [4]. The integration of CHW into formal health systems has emerged as a pivotal strategy in addressing health system gaps, particularly in rural Sub-Saharan African countries, where access to healthcare remains severely limited [3].

Sub-Saharan African Community Health Worker programs exist along an integration continuum defined by the strength of the state, external donor support, and policy development. Among other models, there are three common ones that have re-emerged within the sub-region, including NGO-based but government-focused programs, hybrid models that increasingly transfer ownership and responsibility to government entities, and nationalised Ministry of Health (MoH)-based cadres in government systems. We have numerous models operating simultaneously in

countries [4, 6, 7]. Country adaptations include cooperative-governed and strategy-focused, community-based and mixed models, which maintain public oversight but vary in financing and accountability structures [4]. The models are supposed to support the WHO six building blocks of health system strengthening but each may have their strengths and weaknesses.

Scott et al. (2018) added that CHW programs are effective when properly integrated into health systems with adequate training, supervision, and support [8]. Evidence across systematic reviews, consistently shows that CHWs improve access, uptake of preventive services, and some clinical outcomes, especially in reproductive, maternal, newborn and child health (MNCH) coverage and behaviors, infectious diseases, and selected noncommunicable diseases (NCDs). The contribution of CHWs have increased Human Immunodeficiency Virus (HIV) testing and ART retention; improved malaria case management; modest but meaningful NCD risk factor control; moderate improvements in common mental disorders via task-shared interventions; equity gains in remote/poor populations and generally favorable cost-effectiveness [5].

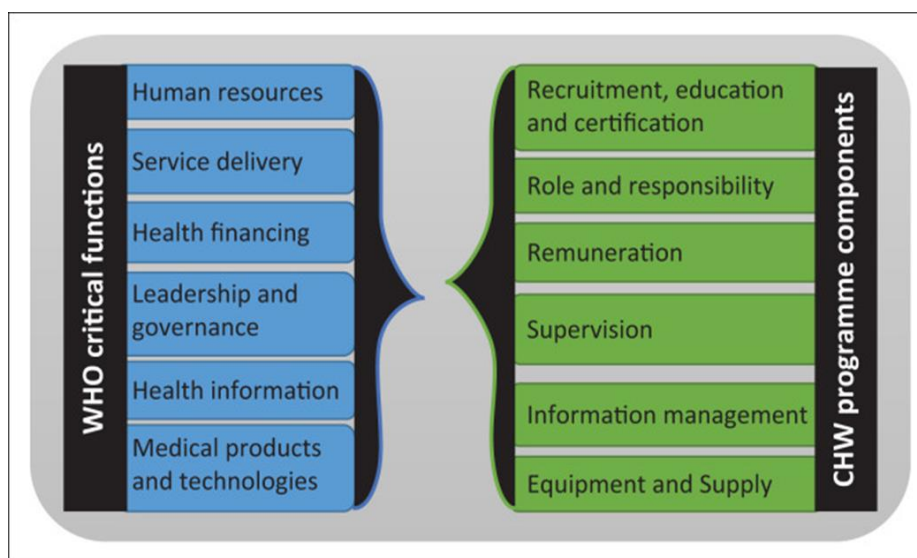
The successful integration of CHWs into formal health systems is significantly influenced by several key enabling factors. Key successful factors for CHW programs include Strong political commitment and supportive policy frameworks provide the foundation for sustainable CHW programs, ensuring their recognition and legitimacy within the health system, appropriate selection and training of CHWs, ongoing supervision and support, integration with formal health systems, community ownership and participation, and sustainable financing mechanisms. As the field continues to evolve, innovations in digital health, performance management, and financing models offer new opportunities to enhance CHW effectiveness and sustainability. These facilitating factors work synergistically

to create an enabling environment for effective CHW integration as a blueprint to Universal Health Coverage [4, 6].

Conceptual Framework of CHW Integration into the Health System

Mupara et al. (2023) outlined the CHW programme components (recruitment, education and certification, roles and

responsibility, documentation and information management, remuneration, supplies and equipment, and supervision) as key variables corresponding to each of the health system building blocks and supported by standardized national policies and guidelines. The conceptual framework demonstrates the links between the health system building blocks and CHW program components in Figure 1, below.



WHO, World Health Organization; CHW, community health worker.

Figure 1. Showing CHW Program Components and the Health System Building Blocks

(Source: Mupara et al. [40])

Methodology

Design and Study Area

A systematic review is been conducted to provide evidence synthesis on Community Health Workers' integration models, effectiveness and policy recommendations for Universal Health Coverage in Sub-Saharan African.

The study is guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The preferred methodology was a systematic review because it is well-suited to achieving the study's goals, which include synthesising published data on integration models, effectiveness, and policy recommendations for Universal Health Coverage in Sub-Saharan Africa. Both

qualitative and quantitative data were included from various identified studies.

Search Strategy

The systematic database search utilized major academic databases for example, WHO Web Site, PubMed/MEDLINE, Scopus, Web of Science, EMBASE, CINAHL, African Index Medicus, and African Journals Online (AJOL). These databases have been selected for their comprehensive coverage of health systems research and their inclusion of African scholarly literature.

The search terms used include community health workers, health system building blocks, integration, Sub-Saharan Africa, CHW integration models, CHW integration effectiveness.

Inclusion and Exclusion

The inclusion criteria: All studies published in the past 15 years (2010 to 2025), to ensure accuracy, while capturing the evolution of CHW integration efforts. Publications in English were used and the countries in Sub-Saharan Africa captured were based on availability of data /publications and these are countries (Ethiopia, Rwanda, Ghana, Kenya and Malawi) that are mostly cited in reviews as case examples with functional CHW integration programs. Other countries also that have made some progress in CHW program integration were also captured. The review encompasses peer-reviewed articles, systematic reviews, meta-analyses, program evaluations and policy documents to provide a comprehensive understanding of the topic.

The systematic review implemented specific exclusion criteria to maintain focus and ensure the quality of included evidence. To ensure currency and relevance of findings, publications dated before 2010 were not be included in the review. Additionally, conference abstracts without accompanying full papers were omitted from the review, as they typically lack the detailed methodology and comprehensive results necessary for thorough analysis.

Data Extraction

The data extraction and analysis process for the systematic review will begin with the

development of a comprehensive data extraction template, capturing study characteristics, methodological features, key findings, integration models and recommendations, ensuring consistency and thoroughness in capturing relevant information from each study. This structured approach ensures consistent and comprehensive data collection across all included studies. Comparative analyses was done among the integrated models: government-led, hybrid (government-partner), and NGO-led. A grading system was developed to assess the extent to which the domains of integration are embedded in the national PHC architecture. Each domain is scored on an ordinal scale reflecting the degree of system integration and routine functionality evident in the literature and cross-country implementation experience.

Results

Selection Process of Articles

Of 270 articles identified 250 from databases and 20 from my laptop archives), having used the key searching words, 118 did not have the relevant information needed, 152 full-text articles were assessed, and 113 duplicate articles were excluded. Therefore, 39 were maintained as they met the criteria and were included. This is also illustrated in Figure 2, below.

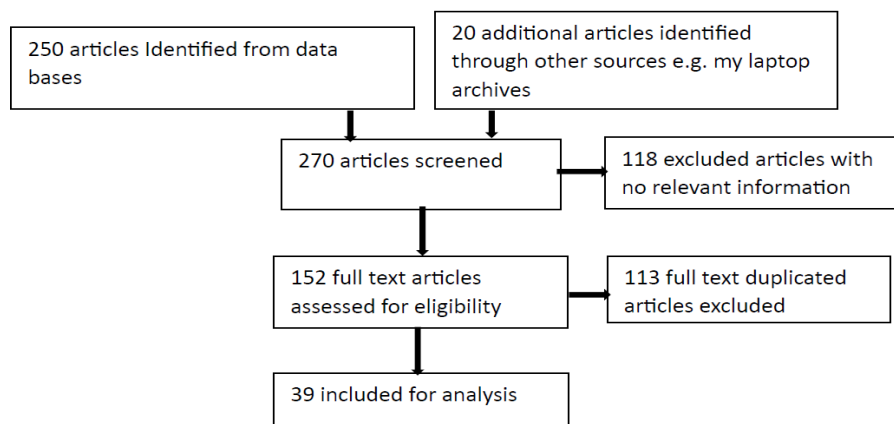


Figure 2. Illustrates, the Selection Process of Articles

Characteristics of Included Studies

The identified studies offer thorough insights into Sub-Saharan African CHW integration models. These consist of policy guidelines, empirical program evaluations, systematic reviews, and country case studies that highlight hybrid, government-led, and non-governmental models. Formalizing CHW hiring, certification, training, supervision, compensation, supply chains, and data integration into national health systems is highly valued. The studies illustrated successful health outcomes that demonstrated the effectiveness of CHW integration in the health system, particularly in maternal and child health, with a particular emphasis on Ethiopia's Health Extension Program, Rwanda's community health system, Ghana's CHP initiative, Kenya's community health strategy and Malawi. Alongside facilitators like community trust, mobile health technologies, and multi-sectoral policy support, obstacles like funding instability, fragmentation, and insufficient supervision are frequently mentioned. When taken as a whole, these pieces highlight the vital role that well-integrated CHW programs play in promoting universal health coverage throughout the region.

CHW Integration Models in Sub-Sahara Africa

In Sub-Saharan Africa, Community Health Worker (CHW) programs are usually organized in three main ways: government-led, NGO-led, and hybrid models. Each approach shapes how the programs are designed, funded, and managed. While they share the same goal of improving community health and the models differ in their structure, leadership, and country examples. For the purpose of this study, the above three models are mainly discussed as they are the most popular ones in Sub-Sahara Africa. These include:

Government-led Model

In government-led models, CHW programs are embedded within the national health

systems, coordinated and regulated by ministries of health. These programs are often aligned with national health policies and receive government funding or co-financing to ensure sustainability. A strong emphasis is placed on formal recruitment, training accreditation, supervision, remuneration, and integration into the health system's reporting and supply chains. For countries Using Government-led Models, Ethiopia's Health Extension Program is a prime example, with over 40,000 government-employed health extension workers delivering essential services at community level. Ghana's Community-based Health Planning and Services (CHPS) initiative similarly emphasizes government ownership and scale-up. Rwanda employs a government-coordinated CHW system that has demonstrated improvements in maternal and child health outcomes. Kenya and Sierra Leone have also institutionalized CHW programs through ministry policies and national strategies. These models show better sustainability, standardization, and alignment with Universal Health Coverage (UHC) goals due to stable funding and formal support systems. Government-led programs face resource limitations and require political commitment to achieve scale [4, 16, 32, 40].

NGO-led Model

Community Health Worker (CHW) programs led by NGOs are usually started and funded by non-governmental organizations or international donors. These programs often take two forms:

1. Vertical projects, which focus on specific diseases or groups of people.
2. Community health initiatives, which work alongside existing health services to fill gaps.

These models are implemented in Mozambique and Malawi, NGOs have played a major role in supporting CHW programs, especially for malaria and HIV/AIDS. In Uganda and Tanzania, many smaller

community projects began with NGO funding and guidance.

NGO-led models are often innovative, flexible, and quick to respond to local needs. They can roll out programs faster than government systems and on a contrary, these models can be fragmented, may not always align with national health systems, and often struggle to stay sustainable once donor funding ends [4, 6, 33].

Hybrid Models

Hybrid models bring together the strengths of both governments and NGOs (or donors). In these setups, governments provide leadership and policy direction, while NGOs or donors contribute resources, training, and support. This mix allows programs to benefit from the structure of formal health systems and the flexibility of NGOs, making them more effective and far-reaching. Countries for example Senegal: The *Bajenu Gox* program is guided by government policy but relies on NGOs for community mobilization and building local capacity [4, 30, 40].

This model succeeds as a result of:

1. They combine the coverage and authority of government systems with the innovation and adaptability of NGOs.
2. Communities often trust them more because they feel both locally responsive and officially recognized.
3. Stronger supervision and supply chains make them more reliable, while their flexibility helps them adjust to changing needs.

Other CHW Integration Models

Beyond the government-led, NGO-led, and hybrid approaches, there are several alternative models for integrating CHWs in health systems in Sub-Saharan Africa. These models can stand alone or be combined with the main ones, depending on local needs.

Types of alternative models include:

1. Volunteer-based: CHWs serve their communities without formal pay, often motivated by social responsibility [31].
2. Private sector or market-based: Health services are supported by businesses or market-driven initiatives [35].
3. Faith-based organization (FBO)-led: Religious groups lead and fund CHW programs, drawing on community trust [36].
4. Social mobilization or community-driven: Local communities organize and manage CHW efforts themselves [31].

While government, NGO, and hybrid models dominate because they scale more easily and align with national policies, these alternative models are crucial in specific contexts, whereby, they are especially effective in reaching underserved or rural populations, where formal systems may struggle and many countries use blended approaches, mixing different models to match their health system's capacity and community preferences [34].

Comparison of Integration Models

The WHO, six building blocks of a health system (Health service delivery, Health workforce, Health information system, Medical products, vaccines and technology, Health financing, and Leadership and governance) further describes the models of integration. Table 1 below compares the three integration models in relation with each of the health system building blocks and their level of risk and strengths are also captured.

In summary, Government-led model, integrates CHWs into national policy, payrolls, and management structures, connecting services to primary health care and public value chains for equity and scale. NGO-led integration is project-based, most often piloting new packages (digital technologies, incentives) with specialist supervision and finance, but vulnerable to fragmentation and limited sustainability. Hybrid integration brings NGO implementation together with government

stewardship: NGOs deliver training, commodities, information systems, and quality improvement and government sets standards, integrates CHWs into HMIS and referral systems, and increasingly takes on financing.

Hybrids are able to scale up innovations and establish robust systems, but success depends on concurrence of roles, transition strategy, harmonized reporting, and shared supervision to avoid duplication.

Table 1. CHW Integration Model Comparison Table Across the Health System Building Blocks

Domains	Nationalized, MoH-led	NGO-led, government-aligned	Hybrid/transition
Governance and Leadership	CHW programs are embedded in Ministry of Health (MoH) policy/legislation with clear scopes of practice, job descriptions, and implementation guidelines. National technical working groups (TWGs) provide standards and coordinate partner alignment; district health management teams steward implementation and partner activities within sector plans [4, 6, 8].	Program rules, protocols, and reporting are guided primarily by NGOs/projects; alignment to national policy varies by partner and geography. local government stewardship can be limited by project timelines [4, 6, 8].	MoH sets policy/standards; partners align to common national plans with district-led coordination. Government stewardship is explicit but relies on partner operational support [4, 8].
Health Financing	Majority of CHW program costs are on-budget within public financial management cycles (e.g., remuneration, training, supervision, commodities) with pooled or aligned donor support. Incentives are standardized to reduce inequities and churn [9, 20].	Project-based funding with variable duration and scope; incentives differ by project and may not align with public sector norms. Geographic disparities in pay and inputs are common [9].	Cost-sharing: government funds supervisors (e.g., salaries for supervisors, some commodities), while partners contribute operational inputs (training refreshers, transport, digital tools) [9].
Health Workforce	A formalized CHW cadre with standardized pre-/in-service training, certification, competency assessments, and clear progression pathways. Supervisory structures and caseload norms are defined; performance management and coaching-oriented supervision are institutionalized [4, 11].	Training quality can be high within project areas, but curricula and certification may not be nationalized; CHWs are often not on government payrolls; supervision and mentorship intensity varies by partner capacity [11, 4].	National curricula used; partners fund refreshers, mentorship, and QA. Partial payroll integration (some CHWs on stipends, others salaried); standardized supervision with partner augmentation (e.g., more frequent coaching), [11].
Health Information System	CHW indicators and registers are integrated into the national HMIS (often DHIS2), aligned with case definitions and data standards. Data is routinely used at district/facility levels for supervision, commodity planning, and performance review [4, 13].	Packages are frequently vertical (e.g., iCCM or HIV/TB-focused), with referral practices depending on project design and facility engagement. Integration with PHC can be partial [6].	National tools are primary; partners support digitalization, data quality assessments, and feedback loops; reporting flows into DHIS2. Joint data reviews at district level are more routine than under NGO-led models [13, 4].
Medical products, vaccines and technology	Standard CHW kits and commodities flow through the national supply chain; resupply occurs via public systems with defined last-mile procedures; stock monitoring is standardized (e.g.,	Commodities often flow through partner-managed procurement/logistics; public resupply is not assured, leading to	Public supply chain is primary; partners backstop last-mile distribution during gaps (e.g., buffer stocks, transport support). Visibility

	consumption-based reporting, eLMIS where available) [4, 14].	stockouts when projects end or shift [4, 14].	tools/eLMIS may be partner-funded initially with a transition plan. [4, 14].
Health Service Delivery	A national CHW service package linked to facility-based PHC and referral loops (e.g., iCCM, RMNCH, health promotion, NCD screening as applicable). Quality indicators and service coverage are monitored and reviewed in routine management cycles [4, 6, 15].	Packages are frequently vertical (e.g., iCCM or HIV/TB-focused), with referral practices depending on project design and facility engagement. Integration with PHC can be partial [6, 7].	The national package is delivered, with partner-supported enhancements (e.g., increased outreach frequency, targeted pilots for NCDs or newborn care). Referral loops function but may be stronger in partner-supported districts [6, 7].
Strengths	Sustainable, standardization, Scalability, equity potential.	Innovation, seed, targeted reach.	Managed risks during scale-up; capacity transfer [10].
Risks	Fiscal shocks; supervision gaps in remote areas; bureaucratic rigidity [10].	Challenges with Sustainability; fragmentation; parallelism [4].	Coordination burden; unclear timelines for absorption.

Facilitators and Barriers to CHW Integration in Health Systems

The successful integration of Community Health Workers into formal health systems is significantly influenced by several key enabling factors including political commitment and clear policies ensuring legal recognition and role clarity, provide the foundation for sustainable CHW programs, ensuring their recognition and legitimacy within the health system, sustainable domestic financing with fair remuneration; and professionalization of the workforce with merit-based recruitment, good pre-service training, ongoing CPD, manageable workloads, and career advancement. Inbuilt, supportive supervision; strong last-mile supply chains; interoperable information systems with data use as routine; functional referral/counter-referral; true community selection and accountability; aligned partners with harmonized tools and transition plans are essential. Pragmatic enablers include transport, safety, job aids, and connectivity [4, 6, 9, 18, 19]. As the field continues to evolve, innovations in digital health, performance management, and financing models offer new opportunities to enhance CHW effectiveness and sustainability.

These facilitating factors work synergistically to create an enabling environment for effective CHW integration.

Despite the potential benefits of CHW integration, several significant barriers often impede successful implementation including; high attrition rates because of inadequate compensation and absence of career development opportunities; fractured governance and weak partner coordination among various stakeholders, including government agencies, NGOs, and community organizations, often results in fragmented approaches and inefficient resource utilization; donor reliance and slow transition to local funding; inadequate supervision and quality assurance; non-integration with HMIS and supply chains; and disproportionate coverage, especially in hard-to-reach and conflict zones. These gaps undermine program sustainability and effectiveness. Employing them through fair remuneration, careered professional moves, aligned stewardship and financing, effective management and use of data, coordinated logistics, and pro-equity targeting is imperative for improved outcomes and SDG progress in Africa [4, 6, 11, 18].

Evidence of Effectiveness of CHW Integration into Health Systems

Community Health Workers (CHWs) are crucial in health care system in many parts of Sub-Saharan Africa. When they are fully integrated into national health systems, they make essential services more accessible, especially in resource-limited settings. Their contribution have supported maternal, newborn, and child health, delivering vaccinations, treating common illnesses, providing health education, and connecting patients to higher level care when needed,

advancing the broader goal of Universal Health Coverage (UHC) and equity.

CHWs don't just treat illnesses they also prevent disease, tackle social determinants of health, and strengthen resilience during crises like Ebola and COVID-19. Their role proves indispensable in building stronger, more equitable health systems. Evidence have shown that the integration of CHWs in health systems have created impact. The table 2 below show case examples of countries with evidence of CHW contribution in creating positive health impact in Sub-Sahara Africa.

Table 2. Impact and Evidence: Case Examples in Sub-Saharan Africa

	Country	Evidence of effectiveness	Reference
1	Ethiopia	Through task shifting to CHWs, Ethiopia saw UHC service coverage rise from 13 (in 2000) to 35 (in 2021), and maternal and child deaths sharply declined. Modern contraceptive use surged by 34 percentage points, DPT3 vaccine coverage increased by 33 percentage points, and facility deliveries rose by nearly 50 percentage points over two decades. Over 40,000+ Health Extension Workers deployed nationwide as salaried, formally trained cadres embedded in primary health care. Sources consistently describe 30–42k HEWs since scale-up.	[16, 37]
2	Rwanda	Rwanda organized CHWs into cooperatives with performance-based financing (PBF), integrating them into the PHC system with strong district stewardship. CHW cooperatives linked to supervision, PBF, and supply chain reliability; evidence shows increased utilization and improved outcomes in maternal and child health.	[17]
3	Ghana	CHPS is widely cited as cost-effective, with per-capita estimates varying across periods and costing methods. Studies report low per-capita recurrent costs (often single-digit USD), with strong improvements in access and MCH outcomes.	[28]
4	Kenya	Community Health Strategy and CHVs integrated into primary care with mixed funding; digital CHIS scaling 64,000 CHWs expanded access to primary care and boosted immunization and MCH coverage and indicators	[21]
5	Uganda	VHT strategy with iCCM expansion improved treatment coverage; sustainability challenges are tied to remuneration and supplies.	[22]
6	Malawi	HSAs as a formal cadre delivering iCCM and immunization with strong supervision; documented reductions in child mortality.	[23]

7	Tanzania	Child morbidity reduced during the WAJA Program, 2011-2015. Cluster-randomised trial of multi-tasked, paid CHWs, integrated via district health teams, reduced childhood illness incidence and boosted timely curative care-seeking in intervention vs. control areas, attributed to community acceptability, supervision, and remuneration	[24]
9	Sierra Leone	Post-Ebola CHW programs institutionalized with national policies, improving surveillance and PHC linkages.	[26]
10	Liberia	CHW led interventions raised confirmed malaria diagnoses from 71% to 95%, exemplifying their direct effect on essential health outcomes Mothers served by CHWs are nearly six times more likely to exclusively breastfeed. Immunization rates and nutrition outcomes improve with CHW involvement	[25, 37]
11	Nigeria	Maternal and child health coverage increase in northern Nigeria states (Jigawa, Kaduna, Zamfara), the CHW scheme under the Subsidy Reinvestment and Empowerment Programme (SURE-P MCH) integrated CHWs into facilities for antenatal care, immunization, and skilled birth attendance referrals. Realist evaluation showed enhanced access and MCH outcomes during implementation (2014-2016)	[27]
12	Senegal	Government led, “Bajenu Gox” maternal–newborn ambassador model, integrated with facility ANC/PNC and family planning services, improved postpartum family planning uptake and early ANC attendance in urban and peri-urban settings	[30]

CHW Roles and Contribution to UHC

Mayo & Mendoza, (2024), highlighted CHW roles that contributes to the achieving the UHC and these include:

1. Expanding Access to Health Services:

CHWs are the backbone of healthcare delivery in many resource-limited areas.

Their roles include:

- Providing maternal, newborn, and child health (RMNCH) interventions.
- Supporting vaccination campaigns and routine immunizations.
- Diagnosing and treating common illnesses (malaria, pneumonia, diarrhea).

- Delivering basic sexual and reproductive health services.
- Health education and behavior change communication.
- Referrals to higher levels of care.

This proximity to households reduces geographic and economic barriers, boosts utilization of health services and helps in achieving higher coverage of essential interventions, especially among vulnerable and hard-to-reach groups.

2. Bridging Gaps in Human Resources for Health:

With projections that Africa alone will face a shortage of over 6 million health workers by 2030, CHWs fill critical workforce gaps, addressing inequities and complementing facility-based care.

Globally, deployments of large cadres have resulted in significant outcomes, such as: Some countries in Sub-Sahara Africa have shown evidence of effectiveness for e.g. Ethiopia, with 42,000 CHWs, have seen a drop in maternal mortality 871 to 267 per 100,000 live births between 2000 and 2020.

3. Catalysts in Disease Prevention and Health Security:

CHWs have proven indispensable in public health emergencies. They were instrumental in Ebola containment (contact tracing, education), in supporting COVID-19 responses (informing, testing, supporting vaccination), and in controlling the HIV epidemic. Their local credibility and cultural competence built trust crucial to overcoming vaccine hesitancy and misinformation.

4. Addressing Social Determinants of Health:

Beyond clinical care, CHWs address broader determinants by promoting sanitation, nutrition, and healthy behaviors. They often serve marginalized populations (women, children, elderly, and rural poor) thus contributing to UHC's equity goal.

5. Enhancing Health System Resilience:

CHWs ensure continuity during health system shocks by maintaining essential services, mobilizing communities, providing psychosocial support, and feeding back grassroots information to guide system responses.

Discussion

CHW Integration Conceptual Framework

The study reinforces and validates the Mupara et al. (2023), health system building blocks linkages with CHW components. The framework establishes systemic alignment as essential, mapping CHW program components including; recruitment, training, certification, and supervision to leadership/governance and human resources building blocks, while remuneration, supplies, and information

management correspond to financing, service delivery, and information systems, thereby creating a blueprint, where misalignment in any single element undermines the overall performance. Policy standardization proves very critical, as national guidelines foster consistency across these components, mitigating fragmentation characteristic of NGO-led model and facilitating scale up towards universal health coverage goals. Holistic integration positions CHWs as extensions of the health systems rather than stand-alone actors. Linkages like supervision improving service delivery, help close equity gaps, especially in rural and underserved areas e.g. Ethiopia's Health Extension Program and Rwanda's model show how this works in practice. For SSA countries, the practical actions are; to audit CHW programs against these components to identify weaknesses, prioritize investments in salaries and supervision to keep workers motivated and retained, while also strengthening supplies and data systems to ensure long-term sustainability, working in achieving UHC.

Comparing CHW Integration Models Across the Health System Building Blocks

The concept illustrates the level of alignment/integration of the models to the six health system domains.

Governance and Leadership

Government-driven programs stand the highest chances of achieving the highest level of integration because functions, scopes of practice, and accountability of CHWs are well articulated in national guidelines and operation policies and aligned with PHC arrangements and subnational administration. Such policy articulation supports supervision standards, caseload expectations, channels for referral, and mechanisms for coordination [4, 8]. National TWGs standardize and align partner coordination, and districts manage

implementation within planning cycles, this reduces fragmentation and allows scale with fidelity [4, 6, 8]. Programs implemented by NGOs are generally compliant with national guidelines but run on project regulations and reporting systems, with relatively TWG involvement and district ownership constrained by project timelines [4, 8]. Hybrid models occupy the space between these extremes: policy and standards are established by MoH, coordination is attained through districts via plans and TWGs, and partners align to these structures, while still retaining operational reliance on partner systems for some functions [4, 8, 7]. Integration reduces fragmentation and makes country-wide coverage possible with a single standard.

Health Financing

In the Government-led model, it is critical that funding becomes mainstreamed in public financial management (PFM) procedures: CHW payment, commodities, supervision, and training have budget lines; funds go through government channels; and medium-term spending frameworks improve predictability. Programs implemented by the government place the majority of costs on-budget salaries, supervision, training, and supplies go through public financial management, with donor funding pooled/aligned. Standardized incentives reduce inequities and turnover [4, 9]. Programs implemented by NGOs are founded upon project funding, creating variability across geographies/time and heterogeneous incentive structures [9]. Hybrid models share costs: governments fund supervisors and core costs, and partners supply operational inputs (e.g., outreach, logistics) for transition intervals [4, 7].

Health Workforce

In government-sponsored schemes, human resource channels are institutionalized, pre-service and in-service competency-based training, standardized recruitment profiles,

credentialing, payroll integration, and (in older schemes) career ladders and incentive mechanisms. These features promote retention and performance, particularly when supplemented with supportive supervision and periodic refresher training [5, 11, 12]. Hybrid models are more likely to adopt national curricula and competency frameworks but may blend government payrolls with donor-funded stipends or top-ups, creating variability in regularity of payment and benefits [9]. NGO-led models can provide solid training and intense support in project fields but possess HR systems (contracts, benefits, performance management) generally beyond government norms and proving difficult to institutionalize at national level.

Two characteristics differentiate higher-performance HR integration across models: a) consistency between role definition and workload and compensation and protections (e.g., PPE, leave, benefits), and b) frequent, coaching-centered supervision driven by data to guide feedback and practice of skills. Where these go off track, programs are faced with mix, inconsistent quality, and equity challenges as services grow up [4, 11, 12].

Health Service Delivery

All models offer services, but integration quality differs in the degree to which services align with the national PHC package and the quality of linkages to facility teams through referral/counter-referral cycles. Government-led and hybrid models more often formalize task lists (e.g., iCCM, RMNCH, FP, selected NCDs), job aids, and quality assurance steps, with clearer escalation criteria and facility linkages. This enables continuity of care, enhanced case management, and more consistent population coverage [7, 10].

NGO-led projects often shine when it comes to small-scale interventions or pilot programs. They can deliver quick results and test new ideas. But when it comes to scaling up, challenges emerge. If their protocols don't

match national standards or if they run on separate data and supply systems, these projects struggle to integrate into the broader health system. The result is a lack of consistency and difficulty sustaining impact beyond the pilot stage [40].

High service delivery integration is characterised by: standardised protocols and job aids; frequent competency maintenance; systematic supervision with field mentorship; and running referral and counter-referral loops, closing care gaps. They are enabled (or disabled) by the capacity of governance, HR, data, and supply chains to support them [7, 12].

Health Information System

Government programs increasingly integrate community indicators into national DHIS2 (or equivalent), with its standardized registers, monthly summaries, and community modules allowing for aggregation, analysis, and use at multiple levels. Where electronic tools are used, they are increasingly aligned with national data dictionaries and interoperability standards, enabling real-time surveillance, decision support, and feedback loops [13]. Hybrid models most commonly entail combining national HMIS tools with partner-delivered digital solutions; integration quality depends on whether data schemas align cleanly to DHIS2 and whether routine reporting occurs through national channels. NGO-led models most commonly operate parallel project systems (including custom mobile apps) with only partial reporting into national systems, frustrating visibility and institutional learning.

What distinguishes "high integration" is not mere digitization but institutionalization: synchronized indicator sets, periodic data quality audits, management meeting use of data, and interoperable systems that prevent double entry and minimize reporting burden. Embedding these practices in supervision and planning cycles strengthens performance and accountability [4, 7, 13].

Medical Products, Vaccines and Technologies

Sufficient reliable last-mile supply is an enduring hurdle with direct impacts on trust and functionality. Public sector schemes leverage national supply chains (quantification, procurement, warehousing, distribution) and, where available, electronic LMIS for transparency. Institutional channels of escalation, redistribution, and accountability are even better articulated in the event of stockouts, improving recovery time [4, 14]. Hybrid configurations commonly use national chains but engage the services of partner "backstopping" (buffer stockpiles, gap-filling transport, emergency procurement) to overcome the deficiencies, short-term successful but potentially masking underlying problems of the system. NGO-managed models are likely to depend upon partner logistics pipelines, which have the capacity to guarantee high availability across project footprints but are hard to sustain or increase nationwide and may not be compatible with government quantification cycles [14].

Integrated supply chains have standardized resupply kits or algorithms by volumes of service, last-mile visibility (stock cards/eLMIS), facilitative oversight of stock control, and accountabilities clearly shared between facilities, districts, and CHW programs. In the absence of these, supply might fail to respond to demand generated by CHWs, undermining credibility and outcomes [4, 14].

Synthesis and Implications of Health System Building Blocks and Integration Models

The sectors reinforce each other. Financing and governance set the policies and funding; HMIS/data enable learning and accountability; HR and supervision translate standards into practice; and supplies ensure readiness for demand creation. Government models best effectively align these factors most persistently, hybrid models can make integration proceed when built as a bridge to government

ownership, and NGO models can facilitate innovations that need to be intentionally harmonized and institutionalized for scaling [4, 7, 8]. For countries that desire to move "right and up" on the integration frontier, top-down practicalities are enacting CHW jobs and pay in policy and PFM; ensuring curriculum convergence and supervision; combining community indicators into DHIS2 with feedback loops; and improving last-mile supply visibility and accountability. These steps collectively promote equity, resilience, and value for money.

Facilitators and Barriers to Integration

Successful integration of CHWs play a vital role in advancing Universal Health Coverage (UHC) across Sub-Saharan Africa, and their success depends on several key facilitating factors including strong political commitment, clear policies, and sustainable financing, provide the foundation, while professionalization through training and career pathways ensures CHWs are recognized as essential members of the health workforce. Supportive supervision, reliable supply chains, and interoperable data systems help them deliver services effectively, and community accountability keeps programs responsive and trusted. Digital health has an enabling role whereby; electronic registers and decision support enhance compliance; referral tracking and dashboards improve continuity and microplanning; and interoperability with DHIS2 raises visibility of data [4]. Together, these factors strengthen CHW retention, performance, and integration into primary health care, helping to close Africa's projected shortfall of six million health workers by 2030. As a result, countries can expand equitable access to maternal and child health services, vaccinations, and chronic care, particularly in rural and vulnerable communities, while also building more resilient health systems that can withstand crises.

Barriers continue to undermine progress toward Universal Health Coverage (UHC) in Sub-Saharan Africa. Challenges such as high attrition due to poor pay and limited career opportunities, fragmented governance, heavy reliance on donors, weak supervision, and the lack of integration between health information systems and supply chains all contribute to inefficiencies and service gaps. These issues result in inequitable coverage, leaving many communities, especially those in hard-to-reach areas, without reliable access to care. The consequences are serious: fragmented services erode public trust, deepen disparities, and threaten progress toward the Sustainable Development Goals (SDGs). To overcome these barriers, strong policy action is needed. This includes fair remuneration for Community Health Workers (CHWs), better-aligned financing and stewardship, data-driven management, and equity-focused strategies. Addressing these priorities is essential to ensure CHW programs are scalable and sustainable, ultimately building resilient health systems and delivering more equitable health gains.

The interaction between facilitating factors and barriers creates a complex dynamic that influences the success of CHW integration efforts. Understanding and addressing these factors is crucial for developing effective integration strategies that can strengthen health systems and improve healthcare delivery in resource-limited settings. This understanding enables policymakers and program implementers to develop targeted interventions that maximize facilitators while systematically addressing barriers to achieve successful CHW integration.

Effectiveness of CHW Integrated Programs

Integrated CHW programs that are included within national primary health care system with defined roles, standardized training, supervision, linkages to commodities, information systems, and domestic funding

repeatedly demonstrate proof of improved RMNCH coverage and specific health outcomes, especially when scaled up as part of system reforms. Government-implemented programs like Ethiopia's Health Extension Program and Rwanda's national CHW system are perpetually associated with substantial service use increases (e.g., immunization, ANC/PNC, facility delivery), under-five mortality declines, and improved timeliness of treatment if supervision and supply reliability are sustained [4, 6, 29, 38]. Key drivers are standardized or paid compensation, routine supervision in PHC hierarchies, being included in HMIS and referral chains, and assured commodity availability, with further digital tools facilitating more stringent protocol follow-up, improved data quality, and follow-up being possible when incorporated into national systems [4, 8, 13]. Community engagement, through local leadership, cooperatives, and accountability mechanisms, improves acceptability, retention, and equity in coverage, thereby improving performance in hard-to-reach places [11].

Relative to others, long-term effectiveness is strongest where there is institutionalized CHW policy, diversified financing with domestic budget lines, and institutionalized program design across districts, reducing short-term project dependency and geographic disparities [4, 6, 9]. Evaluations of large national programs (e.g., Ghana's CHPS, Malawi's HSAs, and iCCM scale-ups) report gains in coverage and child survival contingent on supervision intensity, supply security, and fidelity to standardized roles; conversely, volunteer-only or fragmented models show mixed results and greater variability in outcomes [4]. Post-2015 technologies, digital decision support, client tracking, and integrated dashboards, enhance performance in combination with training, supportive supervision, and application of data within management cycles but cannot substitute for essential investments in workforce, commodities, and referral systems [13, 4].

Overall, there is evidence supporting CHW integration as an effective, low-cost strategy for achieving UHC-aligned outcomes when positioned in well-strengthened PHC systems with strong governance and financing.

Integrated CHW platforms can meaningfully advance progress toward UHC by extending essential services, improving timeliness and continuity, and reducing inequities. However, effectiveness depends less on the label "CHW" and more on the system conditions under which CHWs operate: policy clarity, domestic financing, supervision quality, supply reliability, data-use routines, and community accountability [4, 6, 8].

Limitations

The Synthesis of CHW integration evidence is constrained by substantial heterogeneity in CHW integration models, study methodologies, scopes of practice across countries and over time that limits cross-study comparability and generalizability. Many reviews conflate the presence of CHWs with 'well-integrated CHW systems,' complicating, which components drive effects.

Conclusions

This cross-national synthesis highlights the best results and sustainability of CHW programs in being integrated into national health care systems. A decade of practice in Sub Saharan Africa shows that CHW programs can accelerate nations towards UHC when managed, funded, supplied, supervised, and implemented within PHC and not as parallel projects. Most robust drivers of effectiveness are policy clarity and domestic funding, supportive supervision with Continuous Professional Development (CPD), stable last-mile commodities, interoperable information systems with routine data use, and genuine community accountability. Those nations that make law for CHW policy in national plans, finance programs from domestic budget lines supported by matched partner contributions and

implement at scale with fidelity will be more likely to see improvements in sustained service coverage, timeliness of care, and equity, particularly for RMNCH outcomes. Mechanisms of community engagement, local leadership, cooperatives, and systems for accountability repeatedly improve performance, retention, and acceptability, while digital innovations can accelerate gains when integrated into fundamental routine supervision and decision-making processes. Conversely, projectized financing, fragmented tools, weak oversight, and chronic stockouts undermine performance and erode community trust. There is no one integration model, successful designs are adapted to country context, and health system maturity, but use the same set of system do mains.

Concurrently, experience across Sub-Saharan Africa highlights chronic bottlenecks including volunteer-dependent, project-based, or fragmented models deliver variable and fragile results, inadequate supervision and stockouts compromise effectiveness; and uneven subnational financing sustains geographic inequalities.

A responsive UHC roadmap prioritizes the establishment of a minimum viable, state-owned CHW platform, phasing in supervision, supply, data-use, and CPD upgrades for enhanced quality and equity, consolidating partners under a shared results framework and institutionalizing finance, digital architecture, and professionalization for long-term resilience and value for money. Countries need to contextualize this trajectory to rural remote, urban-informal, or fragile settings, with regular indicators and periodic reviews to iterate.

References

[1]. World Health Organization., United Nations Children's Fund (UNICEF), 2018, Declaration of Astana, Global Conference on Primary Health Care, Astana, Kazakhstan, 25–26 October 2018.

Future efforts need to address implementation research on cost, quality, and equity; monitor outcomes other than coverage and invest in professionalization, career paths, and gender-responsive policies to sustain a skilled, motivated workforce. In short, when CHW programs are planned and budgeted as ongoing government sector activities rather than temporary projects they provide lasting value for money, encourage universal health coverage, and build the resilience of primary health care systems.

Conflict of Interest

The authors declare no conflict of interest

Ethical Approval

No ethical clearance was needed, since we used secondary data and not human subjects. The synthesis considered publish publications.

Data Availability

This article did not generate or analyze any new data, therefore, there is no dataset to share.

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WHO. <https://www.who.int/publications/i/item/WHO-HIS-SDS-2018.61>

[2]. World Health Organization, 2016, Global strategy on human resources for health: Workforce 2030.

WHO. <https://www.who.int/publications/i/item/9789241511131>

- [3]. Schneider, H., Okello, D., & Lehmann, U., 2016, The global pendulum swing towards community health workers in low- and middle-income countries: A scoping review of policies and programmes. *Human Resources for Health*, 14(Suppl 1), S65. <https://doi.org/10.1186/s12960-016-0163-2>
- [4]. World Health Organization, 2018, WHO guideline on health policy and system support to optimize community health worker programmes. WHO. <https://www.who.int/publications/i/item/9789241550369>
- [5]. Nkonki, L., et al., 2017, A systematic review of economic evaluations of CHW interventions aimed at improving child health outcomes. *Human Resources for Health*, 15(1), 17. <https://doi.org/10.1186/s12960-017-0192-1>
- [6]. Perry, H. B., Zulliger, R., & Rogers, M. M., 2014, Community health workers in low-, middle-, and high-income countries: An overview of their history, recent evolution, and current effectiveness. *Annual Review of Public Health*, 35, 399–421. <https://doi.org/10.1146/annurev-publhealth-032013-182354>
- [7]. Naimoli, J. F., Perry, H. B., Townsend, J. W., Frymus, D. E., & McCaffery, J. A., 2014, Strategic partnering to improve community health worker programming and performance: Features of a community health system integrated approach. *Human Resources for Health*, 12, Article 91. <https://doi.org/10.1186/1478-4491-12-91>
- [8]. Scott, K., Beckham, S., Gross, M., Pariyo, G., Rao, K. D., Cometto, G., & Perry, H. B., 2018, Community-based health information systems: A systematic review. *Journal of Global Health*, 8(2), Article 020409. <https://doi.org/10.7189/jogh.08.020409>
- [9]. McCollum, R., Gomez, W., Theobald, S., & Taegtmeier, M., 2019, How health system factors influence CHW programmes: A qualitative comparison of policies and programmes in Tanzania, Uganda and Mozambique. *Human Resources for Health*, 17, Article 58. <https://doi.org/10.1186/s12960-019-0382-8>
- [10]. Ballard, M., Bonds, M., Taylor, L., Dowler, E., Foth, J., Furth, R., & Johnson, A., 2018, Community health worker economic evaluation: Cost and cost-effectiveness. USAID Health Finance and Governance Project, *Abt Associates*. <https://www.hfgproject.org/community-health-worker-economic-evaluation-cost-and-cost-effectiveness/>
- [11]. Kok, M. C., Dieleman, M., Taegtmeier, M., Broerse, J. E. W., Kane, S. S., Ormel, H., Tijm, M. M., & de Koning, K. A. M., 2015, Which intervention design factors influence performance of community health workers? A systematic review. *Health Policy and Planning*, 30(9), 1207–1227. <https://doi.org/10.1093/heapol/czu126>
- [12]. Rowe, A. K., Rowe, S. Y., Peters, D. H., Holloway, K. A., Chalker, J., & Ross-Degnan, D., 2018, Effectiveness of supportive supervision on quality of care: A systematic review. *Tropical Medicine & International Health*, 23(9), 1040–1056. <https://doi.org/10.1111/tmi.13100>
- [13]. Agarwal, S., LeFevre, A. E., Lee, J., L'Engle, K., Mehl, G., Sinha, C., & Labrique, A., 2019, Digital tools for frontline health workers. *BMJ Global Health*, 4(Suppl. 1), Article e001146. <https://doi.org/10.1136/bmjgh-2018-001146>
- [14]. Zachariah, R., Ford, N., Philips, M., Lynch, S., Massaquoi, M., Janssens, V., & Harries, A. D., 2011, Task shifting in HIV/AIDS: Supply chains and outcomes in community-based interventions. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 105(10), 598–606. <https://doi.org/10.1016/j.trstmh.2011.07.019>
- [15]. WHO, 2022, WHO guidance on community health worker programmes: monitoring and evaluation and indicators, *World Health Organization*, Geneva. Available at: <https://www.who.int/publications/i/item/9789240058989>
- [16]. Assefa, Y., Gelaw, Y. A., Hill, P. S., Taye, B. W. & Van Damme, W., 2019, Community health extension program of Ethiopia, 2003–2018: successes and challenges toward universal coverage for primary healthcare, *BMJ Global Health*, vol. 4, e001002. <https://doi.org/10.1136/bmjgh-2018-001002>
- [17]. Condo, J., Mugeni, C., Naughton, B., Hall, K., Tuazon, M. A., Omwega, A., Nwaigwe, F., Drobac,

- P., Hyder, Z., Ngabo, F., Karema, C., Binagwaho, A. & Gaju, E., 2014, Rwanda's evolving community health worker system: a qualitative assessment of client and provider perspectives, *Human Resources for Health*, vol. 12, 71. <https://doi.org/10.1186/1478-4491-12-71>
- [18]. Khatri, R. B., et al., 2024, Enablers and barriers of community health programs for primary health care delivery in the context of universal health coverage: A scoping review. *BMC Primary Care*, 25(1), Article 366. <https://pmc.ncbi.nlm.nih.gov/articles/PMC11520389/>
- [19]. Mlotshwa, L., et al., 2023, Community health worker programmes' integration into national health systems: Scoping review. *African Journal of Primary Health Care & Family Medicine*, 15(1), Article 1925. <https://phcfm.org/index.php/phcfm/article/view/3204>
- [20]. CHW Central, 2015, Investment case and financing recommendations for community health workers. <https://chwcentral.org/wp-content/uploads/2015/09/CHW-Financing-FINAL-July-15-2015.pdf>
- [21]. Ministry of Health (Kenya), 2014, Kenya Community Health Strategy 2014–2019: delivering primary health care for universal health coverage, Ministry of Health, Nairobi. Available at: <https://www.health.go.ke> (policy outlines CHS, CHV integration, roles, and mixed funding modalities)
- [22]. Kalyango, J. N., Rutebemberwa, E., Alfvén, T., Ssali, S., Peterson, S., & Karamagi, C., 2012, Performance of community health workers under integrated community case management of childhood illnesses in eastern Uganda, *Malaria Journal*, 11, 282. <https://doi.org/10.1186/1475-2875-11-282>
- [23]. Gilroy, K. E., Callaghan-Koru, J. A., Cardemil, C. V., Nsona, H., Amouzou, A., Mtimuni, A., Daelmans, B., & Bryce, J., 2013, Quality of sick child care delivered by Health Surveillance Assistants in Malawi, *The American Journal of Tropical Medicine and Hygiene*, 89(1), pp. 144–153. <https://doi.org/10.4269/ajtmh.12-0387>
- [24]. Procter, C. D., et al., 2023, The implementation and effectiveness of multi-tasked, paid community health workers on maternal and child health: A cluster-randomized pragmatic trial and qualitative process evaluation in Tanzania. *PLOS Global Public Health*, 3(9), e0002050. <https://doi.org/10.1371/journal.pgph.0002050>
- [25]. Ministry of Health (Liberia), 2016, National Community Health Services Policy 2016–2021, Ministry of Health, Monrovia. Available at: <https://moh.gov.lr>
- [26]. Ministry of Health and Sanitation (Sierra Leone), 2016, National Community Health Worker Policy 2016–2020, Ministry of Health and Sanitation, Freetown. Available at: <https://mohs.gov.sl>
- [27]. Mirzoev, T., et al., 2016, Study protocol: Realist evaluation of effectiveness and sustainability of a community health workers programme in Nigeria. *Implementation Science*, 11, Article 79. <https://doi.org/10.1186/s13012-016-0443-0>
- [28]. Awoonor Williams, J. K., Bawah, A. A., Nyongator, F. K., Asuru, R., Oduro, A., Ofosu, A., & Phillips, J. F., 2013, The Ghana Essential Health Interventions Program: A plausibility trial of the impact of health systems strengthening on maternal and child survival. *BMC Health Services Research*, 13(Suppl 2), S3.
- [29]. Assefa, Y., Hill, P. S., Gilks, C. F., Van Damme, W., Haregu, T. N., Topp, S. M., Docrat, S., Reddy, T., Östlin, P., & Sanders, D., 2019, Primary health care contributions to universal health coverage, health security, and healthier populations: The South African case study. *BMJ Global Health*, 4(Suppl. 8), Article e001802. <https://doi.org/10.1136/bmjgh-2019-001802>
- [30]. Kane, S., Scott, K., Nacarella, L., Diop, K., Sarr, B., Ndiaye, M., Sylla, M., Gueye, M., Somé, H., & Kok, M., 2016, Strengthening community health worker "Bajenu Gox" to improve maternal and newborn health in Senegal: A qualitative evaluation of program integration and effects on postpartum family planning. *Global Health: Science and Practice*, 4(3), 367–381. <https://doi.org/10.9745/GHSP-D-16-00087>

- [31]. Idriss-Wheeler, D., Ormel, I., Assefa, M., Rab, F., Angelakis, C., Yaya, S., & et al., 2024, Engaging community health workers (CHWs) in Africa: Lessons from the Canadian Red Cross supported programs. *PLOS Global Public Health*, 4(1), Article e0002799. <https://doi.org/10.1371/journal.pgph.0002799>
- [32]. Gebremeskel, A. T., Omonaiye, O., & Yaya, S., 2022, Multilevel determinants of community health workers for an effective maternal and child health programme in sub-Saharan Africa: A systematic review. *BMJ Global Health*, 7(4), Article e008162. <https://doi.org/10.1136/bmjgh-2021-008162>
- [33]. UNICEF, USAID, MCHIP, & WHO, 2014, Community health worker program overviews: Systematic references to program implementation and integration. UNICEF/USAID/MCHIP. (Profiles CHW programs in Mozambique, Malawi, Uganda, and Tanzania, including many NGO led or NGO supported models and their integration challenges.)
- [34]. Perry, H. B., et al., 2014, Developing and strengthening community health worker programs at scale for improved child health outcomes. USAID/MCHIP. https://socialserviceworkforce.org/wp-content/uploads/2024/03/MCHIP_CHW-Ref-Guide.pdf
- [35]. Kumar, M., Nefdt, R., Ribaira, E., & Diallo, K., 2014, Access to healthcare through community health workers in East and Southern Africa. *UNICEF*. <https://teampata.org/wp-content/uploads/2017/06/Access-to-healthcare-through-CHWs-in-ESA.pdf>
- [36]. Abanilla, P. K., Huang, K. Y., Shinnors, D., Levy, A., Ayernor, K., Aikins, A. D., & Ogedegbe, O., 2011, Cardiovascular disease prevention in Ghana: Feasibility of a faith-based organizational approach. *Bulletin of the World Health Organization*, 89(9), 648–656. <https://doi.org/10.2471/BLT.11.086777>
- [37]. Mayo, V., & Mendoza, J., 2024, The role of community health workers in universal health coverage.
- [38]. Gilmore, B., & McAuliffe, E., 2013, Effectiveness of community health workers delivering preventive interventions for maternal and child health in developing countries: A systematic review. *Health Policy and Planning*, 28(7), 633–657. <https://doi.org/10.1093/heapol/czs097>
- [39]. Asamani, J. A., Okoroafor, S. C., Mwinga, K., & et al., 2025, Community health worker requirements to accelerate universal health coverage in Africa. *BMJ Global Health*, 10(Suppl. 1), Article e013628. <https://pmc.ncbi.nlm.nih.gov/articles/PMC11851756/>
- [40]. Mupara, L. M., et al., 2023, Community health worker programmes' integration into national health systems: Scoping review. *African Journal of Primary Health Care & Family Medicine*, 15(1), Article 1925. <https://doi.org/10.4102/phcfm.v15i1.1925>

The Role of a Father in Access to Maternal and Child Health Services in Ethiopia: A Neglected Key to Survival

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Abstract

Children's survival and health critically depend on supportive adults, particularly their parents. Sub-Saharan Africa and Central and Southern Asia bear the highest burden of maternal, stillbirth, and neonatal deaths. Ethiopia ranks 5th globally among countries accounting for 60% of these deaths. The major underlying causes are harmful gender norms, biases and inequalities. This study identifies factors affecting male involvement in Maternal and Child Health (MCH) care in Ethiopia and proposes strategies to enhance father's contributions to maternal and child survival. Methodologically, an extensive literature review and critical analysis of existing studies, health policies, and reports related to MCH, and father's role was conducted. Despite Ethiopia's health system improvements that incorporate life-cycle services, significant inequalities persist by economic status, education, residence, and gender. Political commitment to reducing stillbirths remains insufficient. Key barriers to male involvement include health facility factors (inaccessibility, unwelcoming environments, disrespectful care), sociodemographic characteristics (age, education, occupation), low income, and deep-rooted cultural norms relegating MCH to women's domain. In conclusion, the crucial role of father's in MCH care is widely acknowledged yet underexplored in the policy. Ethiopian men's hesitancy to engage in MCH significantly impacts survival outcomes. Implementing policies promoting male involvement – such as father-friendly clinics, targeted education campaigns, and couple-based antenatal care – can strengthen health systems and improve family well-being.

Keywords: Ethiopia, Father Involvement, Maternal and Child Health, Paternal Support, Survival.

Introduction

Since the 1994 International Conference on Population and Development (ICPD), male involvement in Maternal and Child Health (MCH) care has gained global recognition [1, 2]. However, engagement remains low in most Low- and Middle-Income Countries (LMICs), including Ethiopia [3]. Global evidence consistently demonstrates that male involvement positively impacts family planning use, antenatal care (ANC) attendance, safe birth practices, postnatal care (PNC), and child health service utilization [4].

Mothers and children are universally recognized as highly vulnerable population groups, disproportionately suffering from adverse social and economic conditions [5]. Children's vulnerability stems from their dependence on caregivers, primarily their parents for survival and health, especially from birth to age five. Maternal vulnerability arises from the inherent risks of pregnancy and childbirth [5].

The World Health Organization (WHO)'s 2030 targets aim to reduce the Global Maternal Mortality Ratio (MMR) to <70/100,000 live births (SDG 3.1), reduce neonatal mortality to

≤12/1,000 live births and under-5 mortality to ≤25/1,000 live births (SDG 3.2) and achieve ≤12 stillbirths/1,000 total births (ENAP Goal 2), [6]. Sub-Saharan Africa (SSA) and Central/Southern Asia bear the highest burden

of maternal deaths, stillbirths, and neonatal deaths. Ethiopia ranks 5th among the top 10 countries accounting for 60% of these global deaths [7], (Table 1).

Table 1. Countries with the Largest Numbers of Maternal Deaths, Stillbirths, and Neonatal Deaths in 2020

Country	Total Deaths (thousands)	Share of Total Deaths	Share of Live Births	Maternal Deaths (thousands)	Stillbirths (thousands)	Neonatal Deaths (thousands)
India	788	17%	17%	24	297	468
Nigeria	540	12%	6%	82	181	277
Pakistan	474	10%	5%	10	207	257
DRC	241	5%	3%	22	113	106
Ethiopia	196	4%	3%	10	83	104
Bangladesh	121	3%	2%	4	66	51
China	108	2%	9%	3	63	42
Indonesia	103	2%	3%	8	42	53
Afghanistan	95	2%	1%	9	38	49
Tanzania	94	2%	2%	5	43	46

Source: UN World Population Prospects 2022, UN MMEIG 2023, UNIGME 2023

Harmful gender norms, biases, and inequalities are major underlying causes of maternal mortality and impact newborn survival [7]. While Ethiopia has made significant strides in reducing under-5 mortality

(from 123/1,000 in 2005 to 59/1,000 in 2019) and infant mortality (from 77/1,000 to 47/1,000), maternal (401/100,000 in 2017) and neonatal mortality (33/1,000 in 2019) remain high [8, 9] (Figure 1).

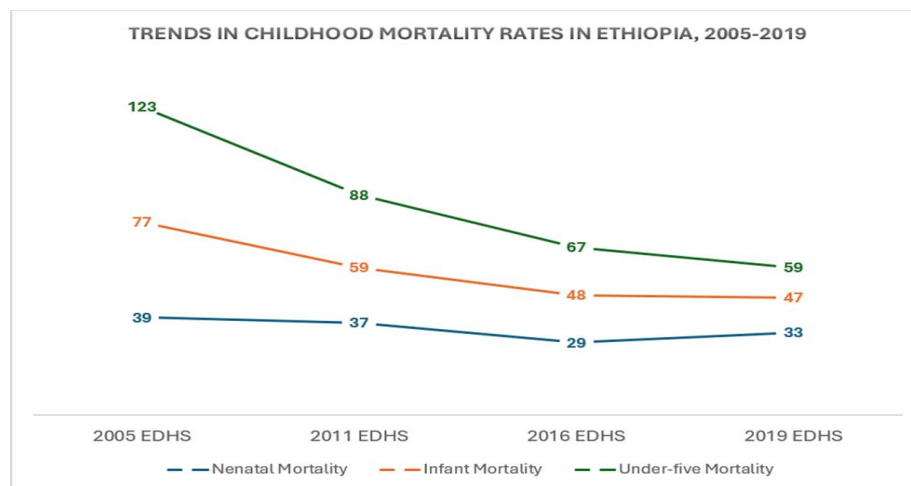


Figure 1. Trends in Childhood Mortality Rates, 2005 – 2019

(Source: Ethiopian Health Sector Transformation Plan II (HSTP II): 2020/21 – 2024/25)

Persistent challenges include sociocultural beliefs, facility-related issues (poor satisfaction, disrespectful care, accessibility, stockouts), and low community health knowledge [8].

Significant disparities exist between urban and rural areas in MCH service uptake and male involvement, with urban areas showing better outcomes [10].

Paternal support demonstrably enhances MCH outcomes. Father involvement leads to the following benefits:

1. **Improved Maternal Health:** Reduced stress/anxiety/depression, increased ANC and PNC attendance, and shared responsibilities.
2. **Improved Child Health & Development:** Higher rates of immunization, growth monitoring, and timely treatment; better nutrition and food security.

This study aims to identify the key factors affecting male involvement in MCH services in Ethiopia and to propose strategies to enhance their contribution to maternal and child survival.

Policy Support

Global policy tracking reveals gaps. While 83% of reporting countries have national targets for reducing Maternal Mortality Ratio (MMR) and Neonatal Mortality Rate (NMR), commitment to reducing stillbirths is insufficient—only 31% have targets, and 34% of those are off-track for 2030 goals [7].

Financing is often misaligned: only 61% of countries have costed Maternal and Newborn Health (MNH) plans, 49% track MNH allocations, and few have specific budget lines for Emergency Obstetric Care (EmOC), (28%) or Small and Sick Newborn Care (SSNC), (22%). Only 12% report fully financed MNH plans [7].

Globally, the Reproductive, Maternal, Newborn, and Child Health (RMNCH) sub-index improved by 12% between 2000-2019, yet significant gaps persist, especially regarding Sexual and Reproductive Health and Rights (SRHR) for marginalized groups and in crises [11, 12].

Ethiopia's Health Sector Transformation Plans (HSTP) prioritized MCH, aligning with global initiatives like the Millennium Development Goals (MDGs). Newborn health gained prominence post-2010. Strong

alignment among development partners under a single national framework (e.g., regular joint assessments) has been a feature [13]. The Reproductive, Maternal, Neonatal, Child, Adolescent and Youth Health plus Nutrition (RMNCAYH+N) strategy integrates services across the life cycle [8]. The foundational Health Extension Program (HEP), launched in 2003, expanded preventive MCH services [14].

Despite progress, significant inequalities persist in economics, education, residence, and gender. The 2019 Ethiopia Mini DHS (EMDHS) shows improvements (e.g., ANC1: 28% in 2005 to 74% in 2019), but critical gaps remain: only 43% had 4+ ANC visits, 20% started ANC early, 50% facility deliveries, 10.6% received adequate iron, 14% delivered in functional Emergency Obstetric and Newborn Care (EmONC) facilities, and low PNC (34% in 2019). Caesarean section rates were very low (4%) with huge regional disparities [9]. Neonatal disorders remain the leading cause of under-5 deaths (40.7%), with malnutrition contributing to nearly half of these deaths. The proportion of neonatal deaths rose from 43% (1990) to 55% (2019) of under-5 deaths [9]. Key challenges include uneven resource distribution, suboptimal quality of care, low care-seeking behaviour, low Kangaroo Mother Care (KMC) coverage, and commodity shortages [8].

Factors Influencing Male Involvement in MCH Care

Sociodemographic Characteristics

1. **Age & Marital Status:** Older age of the spouse and cohabitation are associated with higher male involvement [15].
2. **Education:** Higher education levels significantly increase male involvement. Men with ≥ 8 grade of education were twice as likely to be involved compared to those with no formal or less education [16].
3. **Occupation:** Demanding or unpredictable jobs (e.g., taxi drivers, motorbike taxi riders) reduce the likelihood of

accompanying spouses to health facilities [16].

Health Service Factors

1. **Geographical Accessibility:** Long distances to health facilities deter men, compounded by fears of roadside delivery and shame associated with it [17].
2. **Provider Attitudes & Behaviour:** Disrespectful, harsh, or critical treatment of both women and accompanying men, negative gender-based staff assumptions and attitudes toward men by healthcare workers (HCWs) are major deterrents that discourage future participation [16-18]. Additionally, HCWs lack awareness of and understanding of fathers' needs, contributing to poor communication and treatment of fathers in relation to MCH affairs [18].
3. **Clinic Environment & Space:** MCH clinics often lack space for men, mainly focusing on a mother-oriented environment of services, which creates an unwelcoming atmosphere for men. Men are frequently excluded from delivery rooms and immediate postpartum spaces, limiting their role in the provision of support despite showing interest [16, 18-20].
4. **Policy and Practice Guidelines:** Absence of specific policies, guidelines, and practical frameworks on father involvement in MCH programmes, as well as the presence of unfavourable workplace policies, become obstacles to father involvement in family health programs [18].

Income and Economic Factors

1. **Enabling Factor:** Higher and stable income correlates strongly with greater involvement in ANC, decision-making, and supporting maternal health behaviours [21-23]. Financial security reduces stress and increases time and flexibility for involvement [24].

2. **Barrier:** Poverty, lack of transport, and inflexible jobs hinder participation, especially in rural areas [15]. Even within "free" services, unexpected costs for supplies cause embarrassment and deterrence [17, 25]. Financial stress can reduce emotional and physical availability.

Cultural and Normative Factors

1. **Gender Role Division:** Deeply ingrained patriarchal norms designate MCH, particularly childbirth, as exclusively "women's affairs." Men's involvement is often seen as transgressing traditional roles, risking loss of respect and cause community stigma [17, 26-28].
2. **Provider Role:** Men are culturally defined as decision-makers and financial providers, not direct caregivers within the MCH sphere [19].
3. **Harmful Beliefs:** Beliefs associating male presence at delivery with infidelity, prolonged labour, or bewitchment, which discourage involvement [26, 27].
4. **Traditional Practices & Fatalism:** Preference for Traditional Birth Attendants (TBAs) and beliefs that childbirth is a natural process governed by divine will and power, reduces perceived need for facility-based care and male escort [17, 29].

Strategies for Future Improvement

Addressing low male knowledge and involvement requires multi-faceted interventions:

1. **Community-Level Interventions:** Design culturally sensitive programs (considering traditional roles, religion, work schedules, and education) to reorient men about their crucial role in Reproductive, Maternal, and Child Health (RMCH) and challenge patriarchal beliefs [3].

2. Targeted Male

Engagement: Implement male-specific strategies: tailored health messages, dedicated education sessions, and identifying male-friendly venues (e.g., workplaces, community centers), [18, 20].

3. Health System Adaptations:

- Create welcoming environments (father-friendly clinics with dedicated spaces), [18].
- Train providers on respectful engagement of men and couples.
- Promote couple-based ANC and PNC.
- Implement flexible clinic hours.

4. Socioecological Approach: Utilize a framework addressing barriers at multiple levels (Figure 2):

- Individual: Education, empowerment.
- Relationship: Couple communication, shared decision-making.
- Community: Challenging harmful gender norms through community dialogue, engaging leaders.
- Societal/Structural: Supportive policies, media campaigns promoting positive fatherhood, addressing economic barriers [18, 30].

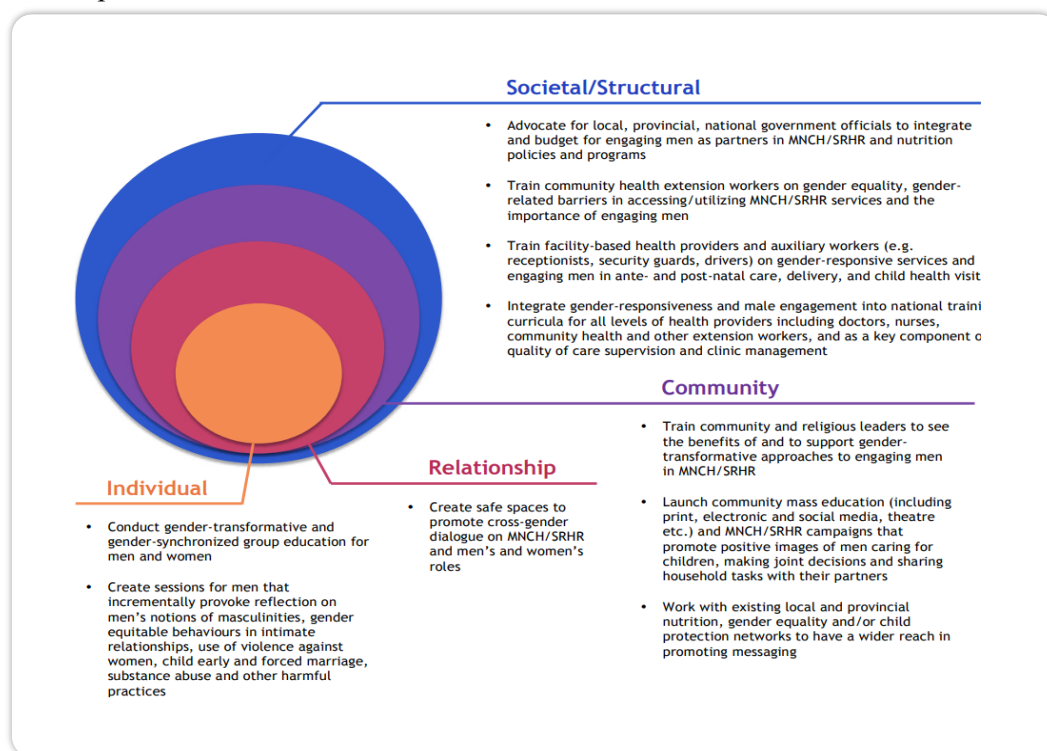


Figure 2. Strategies for Male Involvement in MCH Care

(Adopted from Doyle & Kato-Wallace, 2013)

(Visual depiction of concentric circles: Individual, Relationship, Community, Societal/Structural levels with corresponding intervention strategies listed at each level).

Discussion

This review underscores a critical role of fathers in MCH. While globally acknowledged, it remains a significantly underutilized mean of support within the Ethiopian health system [3, 4]. The findings align with broader literature

from LMICs, confirming that male involvement is not a peripheral concern but a central determinant of MCH outcomes [4, 15]. The persistence of high maternal and neonatal mortality in Ethiopia, despite systemic improvements, highlights a crucial

implementation gap where engaging men could yield substantial survival dividends [8, 9].

The analysis reveals a complex barrier ecosystem. At the structural level, the absence of explicit policy directives and budgetary lines for male engagement programs signals a lack of institutional prioritization [7, 18]. This trickles down to health facilities, manifesting as physical and attitudinal environments that are exclusionary to men, such as unwelcoming clinic spaces and disrespectful treatment from healthcare workers [16-18]. Concurrently, deep-seated patriarchal norms at the community level enforce a rigid gender-based division of labour, casting MCH as a female domain and stigmatizing male participation [17, 26, 27]. These structural and normative barriers are compounded by individual-level factors like low education and economic constraints, which limit men's capacity and flexibility to engage [15, 16, 24].

However, the identified strategies point towards a viable pathway. The proposed multi-level socioecological approach is critical [18, 30]. Isolated interventions, such as training health workers without addressing community norms, or creating father-friendly spaces without flexible clinic hours for working men, are likely to fail [18, 20]. Success requires synergistic action. The health policy must mandate and fund male-inclusive MCH programming [7, 18]. Health systems must operationalize this through infrastructure, training, and couple-friendly service models [18, 20]. Communities must be engaged through trusted leaders and tailored communication to reframe fatherhood and masculine roles [3, 26, 30]. This integrated effort can transform father involvement from a neglected key into a powerful engine for achieving Ethiopia's MCH and Sustainable Development Goals (SDGs) [6, 8].

Conclusion

The vital role of fathers in MCH care, while acknowledged, remains critically

underexplored and underutilized in Ethiopian health policy and practice. Paternal involvement is not merely beneficial but essential for improving maternal health outcomes, enhancing child survival and development, and strengthening family well-being. Ethiopian men's current low participation stems from a complex interplay of factors: entrenched patriarchal norms defining MCH as women's domain, health system barriers (inaccessibility, unwelcoming environments, disrespectful care), socioeconomic constraints (poverty, time limitations due to income generation), and varying levels of education and awareness.

Overcoming these barriers requires deliberate and sustained action. Policies and programs must actively promote male involvement through concrete measures: establishing father-friendly health facilities, implementing widespread education campaigns targeting men and communities to shift gender norms, promoting couple-based ANC and PNC models, and integrating strategies to address economic and logistical barriers. Successfully implementing these interventions holds immense potential to significantly reduce Ethiopia's high burden of maternal, neonatal, and child mortality, moving the country closer to achieving its national health goals and global SDG targets. Engaging fathers is not just an add-on; it is a neglected key to unlocking better survival and health for Ethiopia's mothers and children.

Ethical Approval and Concern to Participate

It is not applicable for this study.

Data Availability

Not applicable. This study is a literature review and does not involve original data.

Author Contributions

- **David Dak:** Conceptualization, Methodology, Writing – Original Draft, Writing – Review & Editing.

- **Dagnechew Degefu:** Writing – Original Draft, Investigation, Formal analysis.
- **Surender Reddy Pulluri:** Supervision, Validation, Writing – Review & Editing.

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References

- [1]. McIntosh, C. A., and Finkle, J. L., 1995, The Cairo conference on population and development: A new paradigm? *Population and Development Review*, 21(2), pp.223-260.
- [2]. Sternberg, P., and Hubley, J., 2004, Evaluating men's involvement as a strategy in sexual and reproductive health promotion. *Health Promotion International*, 19(3), pp.389-396. <https://doi.org/10.1093/heapro/dah312>
- [3]. Okafor, I. P., Chukwudi, C. L., Igwilo, U. U., and Ogunnowo, B. E., 2022, "Men are the head of the family, the dominant head": A mixed method study of male involvement in maternal and child health in a patriarchal setting, Western Nigeria. *PLoS ONE*, 17(10), e0276059. <https://doi.org/10.1371/journal.pone.0276059>
- [4]. Messner, L., Smith, D., Tadesse, H. A., and Santillán, D., 2020, Engaging Men for Positive Maternal and Reproductive Health Outcomes in Ethiopia: Technical Brief. *Rockville, MD: EnCompass LLC*.
- [5]. World Health Organization, 1997, Managing maternal and child health programmes: a practical guide. (WPRO Education in Action Series N° 10). WHO Regional Office for the Western Pacific, Manila. <https://apps.who.int/iris/handle/10665/207028>
- [6]. World Health Organization, 2023, Improving maternal and newborn health and survival and reducing stillbirth: Progress Report 2023. Geneva.
- [7]. World Health Organization, 2022. Improving maternal and newborn health and survival and reducing stillbirth: Progress Report 2022. Geneva.

Competing Interests

The author(s) declared no competing interests.

Disclaimer

The author(s) declared that no generative artificial intelligence (AI) technologies (e.g., ChatGPT, Copilot, Scite) were used in the preparation of this research paper.

- [8]. Ministry of Health [Ethiopia], 2021, Ethiopian Health Sector Transformation Plan II (HSTP II): 2020/21 – 2024/25. Addis Ababa, Ethiopia.
- [9]. EPHI and ICF, 2019, Ethiopia Mini Demographic and Health Survey 2019, Addis Ababa, Ethiopia, and Rockville, Maryland, USA.
- [10]. Mengesha, E. W., Tessema, G. A., Assefa, Y., and Alene, G. D., 2023, Social capital and its role to improve maternal and child health services in Northwest Ethiopia: A qualitative study. *PLoS ONE*, 18(4), e0284592. <https://doi.org/10.1371/journal.pone.0284592>
- [11]. Cardenas, A., Singh, S., Harpin, M., et al., 2023, Center for Reproductive Rights. "Accelerating Progress: Liberalization of Abortion Laws since ICPD." reproductiverights.org/sites/default/files/documents/WorldAbortion-Map-AcceleratingProgress.pdf (Accessed 26 May 2025).
- [12]. United Nations Population Fund, 2024, Navigating Megatrends: The ICPD Programme of Action for a Sustainable Future ICPD30 Think Piece: The Future of Sexual and Reproductive Health and Rights. July 2024.
- [13]. Melesse, D. Y., Tadele, A., Mulu, S., et al., 2024, Learning from Ethiopia's success in reducing maternal and neonatal mortality through a health systems lens. *BMJ Global Health*, 9, e011911. <http://dx.doi.org/10.1136/bmjgh-2023-011911>.
- [14]. World Bank, 2016, Ethiopia - Health Extension Program: An Institutionalized Community Approach for Universal Health Coverage. Washington, DC.
- [15]. Ditekemena, J., Koole, O., Engmann, C., et al., 2012, Determinants of male involvement in

maternal and child health services in sub-Saharan Africa: a review. *Reprod Health*, 9, 32. <https://doi.org/10.1186/1742-4755-9-32>

[16]. Byamugisha, R., Tumwine, J. K., Semiyaga, N., et al., 2010, Determinants of male involvement in the PMTCT of HIV programme in Eastern Uganda: a cross-sectional survey. *Reprod Health*, 7, 12. <https://doi.org/10.1186/1742-4755-7-12>

[17]. Hailemariam, S., Abayneh, M., Genetu, A., 2021, Individual, socio-cultural, and health facility factors affecting men's involvement in facility-based childbirth in Southwest, Ethiopia: A mixed method study. *SAGE Open Med.* 9:20503121211023367. <https://doi.org/10.1177/20503121211023367>

[18]. Baran, M. B., and Sawrikar, V., 2024, Service-level barriers and facilitators to father engagement in child and family services: A systematic review and thematic synthesis of qualitative studies. <https://doi.org/10.1016/j.childyouth.2023.107295>

[19]. Dumbaugh, M., Tawiah-Agyemang, C., Manu, A., et al., 2014, Perceptions of, attitudes towards and barriers to male involvement in newborn care in rural Ghana, West Africa: a qualitative analysis. *BMC Pregnancy Childbirth*, 14, 269. <https://doi.org/10.1186/1471-2393-14-269>

[20]. Ditekemena, J., Matendo, R., Koole, O., et al., 2011, Male partner voluntary counselling and testing associated with the antenatal services in Kinshasa, Democratic Republic of Congo: a randomized controlled trial. *International Journal of STD & AIDS*, 22(3), pp.165-170. Doi:10.1258/ijsa.2010.010379.

[21]. Cabrera, N., and Peters, H. E., 2014, Public policies and father involvement. In *Fatherhood* (pp. 295-314). Routledge.

[22]. Comrie-Thomson, L., Mavhu, W., Makungu, C., Nahar, Q., Khan, R., Davis, J., Hamdani S., Stillo E., and Luchters, S., 2015, Men matter: Engaging men for better MNCH outcomes in Bangladesh, Tanzania and Zimbabwe.

[23]. Kowalczyk, J., Jolly, P., Karita, E., Nibarere, J.A., Vyankandondera, J., and Salihu, H., 2002, Voluntary counselling and testing for HIV among

pregnant women presenting in labor in Kigali, Rwanda. *Journal of Acquired Immune Deficiency Syndromes*, 31(4), pp.408-415. <https://doi.org/10.1097/00126334-200212010-00007>

[24]. Gorman, E. H., 1999, Bringing Home the Bacon: Marital Allocation of Income-Earning Responsibility, Job Shifts, and Wives' Labor-Force Participation. *Journal of Marriage and Family*, 61(1), pp.110-122.

[25]. Worku, G., and Enquselassie, F., 2007, Factors determining acceptance of voluntary HIV counselling and testing among pregnant women attending antenatal clinic at army hospitals in Addis Ababa. *Ethiopian Medical Journal*, 45(1), pp.1-8.

[26]. Bougangue, B., and Ling, H., 2017, Male involvement in maternal healthcare through Community-based Health Planning and Services: the views of the men in rural Ghana. *BMC Public Health*, 17(1), 693. <https://doi.org/10.1186/s12889-017-4680-2>

[27]. Ganle, J., and Dery, I., 2015, 'What men don't know can hurt women's health': a qualitative study of the barriers to and opportunities for men's involvement in maternal healthcare in Ghana. *Reprod. Health*, 12(1), 93. <https://doi.org/10.1186/s12978-015-0083-y>

[28]. Muthiru, A. W., and Bukachi, S. A., 2024, Male involvement in maternal and child nutrition in low-income informal settlements, Nairobi, Kenya. *J Health Popul Nutr*, 43, 47. <https://doi.org/10.1186/s41043-023-00476-1>

[29]. Aborigo, R. A., Reidpath, D. D., Oduro, A. R., et al., 2018, Male involvement in maternal health: perspectives of opinion leaders. *BMC Pregnancy Childbirth*, 18, 3. <https://doi.org/10.1186/s12884-017-1641-9>

[30]. Doyle, K., and Kato-Wallace, J., 2013, MenCare: A Global Fatherhood Campaign; Guide for MenCare Partners; Male Engagement in Maternal, Newborn and Child Health/Sexual Reproductive Health Rights. Promundo-US.

Understanding Socio-Demographic, Environmental, and Behavioral Factors Associated with Malaria Infection Among Children Under Five Years in Tanzania: A Rapid Review

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Abstract

Malaria is a global public health concern and remains one of the major causes of morbidity and mortality among children under five in sub-Saharan Africa, with Tanzania bearing a substantial share of the burden. Although multiple studies have examined risk factors, evidence on socio-demographic, environmental, and behavioral determinants remains fragmented. A comprehensive synthesis of this evidence is critical to guide context-specific interventions. This rapid review synthesised studies published between January 2021 and December 2025 to identify factors associated with malaria infection among children under five. Data on study characteristics and key findings were extracted systematically, verified, and synthesized narratively. The results were organised into socio-demographic, environmental, and behavioural determinant domains. Twenty-one studies met inclusion criteria. Cross-sectional designs predominated (n=8, 38%), followed by randomized trials (n=5, 24%). Most studies were community-based (n=19, 91%) and focused either exclusively on children under 5 (n=8, 38%) or on mixed-age groups (n=6, 29%). Malaria infection among children under five in Tanzania is consistently associated with child age, maternal education, and household socio-economic status. Environmental factors such as housing quality, sanitation, and proximity to mosquito breeding sites, along with behavioral factors including ITN use, care-seeking, and nighttime outdoor exposure, also influence risk. These determinants interact within ecological and socio-economic contexts, underscoring the need for integrated, context-specific interventions. Strengthening vector control, improving housing and environmental conditions, promoting protective behaviors, and addressing socio-economic inequities are key to reducing malaria. This review provides evidence to guide targeted interventions and future research for accelerating malaria control in Tanzania

Keywords: Children, Factors, Malaria, Review, Tanzania, Under-fives.

Introduction

Malaria remains a major global public health challenge, with an estimated 282 million cases and 610,000 deaths reported worldwide in 2024 [1]. The African Region of the World Health Organization (WHO) bears a disproportionate

burden, accounting for 95% of malaria cases and 94% of deaths, with children under five years representing nearly three-quarters of malaria-related mortality [1]. Young children are particularly vulnerable due to their immature immune systems and limited prior exposure to malaria parasites [2]. Despite

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substantial investments in malaria control, transmission persists across sub-Saharan Africa, reflecting complex interactions between biological, environmental, and socio-structural determinants. Tanzania is among the countries most affected by malaria in the WHO African region [3]. The 2022 Tanzania Demographic and Health Survey and Malaria Indicator Survey (TDHS-MIS) reported an average malaria prevalence of 8% among children under five, with substantial regional variation [4]. The country has implemented multiple malaria control interventions, including insecticide-treated nets (ITNs), indoor residual spraying (IRS), prompt diagnosis with rapid diagnostic tests (RDTs), artemisinin-based combination therapy (ACT), intermittent preventive treatment in pregnancy (IPTp), and community-based health education programs [5]. Although these interventions have contributed to national declines in prevalence, residual transmission persists, particularly in rural and socioeconomically disadvantaged areas, highlighting the limitations of biomedical interventions alone. Despite overall declines in national malaria prevalence, transmission persists in rural and socioeconomically disadvantaged areas [5]. This disparity suggests that biomedical interventions alone are insufficient without addressing contextual determinants of infection risk [6, 7]. Accumulating evidence indicates that malaria infection among young children is shaped by interrelated socio-demographic, environmental, and behavioral factors. Socio-demographic determinants such as household wealth, maternal education, and child age influence exposure patterns and health access [8, 9]. Environmental conditions including proximity to mosquito breeding sites, sanitation, housing quality, and seasonal rainfall patterns modulate vector density and transmission intensity [10–13]. Behavioral factors, particularly consistent ITN utilization, IRS uptake, care-seeking practices, and nighttime outdoor exposure [14, 15], further mediate infection risk. However,

evidence on malaria among children under five remains fragmented, varying across study designs and ecological settings. In addition, there is limited systematically synthesized information for the recent Tanzanian context. To address this gap, a rapid review of studies published between 2021 and 2025 was conducted to consolidate contemporary evidence on socio-demographic, environmental, and behavioral determinants of malaria infection among children under five in Tanzania. By synthesizing current evidence, the review aims to identify dominant risk patterns, clarify key determinants, highlight knowledge gaps, and inform context-responsive strategies for targeted malaria prevention and control.

Materials and Methods

Review Design

This study employed a rapid review design conducted in accordance with the Cochrane Rapid Reviews Interim Guidance [16] and reported findings in line with PRISMA 2020 recommendations where applicable [17]. A streamlined methodological approach was adopted to expedite evidence synthesis while maintaining transparency and methodological rigor. The review question, eligibility criteria, and analytical framework were defined a priori in a structured protocol developed by the research team. Due to the expedited timeline of the rapid review, we did not register the protocol in PROSPERO. This review focused on socio-demographic, environmental, and behavioral determinants associated with laboratory-confirmed malaria infection among children under five years in Tanzania. Key methodological stages included structured database searching, study selection, data extraction, and narrative synthesis.

Search Strategy and Data Sources

A structured literature search was conducted in PubMed, OpenAlex, and Google Scholar from November 2025 and January 2026. Database selection was guided by Cochrane

Rapid Review recommendations to balance comprehensiveness and feasibility. The number of databases was intentionally limited to enhance efficiency while ensuring adequate coverage of relevant literature. In addition, grey literature sources were also screened, including reports from the Tanzanian Ministry of Health, the National Malaria Control Program, and the World Health Organization (WHO), to contextualize findings and identify relevant primary studies. The search was restricted to studies published between 2021 and 2025 to reflect contemporary malaria epidemiological patterns, intervention coverage, and policy relevance in Tanzania. Only English-language publications were included. Search terms combined controlled vocabulary and free-text keywords related to malaria (“malaria,” “*Plasmodium falciparum*”), population (“children under five,” “under-five,” “<5 years”), setting (“Tanzania,” “United Republic of Tanzania”), and determinants (“risk factors,” “determinants,” “predictors,” “socio-demographic,” “environmental,” “behavioral,” “insecticide-treated nets,” “ITN,” “indoor residual spraying,” “IRS”). Boolean operators were used to combine terms, and search syntax was adapted to each database.

Eligibility Criteria

Studies were considered eligible if they (1) included children under five years residing in Tanzania; (2) examined socio-demographic, environmental, or behavioral determinants of malaria infection; (3) reported laboratory-confirmed malaria diagnosed using microscopy, rapid diagnostic tests (RDTs), or polymerase chain reaction (PCR); and (4) employed observational (cross-sectional, cohort, or case-control) or interventional study designs. Studies were excluded if they were conducted outside Tanzania, did not report age-specific findings for children under five years, lacked primary data (e.g., editorials, commentaries, or opinion pieces), or did not

assess associations between malaria infection and the specified determinant domains.

Study Selection

All identified records were imported into the Rayyan AI platform for de-duplication and screening. The search yielded 2,012 records, of which 930 duplicates were removed. We screened 1,082 titles and abstracts and assessed 198 full-text articles for eligibility, resulting in 21 included studies. Following Cochrane rapid review guidance, two reviewers independently screened at least $\geq 20\%$ of titles and abstracts to ensure consistency in eligibility interpretation [16]. A single reviewer screened the remaining records. Full-text articles deemed potentially eligible were assessed for inclusion, and all exclusions at the full-text level were verified by a second reviewer. Discrepancies were resolved any disagreements through discussion and consensus.

Data Extraction

Data were extracted using a piloted and standardized extraction form in Microsoft Excel. To maintain feasibility within the rapid review framework, extraction focused on core descriptive and methodological characteristics, including author, year of publication, study design, population characteristics, setting, geographic location, and reported determinant categories. Effect size estimates and quantitative synthesis parameters were not systematically extracted, as the objective of the study was to map and categorize determinants rather than perform a quantitative meta-analysis.

Risk of Bias Assessment

Consistent with Cochrane Rapid Review guidance, a formal risk-of-bias assessment was not conducted due to time and resources constraints. Instead, study designs and notable methodological limitations were documented narratively to inform interpretation of findings.

Data Synthesis

Given the heterogeneity in study designs, exposure measurement, and outcome definitions, a meta-analysis was not appropriate. Findings were synthesized descriptively and organized thematically into three determinant domains: socio-demographic, environmental, and behavioral factors. Patterns of association were examined across studies to identify consistent risk factors and contextual influences.

Software and Reporting

Rayyan was used for the initial screening of titles and abstracts [18]. Microsoft Excel 365 was employed for systematic data extraction and organization. In addition, Zotero version 7.0.32 was used for citation management and reference organization. The study selection process is presented in a PRISMA flow diagram (*Figure 1*).

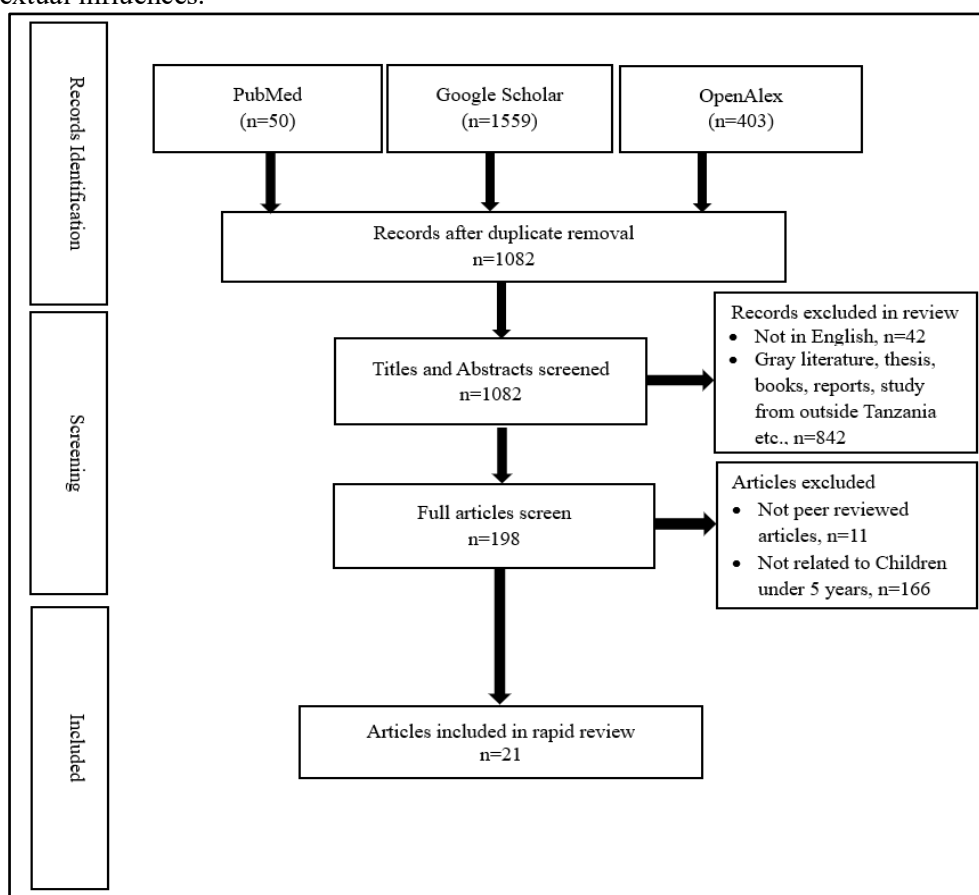


Figure 1. Prisma Flow Diagram for Identification, Screening, and Inclusion of Articles

Results

Characteristics of included studies

Twenty-one studies met the eligibility criteria. All were published in English between January 2021 and March 2025. Nearly half of the selected studies were published in 2025 (n = 10; 47.6%), reflecting increased recent research attention. Cross-sectional designs predominated (n = 8; 38.0%), followed by randomized controlled trials (n = 5; 23.8%).

Additional designs included qualitative studies (n = 2; 9.5%), mixed-methods studies (n = 2; 9.5%), record reviews (n = 2; 9.5%), one prospective cohort study (4.7%), and one entomological investigation (4.7%). With regard to populations, eight studies (38.0%) focused exclusively on children under five years, while six (28.6%) included both adults and children but reported age-disaggregated findings. One study (n=1; 4.7%) examined mosquito vectors to contextualize transmission

dynamics. Most studies were conducted in community settings (n=19; 90.5%), with broad geographic presentation across mainland Tanzania and Zanzibar, including high-transmission regions such as Mtwara, Kagera,

geita, Kigoma, Ruvuma and Lake Zone regions (*Table 1*). Overall, the evidence base was dominated by observational designs, with limited longitudinal data and few nationally representative studies.

Table 1. Characteristics of Studies Included in the Rapid Review

Authors	Language	Study Design	Study Population	Setting	Location
Animut et al., 2025	English	Cross-sectional	Children	Community	Tanzania
Mwaiswelo et al., 2021	English	Cross-sectional	Children	Community	Nanyumbu and Masasi Districts, Mtwara Region, Tanzania
Adam et al., 2025	English	Cross-sectional	Children	Community	Tanzania
Pauline et al., 2025	English	Cross-sectional	Children	Community	Tanzania
Mohammed et al., 2025	English	Cross-sectional	Children	Community	Tanzania
Chacky et al., 2025	English	Cross-sectional	Children	Community	Tanzania
Petro et al., 2024	English	Record review	Pregnant women and children	Health facility	Kagera Region, Tanzania
Mshamu et al., 2022	English	Randomized controlled trial	Children	Community	Mtwara Region, Tanzania
Mshamu et al., 2023	English	Randomized controlled trial	Children	Community	Mtwara Region, Tanzania
Challe et al., 2025	English	Cross-sectional	Children and adults	Community	Kigoma, Ruvuma, and Tanga Regions, Tanzania
Lutambi et al., 2025	English	Cross-sectional	Children and adults	Community	Tanzania
Mwalimu et al., 2023	English	Record review	Children and adults	Community	Lake Zone Regions, Tanzania
Lukole et al., 2025	English	Randomized controlled trial	Children and adults	Community	Misungwi District, Mwanza Region, Tanzania
Mmbando et al., 2025	English	Randomized controlled trial	Children and adults	Community	Mtwara Region, Tanzania
Odufuwa et al., 2025	English	Randomized controlled trial	Children and adults	Community	Chalinze District, Pwani Region, Tanzania
Matovelo et al., 2021	English	Qualitative	Women (caregivers)	Community	Misungwi District, Mwanza Region, Tanzania

Bofu et al., 2023	English	Mixed methods	Adults	Community	Mlimba, Malinyi, Ulanga, and Ifakara Districts, Morogoro Region, Tanzania
Kihwele et al., 2023	English	Qualitative	Adults	Community	Rufiji and Kibiti Districts, Pwani Region and Kilwa District, Lindi Region, Tanzania
Fink et al., 2022	English	Prospective cohort	Adults	Community	Kilombero and Ulanga Districts, Morogoro Region, Tanzania
Liheluka et al., 2023	English	Mixed methods	Adults	Community	Geita, Kigoma, Mtwara, and Ruvuma Regions, Tanzania
Khatib et al., 2025	English	Entomological (mosquito collection)	Mosquito vectors	Field	Zanzibar, Tanzania

Socio-Demographic Factors

Age emerged as the most consistently reported socio-demographic determinant. Children aged 12–59 months had higher malaria prevalence compared with infants under 12 months [19], with peak prevalence frequently observed among those aged 24–47 months [8, 9]. This pattern likely reflects a gradual decrease of maternal immunity combined with increased environmental exposure. No statistically significant association was observed between the sex of children under five and malaria infection [8, 20]. Maternal education was consistently associated with reduced malaria risk. It was shown that, higher educational attainment was linked to improved preventive practices, including appropriate ITN use and timely care-seeking [20, 21]. Household socio-economic status also demonstrated a strong gradient effect: children from lower-wealth households experienced disproportionately higher malaria prevalence compared with those from wealthier households [8, 20]. This association appeared mediated by differences in housing quality, access to vector control interventions, and healthcare utilization. On the other hand, rural

residence was repeatedly identified as a structural risk factor, with higher infection prevalence observed in rural compared with urban or peri-urban settings. Several studies further reported ecological heterogeneity, with substantial variation across administrative regions and transmission zones [15, 22, 23].

Environmental Factors

Environmental exposures were significantly associated with increased malaria risk. Children living in households close to mosquito breeding sites, such as stagnant water bodies, agricultural irrigation schemes, and poorly drained areas, was linked to higher infection prevalence [24, 25]. Housing quality emerged as a consistent determinant. Children residing in houses with mud walls, thatched roofs, open eaves, or unscreened windows experienced higher malaria prevalence than those living in improved housing [10–13]. It was reported across nearly all studies that structural vulnerabilities likely facilitate mosquito entry and indoor-biting exposure. Likewise, climatic variability, including rainfall, temperature, and humidity, was reported to influence malaria transmission intensity [26, 27]. Seasonal peaks

in malaria incidence coincided with rainy periods, reflecting increased vector breeding and survival. Regional variation in transmission patterns further underscored the interaction between ecological conditions and household-level risk factors. The entomological study included in the review provided contextual evidence of vector persistence and outdoor biting behavior in certain settings, supporting epidemiological findings related to residual transmission [14].

Behavioral Factors

Insecticide-treated nets (ITNs) use was the most frequently examined behavioral factor. Consistent evidence indicated that malaria prevalence was lower among children who slept under an ITN compared to those who did not [9, 15, 28]. Importantly, several studies distinguished between ITN ownership and actual utilization, demonstrating that protective effects were strongest when consistent nightly use was reported [8, 27, 29]. Moreover, evidence shows that consistent implementation of IRS effectively reduces malaria prevalence, while lapses in IRS maintenance can lead to malaria resurgence [30], underscoring the critical need for sustained vector control coverage. Care-seeking practices also influenced infection outcomes. Delayed presentation to health facilities following onset of fever and other malaria symptoms and reliance on informal or traditional treatment were reported in several settings among malaria-positive children. Likewise, Caregivers' knowledge of malaria transmission and prevention was positively associated with adoption of protective behaviors and reduced infection prevalence [22, 29]. The evening and nighttime outdoor exposure emerged was also reported as a relevant behavioral risk factor. Children who remained outdoors after sunset, either playing or accompanying caregivers, had higher malaria prevalence, consistent with documented early-evening and outdoor-biting patterns in some regions [14, 15]. Moreover,

lower malaria prevalence was reported among children from households demonstrating awareness of malaria transmission and preventive measures [29].

Evidence Gaps and Research Limitation

Despite the growing body of literature important gaps remain. Longitudinal studies are scarce, limiting understanding of temporal trends and sustained intervention effects. Few studies simultaneously examined socio-demographic, environmental, and behavioral determinants within integrated analytical frameworks, constraining causal inference and interaction assessment.

Additionally, limited research integrates household-level determinants with parasite resistance patterns, vector behavioral adaptation, or climate variability. Such integration is critical to understanding emerging transmission dynamics and informing adaptive malaria control strategies, especially to local contexts [31].

Discussion

This rapid review synthesizes recent evidence demonstrating that malaria infection among children under five in Tanzania is shaped by intersecting socio-demographic, environmental, and behavioral determinants. The findings indicate that malaria risk is not driven by single exposure but by the cumulative and reinforcing effects of structural vulnerability, ecological context, and household-level practices. Despite sustained scale-up of vector control interventions, persistent transmission of malaria in specific populations and regions underscores the importance of addressing contextual and structural drivers alongside biomedical tools.

Age was the most consistently reported individual-level determinant, with children aged 12-59 months, particularly those 24-47 months, experiencing higher infection prevalence than infants [8, 9]. This pattern is likely attributed to the waning of maternal

antibodies acquired during pregnancy, leaving older infants more susceptible to *Plasmodium* infection [2]. In contrast, sex differences were minimal across studies, suggesting that gender does not substantially modify malaria risk in early childhood in this context [8, 20]. Socioeconomic factors were also prominent, with lower household wealth and limited maternal education consistently associated with higher malaria prevalence [8, 20, 21]. These findings suggest that socioeconomic disadvantage constrains the consistent uptake and correct use of malaria prevention and treatment measures. These disparities reflect broader inequities in access to information, housing quality, and health services, particularly in rural and hard-to-reach areas [32]. The protective role of maternal education observed across studies aligns with evidence from other malaria-endemic settings in sub-Saharan Africa [33, 34], underscoring the importance of women's education as a long-term malaria control strategy. Environmental exposure remains a key challenge, particularly in rural and agricultural settings where vector breeding sites are difficult to eliminate [24, 25]. Furthermore, poor housing infrastructure increases indoor mosquito exposure and reduces the effectiveness of household-level interventions [10–13]. These findings support growing recognition that malaria control must extend beyond the health sector to include housing improvement, environmental management, and collaboration with sectors responsible for water, agriculture, and urban planning [34, 35]. Likewise, behavioral determinants act as critical modifiers of risk and intervention effectiveness. Inconsistent use of ITNs, delays in care-seeking, and variation in risk perception reduce the protective impact of existing malaria control tools [9, 15, 28]. These behaviors are shaped by contextual factors such as cultural norms, household decision-making dynamics, and perceived quality of health services [29]. Community-based health education and engagement strategies remain

essential for sustaining preventive behaviors, particularly in high-transmission and seasonal settings [33, 34, 36]. The review also highlights some challenges in the current evidence base. Limited integration of social, environmental, and biological factors restricts understanding of how risks accumulate at household and community levels. Furthermore, insufficient consideration of evolving challenges such as insecticide resistance, changing vector ecology, and climate variability may limit the relevance of existing findings for future malaria control planning [37]. Addressing these gaps through integrated, longitudinal, and interdisciplinary research would strengthen the evidence needed to refine targeted interventions [38]. Overall, the findings reinforce the need for malaria control strategies in Tanzania that are equity-oriented, context-specific, and adaptive to local ecological and social conditions. Strengthening community health systems, improving living environments, and aligning prevention efforts with broader development initiatives are likely to enhance the impact of existing malaria interventions among children under five.

Conclusion

Malaria infection among children under five years in Tanzania is driven by interconnected socio-demographic, environmental, and behavioral determinants. Socioeconomic disadvantage, substandard housing, ecological exposure, inconsistent ITN use, and gaps in sustained vector control coverage collectively shape the risk of infection. Integrated strategies that combine strengthened community health systems, sustained vector control, environmental management, and targeted behavioral interventions are essential to accelerate progress toward malaria reduction. Future research should prioritize longitudinal and interdisciplinary approaches to better capture dynamic transmission patterns and inform adaptive, locally tailored interventions.

Limitations

This review has several limitations. The streamlined methodology, including restriction to three databases and English-language publications, may have resulted in omission of relevant studies. A formal risk-of-bias and certainty-of-evidence assessment was not conducted, consistent with rapid review guidance, which may limit confidence in the strength of conclusions. The predominance of cross-sectional designs constrains causal interpretation, and heterogeneity in study settings, diagnostic methods, and outcome definitions limits comparability across studies. Despite these limitations, the review provides an updated synthesis of key determinants influencing malaria infection among children under five in Tanzania and identifies priority areas for intervention and research.

Conflict of Interest

The authors declare no conflict of interest.

References

- [1]. World Health Organization, 2025, *Malaria*, Available from: <https://www.who.int/news-room/fact-sheets/detail/malaria>.
- [2]. Ranjha, R., Singh, K., Baharia, R. K., Mohan, M., Anvikar, A. R., Bharti, P. K., 2023, Age-specific malaria vulnerability and transmission reservoir among children, *Global Pediatrics*, 6, <https://doi.org/10.1016/j.gped.2023.100085>.
- [3]. World Health Organization, 2021, Tanzania to ensure every malaria case is reported and investigated promptly., Available from: <https://www.afro.who.int/news/tanzania-ensure->

Ethical Approval

Ethical approval was not required for this study because it was based solely on a review and synthesis of previously published literature.

Authors' Contribution

HN conceptualised the study, designed the rapid review protocol, conducted the literature search, and drafted the manuscript. EM and AL-R supervised the study and revised the manuscript. HSA contributed to data interpretation, validation, and manuscript review. All authors read and approved the final manuscript.

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Data Availability

All data used in this rapid review were obtained from publicly available sources. The extracted dataset and supporting materials used for the analysis are available from the corresponding author upon reasonable request.

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every-malaria-case-reported-and-investigated-promptly.

- [4]. Ministry of Health, Ministry of Health (MoH) [Zanzibar], National Bureau of Statistics (NBS), Office of the Chief Government Statistician (OCGS), ICF), 2022, *Tanzania Demographic and Health Survey and Malaria Indicator Survey 2022: Key indicators report*.
- [5]. Ministry of Health, 2020, National Malaria Strategic Plan 2021–2025, <https://www.nmcp.go.tz/storage/app/uploads/public/643/916/391/6439163912677679591851.pdf>.
- [6]. Akowe, E., Ahman, Q. O., Agbata, B. C., Joseph, S. O., Senewo, E. O., Danjuma, A. Y.,

- Yahaya, D. J., 2025, A novel malaria mathematical model: integrating vector and non-vector transmission pathways, *BMC Infectious Diseases*, 25(1), <https://doi.org/10.1186/s12879-025-10653-8>.
- [7]. Savi, M. K., 2022, An Overview of Malaria Transmission Mechanisms, Control, and Modeling, *Medical Sciences*, 11(1), <https://doi.org/10.3390/medsci11010003>.
- [8]. Adam, J., Luoga, P., Nyamhanga, T., Makunenge, C., Ayubu, M., 2025, Prevalence and determinants of malaria among children aged 6–59 months in Tanzania: a nationwide cross-sectional study, *Malaria Journal*, 24(1), <https://doi.org/10.1186/s12936-025-05409-3>.
- [9]. Mwaiswelo, R. O., Mmbando, B. P., Chacky, F., Molteni, F., Mohamed, A., Lazaro, S., Mkalla, S. F., Samuel, B., Ngasala, B., 2021, Malaria infection and anemia status in under-five children from Southern Tanzania where seasonal malaria chemoprevention is being implemented, *PLOS ONE*, 16(12), <https://doi.org/10.1371/journal.pone.0260785>.
- [10]. Bofu, R. M., Santos, E. M., John, B., Kahamba, N., Swilla, J., Njalambaha, R., Kelly, A. H., Lezaun, J., Christofides, N., Okumu, F. O., Finda, M. F., 2023, The Needs and Opportunities for Housing Improvement as a Malaria Intervention in Southern Tanzania, <https://doi.org/10.21203/rs.3.rs-2431993/v1>, <https://www.researchsquare.com/article/rs-2431993/v1>.
- [11]. Mmbando, A. S., Ngonzi, A. J., Mshamu, S., Bradley, J., Bøjstrup, T. C., Ngowo, H. S., Knudsen, J., Von Seidlein, L., Okumu, F. O., Lindsay, S. W., 2025, Effect of a novel house design (star home) on indoor malaria mosquito abundance in rural Tanzania: secondary outcomes of an open-label, household, randomised controlled trial, *The Lancet Planetary Health*, 9(4), [https://doi.org/10.1016/S2542-5196\(25\)00046-4](https://doi.org/10.1016/S2542-5196(25)00046-4).
- [12]. Mshamu, S., Mmbando, A., Meta, J., Bradley, J., Bøjstrup, T. C., Day, N. P. J., Mukaka, M., Okumu, F., Olotu, A., Pell, C., Deen, J., Knudsen, J., Lindsay, S. W., Von Seidlein, L., 2022, Assessing the impact of a novel house design on the incidence of malaria in children in rural Africa: study protocol for a household-cluster randomized controlled superiority trial, *Trials*, 23(1), <https://doi.org/10.1186/s13063-022-06461-z>.
- [13]. Mshamu, S., Halifa, S., Meta, J., Mmbando, A., Lindsay, S. W., Okumu, F., Wood, H. S., Wood, O. S., Bøjstrup, T. C., Day, N. P. J., Knudsen, J., Deen, J., Pell, C., Von Seidlein, L., 2023, Studying the health benefits of improved housing in rural Tanzania: challenges and progress, *Transactions of The Royal Society of Tropical Medicine and Hygiene*, 117(10), <https://doi.org/10.1093/trstmh/trad039>.
- [14]. Khatib, B., Mcha, J., Pandu, Z., Haji, M., Hassan, M., Ali, H., Mrisho, R., Abdallah, K., Ali, A., Ali, K., Said, T., Mohamed, S., Mkali, H., Mgata, S., Makwaruzi, S., Gulaka, M., Makenga, G., Mkude, S., Githu, V., Mero, V., Serbantez, N., Ballard, S.-B., Chan, A., Shija, S. J., Govella, N. J., 2025, Early evening outdoor biting by malaria-infected *Anopheles arabiensis* vectors threatens malaria elimination efforts in Zanzibar, *Malaria Journal*, 24(1), <https://doi.org/10.1186/s12936-025-05333-6>.
- [15]. Kihwele, F., Gavana, T., Makungu, C., Msuya, H. M., Mlacha, Y. P., Govella, N. J., Chaki, P. P., Sunguya, B. F., 2023, Exploring activities and behaviours potentially increases school-age children's vulnerability to malaria infections in south-eastern Tanzania, *Malaria Journal*, 22(1), <https://doi.org/10.1186/s12936-023-04703-2>.
- [16]. Garritty, C., Hamel, C., Trivella, M., Gartlehner, G., Nussbaumer-Streit, B., Devane, D., Kamel, C., Griebler, U., King, V. J., 2024, Updated recommendations for the Cochrane rapid review methods guidance for rapid reviews of effectiveness, *BMJ*, 384, <https://doi.org/10.1136/bmj-2023-076335>.
- [17]. Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., McGuinness, L. A., Stewart, L. A., Thomas, J., Tricco, A. C., Welch, V. A., Whiting, P., Moher, D., 2021, The PRISMA 2020 statement: an updated guideline for reporting

- systematic reviews, *BMJ*,
<https://doi.org/10.1136/bmj.n71>.
- [18]. Ouzzani, M., Hammady, H., Fedorowicz, Z., Elmagarmid, A., 2016, Rayyan—a web and mobile app for systematic reviews, *Systematic Reviews*, 5(1), <https://doi.org/10.1186/s13643-016-0384-4>.
- [19]. Animut, Y., Nigatu, S. G., Teklu, R. E., Abiy, S. A., 2025, Spatial distribution of malaria among under-five children and associated factors in Tanzania: a spatial and multilevel analysis, *Malaria Journal*, 24(1), <https://doi.org/10.1186/s12936-025-05313-w>.
- [20]. Pauline, R. N., Kikwale, E. A., Migamba, J. D., 2025, Socio-economic and Environmental Factors Influencing Malaria Prevalence among Children Under Five in Tanzania, *Rural Planning Journal*, 27(2), <https://doi.org/10.59557/rpj.25.2.2025.208>.
- [21]. Matovelo, D., Ndaki, P., Yohani, V., Laisser, R., Bakalemwa, R., Ndaboine, E., Masatu, Z., Mwaikambo, M., Brenner, J. L., Wilson, W. M., 2021, Why don't illiterate women in rural, Northern Tanzania, access maternal healthcare? *BMC Pregnancy and Childbirth*, 21(1), <https://doi.org/10.1186/s12884-021-03906-2>.
- [22]. Chacky, F., Hicks, J. T., Remiji, M. J., Rumisha, S. F., Walker, P. G. T., Chaki, P., Aaron, S., Nhiga, S. L., Reaves, E., Serbantez, N., Molteni, F., Ngasala, B., Kc, A., Mmbando, B. P., Snow, R. W., Van Geertruyden, J.-P., 2025, Trends in malaria prevalence among school-age children in Mainland Tanzania, 2015–2023: A multilevel survey analysis, *PLOS Global Public Health*, 5(4), <https://doi.org/10.1371/journal.pgph.0004386>.
- [23]. Challe, D. P., Petro, D. A., Francis, F., Seth, M. D., Madebe, R. A., Mandai, S. S., Budodo, R., Kisambale, A. J., Chacha, G. A., Moshi, R., Mbwambo, R. B., Pereus, D., Bakari, C., Mbata, D., Lyimo, B., Kanyankole, G. K., Aaron, S., Mbwambo, D., Kajange, S., Lazaro, S., Kapologwe, N., Mandara, C. I., Makene, V. W., Ishengoma, D. S., 2025, Trends of malaria prevalence among individuals from rural communities in three regions with varying transmission intensities in Mainland Tanzania; Data from 2021 - 2023 *community cross-sectional surveys*, <https://doi.org/10.1101/2025.02.13.25322171>.
- [24]. Mohammed, K., Dhillon, S., Pienaah, C. K. A., Luginaah, I., Knoll, E.-M., Campbell, G., Hambati, H., 2025, Where environment and malaria intersect: Exploring the spatio-temporal footprints of *Plasmodium falciparum* in Tanzania, *PLOS One*, 20(5), <https://doi.org/10.1371/journal.pone.0321200>.
- [25]. Petro, D. A., Shaban, N., Aaron, S., Chacky, F., Lazaro, S., Boni, M. F., Ishengoma, D. S., 2024, Geospatial Analysis of Malaria Burden in Kagera Region, Northwestern Tanzania Using Health Facility and Community Survey Data, *Open Forum Infectious Diseases*, 11(11), <https://doi.org/10.1093/ofid/ofae609>.
- [26]. Lutambi, A. M., Emidi, B., Mbuya, F. G., Ryoba, M., Sagamiko, T. D., Hugo, A. K., Mbalawata, I. S., 2025, Modelling the impact of climatic and environmental variables on malaria incidence in Tanzania: Implications for achieving the WHO's 2030 Targets, *PLOS Global Public Health*, 5(8), <https://doi.org/10.1371/journal.pgph.0005075>.
- [27]. Odufuwa, O. G., Moore, S. J., Mboma, Z. M., Mwanga, R., Matwewe, F., Hofer, L. M., Matanila, I., Abbasi, S., Rashid, M. A., Philipo, R., Kihwele, F., Moore, J., Nguyen, H., Bosselmann, R., Skovmand, O., Stevenson, J. C., Muganga, J. B., Bradley, J., 2025, A household randomized-control trial of insecticide-treated screening for malaria control in unimproved houses in Tanzania, *Malaria Journal*, 24(1), <https://doi.org/10.1186/s12936-025-05434-2>.
- [28]. Lukole, E. A., Cook, J., Mosha, J. F., Matowo, N. S., Kulkarni, M. A., Mallya, E., Aziz, T., Martin, J., Rowland, M., Kleinschmidt, I., Manjurano, A., Mosha, F. W., Protopopoff, N., 2025, Community benefits of mass distribution of three types of dual-active-ingredient long-lasting insecticidal nets against malaria prevalence in Tanzania: evidence from a 3-year cluster-randomized controlled trial, *BMC Public Health*, 25(1), <https://doi.org/10.1186/s12889-025-21586-x>.
- [29]. Liheluka, E. A., Massawe, I. S., Chiduo, M. G., Mandara, C. I., Chacky, F., Ndekuka, L., Temba, F.

- F., Mmbando, B. P., Seth, M. D., Challe, D. P., Makunde, W. H., Mhina, A. D., Baraka, V., Segeja, M. D., Derua, Y. A., Batengana, B. M., Hayuma, P. M., Madebe, R. A., Malimi, M. C., Mandike, R., Mkude, S., Molteni, F., Njau, R., Mohamed, A., Rumisha, S. F., Ishengoma, D. S., 2023, Community knowledge, attitude, practices and beliefs associated with persistence of malaria transmission in North-western and Southern regions of Tanzania, *Malaria Journal*, 22(1), <https://doi.org/10.1186/s12936-023-04738-5>.
- [30]. Mwalimu, C. D., Lazaro, S. N., Kisinza, W. N., Magesa, S. M., Kiware, S. S., 2023, The impact of Indoor Residual Spraying (IRS) withdrawal in the Lake Zone Regions in Mainland Tanzania. *Should Tanzania withdrawal its IRS program?*, <https://doi.org/10.21203/rs.3.rs-2888818/v1>, <https://www.researchsquare.com/article/rs-2888818/v1>.
- [31]. Amoroso, C. R., 2021, Integrating Concepts of Physiological and Behavioral Resistance to Parasites, *Frontiers in Ecology and Evolution*, 9, <https://doi.org/10.3389/fevo.2021.635607>.
- [32]. Langat, E. C., Ward, P., Gesesew, H., Mwanri, L., 2025, Challenges and Opportunities of Universal Health Coverage in Africa: A Scoping Review, *International Journal of Environmental Research and Public Health*, 22(1), <https://doi.org/10.3390/ijerph22010086>.
- [33]. Firdaus, M. H., Wan Puteh, S. E., Sutan, R., Abdul Manaf, M. R., 2025, Effectiveness of family health education in malaria elimination programmes: a scoping review, *Malaria Journal*, 24(1), <https://doi.org/10.1186/s12936-025-05371-0>.
- [34]. Nketiah-Amponsah, E., Adjotor, F. N., 2025, The impact of Malaria-related expenditures on Malaria incidence and mortality rates in Sub-Saharan Africa (SSA), *Development Studies Research*, 12(1), <https://doi.org/10.1080/21665095.2025.2481830>.
- [35]. Kaseya, J., Dereje, N., 2025, The resurgence of malaria in Africa is an avoidable crisis—here’s what we must do, *BMJ*, 390, <https://doi.org/10.1136/bmj.r1874>.
- [36]. Onyinyechi, O. M., Mohd Nazan, A. I. N., Ismail, S., 2023, Effectiveness of health education interventions to improve malaria knowledge and insecticide-treated nets usage among populations of sub-Saharan Africa: systematic review and meta-analysis, *Frontiers in Public Health*, 11, <https://doi.org/10.3389/fpubh.2023.1217052>.
- [37]. Beloconi, A., Nyawanda, B. O., Bigogo, G., Khagayi, S., Obor, D., Danquah, I., Kariuki, S., Munga, S., Vounatsou, P., 2023, Malaria, climate variability, and interventions: modelling transmission dynamics, *Scientific Reports*, 13(1), <https://doi.org/10.1038/s41598-023-33868-8>.
- [38]. Mao, W., Cooke, R., Silimperi, D., Urli Hodges, E., Ortiz, E., Udayakumar, K., 2023, Scaling malaria interventions: bottlenecks to malaria elimination, *BMJ global health*, 8(11), <https://doi.org/10.1136/bmjgh-2023-013378>.

Barriers and Facilitators of Mental Health Well-Being Among Postnatal Mothers: A Systematic Review

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Abstract

The postnatal mothers experience mental health challenges which include depression, anxiety, and stress. Although frequency is markedly higher in low- and middle-income countries (LMICs), systemic and cultural barriers often impede help-seeking and access to care, even as various facilitators promote resilience and recovery. This systematic review aims to assess the barriers and facilitators to mental health and well-being among postnatal mothers in St. Vincent and the Grenadines, synthesising findings from both qualitative and quantitative studies. A thorough, systematic search was conducted in electronic databases, including EBSCOhost, PubMed, PsycARTICLES, Google Scholar, and ScienceDirect, for studies published between January 2015 and April 2025. Studies included in this review are qualitative, quantitative, or mixed methods. The identified themes were categorized as individual, interpersonal, organizational, community and societal. The systematic review included eighteen studies. The main barriers were as follows: (1) Individual: low mental health literacy, stigma, and fear of judgment; (2) Interpersonal: lack of partner or family support; (3) Organizational: healthcare systems focused predominantly on infant physical health, poor provider communication, and fragmented referral pathways; (4) Community: cultural norms discouraging disclosure of emotional distress; and (5) Societal: financial constraints, geographical inaccessibility, and under resourced mental health services. The main facilitators included: strong social support networks, perceived self-efficacy, culturally sensitive and integrated care models, peer support programs, and technology-enabled interventions. By focusing on the unique culture within regions like the Caribbean, researchers can build a support system that ensures no mother has to struggle through the postnatal period alone.

Keywords: Barriers, Facilitators, Help-Seeking, Maternal Mental Health, Postnatal, Postpartum, Systematic Review, Well-being.

Introduction

Postnatal mental disorders are a significant public health concern internationally, with major implications for maternal morbidity, child development, and family wellbeing [1]. The most common condition identified is postpartum depression (PPD), with research estimating worldwide prevalence at 10-15% in high-income countries and 18-30% in low- and

middle-income countries (LMICs) [2, 3]. In addition to depression, high levels of anxiety, post-traumatic stress disorders (PTSD), and adjustment disorders have been recorded, especially in resource-constrained environments with limited systemic support [4].

The implications of unaddressed postnatal mental illness are extensive, impacting mother-

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to-infant attachment, child cognitive and emotional development, and overall family functioning [5]. Despite this significant burden, a substantial treatment gap persists, globally.

A multifaceted network of individual, social, and systemic barriers prevents many women from being diagnosed and accessing treatment [4, 6]. Concurrently, an increasing number of studies identify protective factors, facilitators, and effective intervention strategies that can encourage resilience and recovery [7, 8].

Although previous reviews have examined PPD prevalence or intervention effectiveness, none have comprehensively considered barriers and facilitators of postnatal mental health well-being as a broader construct integrating positive mental states and functioning. Furthermore, the evidence base is biased toward high-income Western settings, with a notable gap in Caribbean regions such as St. Vincent and the Grenadines, where no local research on this subject was identified during initial scoping.

This systematic review addresses these gaps by evaluating and synthesizing international evidence on factors that inhibit or promote mental health well-being in postnatal mothers. The findings are expected to inform culturally sensitive, realistic, and effective interventions to enhance maternal mental health outcomes, particularly in under resourced and under researched context.

Methodology

Protocol Registration and Reporting

This review has been registered with PROSPERO (registration number CRD420261298809). PRISMA outlines the process involved in identifying, screening and selecting eligible articles that meet the inclusion and exclusion criteria [9]. PRISMA provides an internationally accepted framework ensuring transparency, completeness, and reproducibility. Using PRISMA helped reduce bias in search, selection, appraisal, and synthesis procedures, improving the reliability and credibility of our findings.

Specifically, the PRISMA checklist guided documentation of the search strategy, study selection criteria, data extraction methods, quality assessment procedures, and synthesis approach. Details for all records were maintained at each review stage. This methodological order was important given the sensitive nature of maternal mental health research and the importance of basing conclusions on the best available evidence.

Inclusion and Exclusion Criteria

The review included qualitative studies, quantitative cross-sectional studies, cohort studies, and mixed-methods studies meeting the following criteria: (1) focused on postnatal mothers up to 12 months postpartum; (2) investigated barriers and/or facilitators related to mental health well-being, help-seeking, or service utilization; (3) published in English between 2015 and 2025; and (4) peer-reviewed primary research.

Exclusion Criteria

Studies focusing only on antenatal mental health; interventions not reporting baseline data on barriers or facilitators; studies where the postnatal period was not clearly defined or was combined with pregnancy data without separate analysis; and studies not in English.

Information Sources and Search Methods

Studies were searched using online databases such as EBSCOhost, PubMed, Google Scholar, PsycARTICLES, and ScienceDirect from January 2015 to April 2025. One of the main criteria was the study must be in English. Search terms were combined using Boolean operators and included: "postnatal" OR "postpartum" as well as "mother" OR "maternal", "mental health" "wellbeing", "depression" OR "anxiety", "barrier" OR "facilitator*" OR "help-seeking" OR "access".

Selection of Studies

The study selection process was rigorously documented and visually represented using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flowchart, as recommended by the PRISMA guidelines. This standardized approach ensured full transparency and reproducibility of our selection process.

The selection proceeded in four distinct phases, corresponding to the four main sections of the PRISMA flowchart, namely; identification, screening, eligibility, and inclusion. Each is detailed as follows: -

Identification: All records identified through the database searches were collated, and duplicates were removed using End Note reference management software.

Screening: The titles and abstracts of all unique records were screened independently by the researchers against the inclusion and exclusion criteria. Records that clearly did not meet the criteria were excluded at this stage.

Eligibility: The full texts of all potentially relevant records were retrieved and assessed in detail for eligibility by the same two independent reviewers.

Inclusion: Studies that met all eligibility criteria were included in the final synthesis.

At each phase of screening and eligibility assessment, discussion was held between the researchers.

Some studies were excluded at the full-text review stage. The reasons were systematically recorded as for example, the population focused only on antenatal mental health, wrong outcome, and incorrect study design. These numbers, along with the counts of records at each stage, were used to populate the PRISMA flow diagram as shown in Figure 1.

This diagram provides a clear summary of the volume of literature identified, screened, excluded, and finally included, thereby documenting the decision trail and minimizing selection bias.

Data Extraction

The researcher reviewed titles and abstracts against the inclusion criteria. The full articles of prospective studies were retrieved and assessed. The data from included studies were extracted using a standardized form, capturing authors, year, country, study design, sample characteristics, key findings on barriers, as well as key findings on facilitators.

Assessment of Risk of Bias in Included Studies

Given the inclusion of diverse study designs (qualitative, quantitative, and mixed-methods), a rigorous and appropriate quality appraisal was conducted for all eighteen (18) included studies to assess methodological thoroughness and potential sources of bias. This assessment informed the interpretation of findings and contributed to the overall certainty of the evidence synthesized.

The methodological quality of the included studies was appraised using the relevant checklists from the Critical Appraisal Skills Programme (CASP), a widely recognized and validated tool for evidence-based practice. The appropriate CASP checklist was applied based on each study's design. See Table 1: CASP Quality Appraisal of Included Studies (n=18)

Certainty of Evidence - GRADE-CERQual

This approach was applied to qualitative findings to assess confidence in the findings based on methodological limitations, relevance, coherence, and data adequacy. Each synthesized qualitative theme was rated as having high, moderate, low, or very low confidence.

Table 1. CASP Quality Appraisal of Included Studies (n=18)

Authors (Year)	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	%Yes	Risk of Bias
Qualitative Studies												
Adams et al. (2023)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100%	Low
Ahmed et al. (2017)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100%	Low
Ash et al. (2025)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100%	Low
Oladeji et al. (2025)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	90%	Low
Meireles et al. (2025)	Y	Y	Y	Y	Y	Y	N	N	Y	N	70%	Moderate
Place et al. (2024)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100%	Low
RCT Studies												
Dimidjian et al. (2016)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N/A	88.9%	Low
Grote et al. (2015)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N/A	88.9%	Low
Milgrom et al. (2016)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N/A	88.9%	Low
Shorey et al. (2019)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N/A	88.9%	Low
Letourneau et al. (2011)	Y	Y	Y	Y	Y	N	Y	Y	Y	N/A	77.8%	Moderate
Quantitative Cross-Sectional Studies												
Gidey et al. (2025)	Y	Y	Y	Y	Y	Y	N/A	Y	Y	N/A	87.5%	Low
Al Nasr et al. (2020)	Y	Y	Y	Y	Y	Y	N/A	Y	Y	N/A	87.5%	Low
Letourneau et al. (2012)	Y	Y	Y	Y	Y	Y	N/A	Y	Y	N/A	87.5%	Low
Mixed-Methods Studies												
McLeish et al. (2023)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100%	Low
Uzobo et al. (2022)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	90%	Low
Zhu et al. (2025)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	90%	Low
Fonseca et al. (2015)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	90%	Low

Q indicates questions based CASP Qualitative Studies Checklist

Data Synthesis

A convergent narrative synthesis was employed. Quantitative and qualitative findings were first analyzed separately and then integrated using a socioecological framework (individual, interpersonal, organizational, community, societal). Qualitative themes were used to contextualize and explain quantitative associations, enabling a comprehensive understanding of how and why barriers and facilitators operate across levels.

Results

Search Result

Search Yield and Screening Process

The systematic search across five electronic databases (EBSCOhost, PubMed, PsycARTICLES, Google Scholar, and ScienceDirect) yielded an initial pool of 2,156 records published between January 2015 and April 2025. After removing 524 duplicate records using EndNote reference management

software, 1,632 unique records remained for title and abstract screening.

Title and Abstract Screening

During this initial screening phase, 1,498 records were excluded as they did not meet the predefined inclusion criteria. Primary reasons for exclusion at this stage included:

1. Studies focusing exclusively on antenatal mental health without postnatal data (n=402);
2. Studies not investigating barriers, facilitators, help-seeking, or service utilization related to mental health (n=531);
3. Studies with an irrelevant population (e.g., focusing on fathers, healthcare providers only, or non-postnatal women) (n=312); and
4. Non-primary research articles, such as reviews, commentaries, or editorials (n=253).

The full texts of the remaining 134 potentially relevant articles were retrieved and assessed in detail against the eligibility criteria. During this phase, 116 articles were excluded. The main reasons for exclusion were:

1. The study population or timeframe - (postnatal period not defined or combined with antenatal data without separate analysis); n=51.
2. The outcome was not related to the inclusion criteria (did not examine barriers/facilitators of mental health wellbeing or related constructs); n=39.
3. The study design (e.g., protocol papers, intervention studies without relevant baseline qualitative or quantitative data on barriers/facilitators); n=20.

Articles not published in English: n=6

Final Included Studies

Eighteen (18) studies met all inclusion criteria and were included in the final systematic review and synthesis. See PRISMA flow diagram (Figure 1).

Study Characteristics

The final review included eighteen (18) peer-reviewed studies published between 2015 and 2025. The studies employed diverse methodological approaches: qualitative designs (n=6), quantitative cross-sectional designs (n=3), randomized controlled trials (RCTs) (n=5), and mixed-methods designs (n=4). See *Table 2: Comprehensive Characteristics of All Included Studies (n = 18)*

The studies were conducted across fifteen different countries and regions, namely:

1. Low and Middle-Income Countries (LMICs) (10 studies): Ghana, Ethiopia, Nigeria, Belize, Brazil, China, Portugal, Singapore, and multinational LMIC studies.
2. High-Income Countries (HICs) (8 studies): United States 4 studies), Canada (2 studies), United Kingdom, and Australia.

The geographical distribution reflects a notable, though not exclusive, focus on LMIC contexts, with strong representation from North America and Europe. This balance allows for comparison of barriers and facilitators across different healthcare systems and resource settings.

The inclusion of several study designs enabled a comprehensive examination of the research question. Qualitative studies (e.g., Ahmed et al., 2017; Ash et al., 2025) provided in depth insights into lived experiences and contextual factors influencing mental health help seeking. Quantitative cross-sectional studies (e.g. Gidey et al., 2025; Letourneau et al., 2017) identified frequency rates and statistical associations with barriers like low social support. Whereas, Randomized Control Trials, (e.g., Milgrom et al., 2016; Grote et al., 2015) evaluated the effectiveness of specific interventions such as internet based cognitive behavioral therapy and collaborative care models. Mixed-methods studies (e.g., e.g., McLeish et al., 2023; Zhu et al., 2025) offered integrated perspectives by combining statistical trends with qualitative explanations.

Participant Characteristics

Participants across eighteen included studies were postnatal mothers from diverse geographical, cultural, and socioeconomic backgrounds. The review captured experiences from both high-income settings (n=8 studies) and low and middle-income countries (n=10 studies), providing a global perspective.

The age range of participants across all studies was 18 to 45 years, consistent with the typical reproductive age for postnatal mothers. Sample sizes varied from smaller qualitative explorations (n=22-43) to larger quantitative surveys (n=300-800). Several studies specifically focused on populations facing distinct vulnerabilities or systemic barriers.

Barriers of Mental Health Well-being Among Postnatal Mothers

The obstacles identified were many-sided and interrelated on five levels.

Individual Level Barriers.

Commonly identified barriers included a lack of mental health literacy and stigma [10, 11]. In qualitative studies, participants described normalizing their distress as part of the “motherhood experience.” For example, one mother in Ghana shared:

“I thought feeling sad was just part of having a baby... I didn’t know it could be treated.” (10)

Another participant from a Syrian refugee community in Canada expressed:

“If I say I am not well in my mind, people will say I am a bad mother.” (11)

These narratives illustrate how shame and fear of being labeled an “unfit mother” deter help-seeking [12]. Quantitative studies supported this, showing that lower mental health literacy scores were significantly associated with delays in seeking care (17).

Interpersonal Level Barriers

Lack of social support, particularly from intimate partners and family members was a powerful predictor of poor mental health outcomes and negatively influenced help-seeking [14, 15]. Qualitative data revealed emotional themes, as one mother noted:

“That admitting to needing help would make them appear as “weak.” (15)

Quantitative surveys confirmed that low partner support was a significant risk factor for postnatal depression (14).

Organizational and Institutional Barriers

A major theme was the neglect of maternal mental health assessment in postnatal care services. Healthcare systems were perceived as primarily focused on infant physical health, with little attention to maternal mental health [10]. A mother in Belize explained as follows:

“The nurse only checked the baby. She never asked how I was feeling.” [21]

Fragmented care and ineffective referral systems also created uncertainty about where to seek help [11]. Quantitative studies from LMICs highlighted that fewer than 20% of postnatal visits included mental health screening [17].

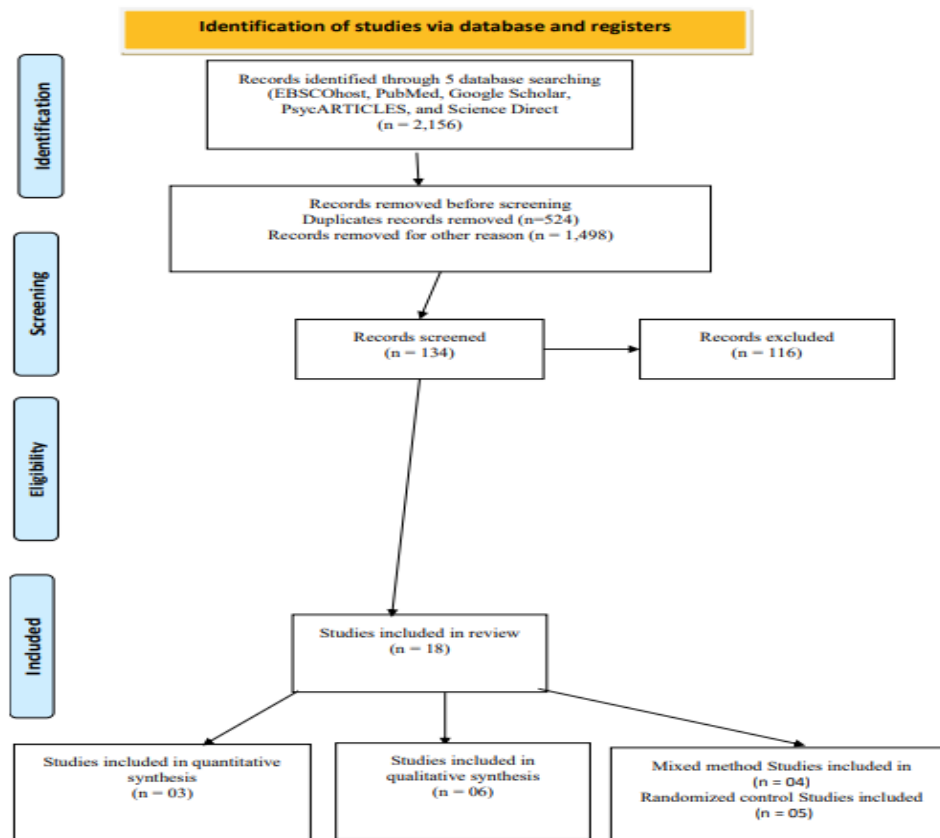


Figure 1. PRISMA Flow Diagram of Study Selection Process

Table 2. Summary of Included Study Characteristics

Author(s) (Year)	Country/Region	Study Design	Sample Size & Characteristics	Key Focus Area	Main Findings Related to Barriers	Main Findings Related to Facilitators
Adams et al. (2023)	Ghana	Qualitative descriptive	30 participants (15 mothers, 15 providers)	Postpartum care needs assessment	Focus on infant health; poor provider communication; low symptom awareness	Need for integrated maternal mental health screening (10)
Ahmed et al. (2017)	Canada (Syrian refugees)	Qualitative phenomenological	25 refugee postnatal women	Maternal depression in refugee women	Stigma; cultural shame; distrust of Western medicine	Importance of culturally safe spaces; interpreter services (11)
Ash et al. (2025)	USA	Qualitative focus groups	43 Black perinatal women	Barriers to accessing mental health supports	Affordability; medical distrust; racial bias	Culturally concordant providers; community-based programs (12)

Oladeji et al. (2025)	Belize	Qualitative exploratory	22 young mothers	Help-seeking barriers in SIDS	Stigma; service availability; awareness	Community education; youth-friendly services (21)
Meireles et al. (2025)	Brazil & Spain	Qualitative cross-cultural	35 postpartum women	Perinatal support and maternal mental health	"Baby blues" normalization	Cultural adaptation of interventions (26)
Dimidjian et al. (2016)	USA	RCT	86 women with depression history	Mindfulness-based cognitive therapy	Risk of relapse; anxiety about treatment	Mindfulness skills; relapse prevention strategies (16)
Grote et al. (2015)	USA	RCT (MOMCare)	168 disadvantaged mothers	Collaborative care for perinatal depression	Fragmented care; socioeconomic barriers	Stepped care; care coordination; psychotherapy access; 50% increased service utilization (18)
Milgrom et al. (2016)	Australia	RCT	63 postnatal women	Internet-based CBT (MumMoodBooster)	Stigma; accessibility issues	Online CBT accessible; private; effective (20)
Shorey et al. (2019)	Singapore	RCT	50 postnatal mothers	Technology-based peer-support intervention	Time constraints; childcare duties	Mobile apps convenient; peer support online (22)
Letourneau et al. (2011)	Canada	RCT	120 mothers	Home-based peer support for PPD	Isolation; transportation issues	Telephone support bridges access gaps (25)
Gidey et al. (2025)	Ethiopia	Quantitative cross-sectional	800 postnatal mothers	Prevalence of postpartum depression	High anxiety (22.2%); PTSD (8.3%); spiritual beliefs reduce help-seeking by 40%	Screening for anxiety disorders (17)
Al Nasr et al. (2020)	Saudi Arabia	Quantitative cross-sectional	246 postnatal mothers	Prevalence and predictors of PPD	Low social support; previous depression history	Partner support; family involvement (14)
Place et al. (2024)	USA	Qualitative systematic review	Qualitative systematic review	Not specified	Individual: stigma, embarrassment, fear of judgment, low mental health literacy Interpersonal: lack of	Multi-level recommendations: public awareness campaigns; partner involvement; integrated care models; culturally competent care;

					partner/family support, fear of child removal Organizational: poor provider communication, fragmented care Community: cultural norms, community stigma Societal: financial constraints, policy gaps	policy changes; universal screening (15)
McLeish et al. (2023)	UK	Mixed-methods realist review	150 postnatal mothers	Community-based perinatal mental health peer support	Isolation; lack of accessible services	Peer support reduces isolation; flexible service delivery (13)
Uzobo et al. (2022)	Nigeria	Mixed-methods	120 postnatal mothers	Prevalence and coping strategies for PPD	Stress from role transition; limited support	Resilience; adaptive coping; social support (19)
Zhu et al. (2025)	China	Mixed-methods convergent	561 screening-positive women	Mental health service utilization	Financial barriers (45.5%); spousal support lack	Financial support; partner education (23)
Fonseca et al. (2015)	Portugal	Mixed-methods	200 perinatal women	Acceptability of e-mental health interventions	Digital literacy; privacy concerns	High acceptance of online resources (24)
Webb et al. (2021)	UK (Systematic review)	Systematic review	52 studies included	Barriers and facilitators to implementing perinatal mental health care	Fragmented services; inadequate training; lack of referral pathways; stigma; time constraints	Collaborative care models; integrated services; specialist perinatal mental health teams; clear referral pathways; leadership support. (27)

Comprehensive Characteristics of All Included Studies (n = 18)

Note. Note. PPD = postpartum depression; SIDS = Small Island Developing States; RCT = randomized controlled trial; CBT = cognitive behavioral therapy; PTSD = post-traumatic stress disorder.

Community and Cultural Barriers

Cultural attitudes that stigmatized mental health issues while glorifying maternal strength

inhibited disclosure. In some contexts, spiritual attributions prevented women from seeking medical care. As a participant from Nigeria stated,

"In my culture, we say it's an evil spirit... so you pray, you don't go to hospital." [19]

Quantitative findings from Ethiopia showed that women who held spiritual beliefs about mental distress were 40% less likely to seek professional help [17].

Societal and Structural Barriers

Practical and economic constraints were significant, especially in LMICs and marginalized communities. These included direct care costs, transportation challenges, childcare responsibilities, and inflexible work policies [16, 23]. For instance, a black mother in the U.S. shared:

"I couldn't afford therapy, and I had no one to watch the baby." [12]

Macro-level barriers included under resourced mental health services and lack of insurance coverage [27], which were quantitatively linked to lower service utilization in LMICs [23].

Integration of Qualitative and Quantitative Findings

The synthesis followed a convergent narrative approach. Quantitative data identified the prevalence and statistical associations of barriers (e.g., low social support predicting PPD), while qualitative findings provided depth, context, and lived-experience explanations.

Examples of quantitative studies showed that stigma was correlated with help-seeking delays [17]; qualitative narratives illustrated how stigma was experienced in daily interactions and internalized as shame [11, 12].

This integration enabled a richer, multi-layered understanding of how barriers operate and reinforce each other across individual, interpersonal, and systemic levels.

Facilitators of Mental Health Well-being Among Postnatal Mothers

From the review many of the facilitators were a direct opposite of those identified as barriers.

Individual and Interpersonal Levels

High maternal self-efficacy and resilience were identified as key protective factors [14]. Qualitatively, mothers expressed how confidence in their parenting abilities improved their emotional well-being. One participant in Nigeria shared:

"Knowing I can comfort my baby made me feel stronger in myself." [19]

Strong, empathetic social support from partners, family, and friends was especially vital [18]. A mother in Canada noted:

"My sister listened without judgment. That alone lifted a weight." [15]

A recent systematic review confirmed that social support serves as a critical coping resource for psychosocial conditions throughout the postpartum period, with strong support networks significantly reducing the risk of adverse mental health outcomes [31, 32].

Peer support was particularly effective in reducing loneliness and normalizing emotional experiences. In a UK-based study, a participant explained:

"Talking to other mums who felt the same, it made me feel normal, not broken." [13]

Quantitative studies reinforced these findings, showing that high social support scores were associated with significantly lower depression and anxiety scores [14, 17].

Organizational and Service-Level Facilitators Integrated healthcare models that incorporated mental health screening and support into routine maternal and child health visits were highly beneficial [21, 22]. A mother in the U.S. reported,

"When my pediatrician asked about my mood, I finally felt seen." [18]

Trusting, compassionate, and knowledgeable healthcare providers who initiated mental health conversations were crucial. Warm referral pathways where providers directly connected mothers to mental health services also improved engagement.

Qualitative themes highlighted the importance of continuity and empathy, as reflected in a participant's comment from Ghana:

"The midwife stayed with me, she explained everything. I trusted her advice." [10]

Quantitative data from RCTs supported that integrated care models increased mental health service utilization by up to 50% in disadvantaged populations [18].

Intervention and Innovation Facilitators Evidence-based psychosocial interventions such as cognitive behavioral therapy (CBT) and interpersonal therapy (IPT) delivered individually or in groups were effective [23, 24, 29]. Home-based peer support programs have also demonstrated significant improvements in maternal-infant interactions among women with postpartum depression [25]. Culturally adapted preventive interventions have shown particular promise for high-risk populations, including immigrant and minority women [30].

Technology based interventions, including internet-based CBT programs and mental health apps, showed promise in overcoming accessibility barriers and reducing stigma.

A participant from Australia noted: *"Doing the online program at night when the baby slept... it was private and on my time."* [20]

Another mother in Singapore appreciated the flexibility of mobile support:

"The app connected me to other mums and tips, without having to leave home." [22]

Quantitative RCT results confirmed that digital interventions significantly reduced depressive symptoms compared to usual care [20, 22].

Community and Societal Facilitators Community health worker programs and public health campaigns that promoted mental health literacy and reduced stigma helped create supportive environments.

Policies that mandated maternal mental health screening and provided perinatal resources served as critical structural

facilitators [21]. International guidelines, such as those from the World Health Organization, emphasize the importance of integrating mental health assessment into routine postnatal care [28].

In Belize, a young mother highlighted the role of community education: *"After the village talk about postnatal depression, my family started to understand."* [21]

Quantitative evaluations indicated that communities with active mental health awareness campaigns reported higher help-seeking intentions [23, 27].

Integration of Qualitative and Quantitative Findings

The facilitators were synthesized using a convergent narrative approach, where quantitative evidence identified what works (e.g., effect sizes of interventions) and qualitative data explained why and how these facilitators are experienced as meaningful.

For example, quantitative studies showed peer support reduced depression score [13, 20]; qualitative accounts revealed that this was due to reduced isolation and increased validation. Similarly, while RCTs demonstrated the efficacy of digital tools [20, 22], qualitative feedback highlighted their value in providing privacy and flexibility. This integration underscores that effective facilitation requires both evidence-based strategies and empathetic, context-sensitive delivery.

Discussion

This systematic review of eighteen (18) studies from multiple countries provided a multi-level analysis of factors impeding and promoting mental health well-being in postnatal mothers. Results reveal an intricate network of interrelated factors, with obstacles reinforcing each other across levels and creating cumulative disadvantages, particularly for women in LMICs and marginalized groups.

The findings reaffirm that challenges are rarely unidimensional. A mother experiencing

postnatal depression may simultaneously contend with internalized stigma (individual level), lack of childcare resources (interpersonal level), dismissive healthcare interactions (organizational level), and care unaffordability (societal level). These intersecting challenges are particularly acute for mothers in LMICs and marginalized groups [2, 17].

The identified facilitators offer a blueprint for intervention. These facilitators move beyond simply "increasing services" to emphasise how services should be delivered in an integrated, stigma-free, relationship-centred manner. The effectiveness of peer support and task sharing interventions suggests strengthening community networks as a high-impact strategy in resource-constrained areas. The effectiveness of peer support and task sharing interventions, including home-based programs [25] and culturally adapted approaches [30], suggests strengthening community networks as a high-impact strategy in resource-constrained areas.

Digital interventions show promise for reaching isolated mothers and those unable to access services in person.

The lack of research from Caribbean has been identified as a significant literature gap. It is therefore recommended that future studies address this to develop contextually appropriate interventions, potentially drawing on cross-cultural insights from similar contexts [26] and established international guidelines [28].

Limitations

This review gathered both qualitative and quantitative data to examine existing barriers and facilitators to accessing mental health wellbeing among postnatal mothers. There are several limitations to our systematic review methods.

Firstly, the exclusion of research published in languages other than English may result in the omission of valuable data from non-English speaking regions, potentially introducing

language bias and limiting the global comprehensiveness of our findings.

Secondly, the heterogeneity of study designs included (qualitative, quantitative cross-sectional, RCTs, mixed-methods) presents challenges for direct comparison and synthesis. While this diversity allowed for a multi-faceted understanding of the issue, it limited our ability to conduct a meta-analysis or draw unified quantitative conclusions about the prevalence or effect sizes of specific barriers and facilitators.

Thirdly, there is an over representation of qualitative studies from LMIC contexts in our included studies. While this provides rich, context specific insights into under researched populations, it affects the balance of evidence and may limit the transferability of some findings to high income settings. Conversely, quantitative evidence, particularly intervention studies was more prevalent from high-income countries, creating a geographical imbalance in the types of evidence available.

Furthermore, some data might have been unrepresented, underreported, or misreported due to the sensitive and highly stigmatizing nature of mental health issues among postnatal mothers globally. This might have resulted in publication bias and methodological quality issues.

Additionally, while we conducted a quality appraisal using CASP checklists, the lack of a standardized, weighted quality scoring system across all study designs means our appraisal was primarily descriptive. Future reviews could benefit from a more quantitative approach to quality assessment to better weigh evidence from studies of differing methodological rigor.

Lastly, most studies lacked sufficient reflexivity about researchers' positions and assumptions, particularly in qualitative studies exploring culturally sensitive topics. This situation limited the critical interpretation of how the researcher's background has influenced data collection and analysis.

Conclusion

This systematic review examined the barriers and facilitators to mental health well-being among postnatal mothers. The evidence suggests that stigma, practical constraints, and limited social support are major barriers for postnatal women. The main facilitators include strong support networks, accessible and appropriate services, and maternal resilience. These findings can inform the development of targeted interventions, policy changes, and clinical practices to better support postnatal mental health.

Abbreviations

PPD = postpartum depression; LMICs = low- and middle-income countries; SIDS = Small Island Developing States; RCT = randomized controlled trial; CBT = cognitive behavioral therapy; IPT = interpersonal therapy; PTSD = post-traumatic stress disorder; DASS = Depression Anxiety Stress Scales; PRISMA-P: Preferred Reporting Items for Systematic Review and Meta-analysis Protocols; PROSPERO: International Prospective Register of Systematic Reviews; WHO: World Health Organization.

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Authors' Contributions

Simone Roberts Kent conceptualized the study, developed the methodology, performed data collection and analysis, and wrote the original draft. Dr. Joseph Jeganathan provided supervision, validated the results, and reviewed and edited the manuscript. Both authors read and approved the final version.

Data Availability Statement

The data used in this systematic review were obtained from publicly available databases, including EBSCOhost, PubMed, Google Scholar, PsycARTICLES, and Science Direct and are fully referenced in the manuscript. Data are available on reasonable request to the corresponding author.

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Ethics Approval and Consent to Participate

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Consent for Publication

Not applicable.

Competing Interests

Authors declare that they have no competing interests.

References

- [1]. Howard, L. M., Khalifeh, H., 2020, Perinatal mental health: A review of progress and challenges. *World Psychiatry*, 19(3), 313-327, <https://doi.org/10.1002/wps.20769>.
- [2]. Shorey, S., Chee, C. Y. I., Ng, E. D., Chan, Y. H., Tam, W. W. S., Chong, Y. S., 2018, Prevalence and incidence of postpartum depression among healthy mothers: A systematic review and meta-

- analysis. *Journal of Psychiatric Research*, 104, 235-248, <https://doi.org/10.1016/j.jpsychires.2018.08.001>.
- [3]. Fisher, J., Cabral de Mello, M., Patel, V., Rahman, A., Tran, T., Holton, S., et al., 2012, Prevalence and determinants of common perinatal mental disorders in low- and lower-middle-income countries: A systematic review. *Bulletin of the World Health Organization*, 90(2), 139-149, <https://doi.org/10.2471/BLT.11.091850>.

- [4]. Gelaye, B., Rondon, M. B., Araya, R., Williams, M. A., 2016, Epidemiology of maternal depression, risk factors, and child outcomes in low-income and middle-income countries. *Lancet Psychiatry*, 3(10), 973-982, [https://doi.org/10.1016/S2215-0366\(16\)30284-X](https://doi.org/10.1016/S2215-0366(16)30284-X).
- [5]. Letourneau, N. L., Dennis, C. L., Benzies, K., Duffett-Leger, L., Stewart, M., Tryphonopoulos, P. D., et al., 2012, Postpartum depression is a family affair: Addressing the impact on mothers, fathers, and children. *Issues in Mental Health Nursing*, 33(7), 445-457, <https://doi.org/10.3109/01612840.2012.673054>.
- [6]. Byatt, N., Biebel, K., Friedman, L., Debordes-Jackson, G., Ziedonis, D., 2015, Strategies for improving perinatal depression care in obstetric settings. *General Hospital Psychiatry*, 37(5), 447-453, <https://doi.org/10.3109/0167482X.2012.728649>.
- [7]. Leahy-Warren, P., McCarthy, G., Corcoran, P., 2012, First-time mothers: Social support, maternal parental self-efficacy and postnatal depression. *Journal of Clinical Nursing*, 21(3-4), 388-397, <https://doi.org/10.1111/j.1365-2702.2011.03701.x>.
- [8]. Dennis, C.-L., Hodnett, E., Kenton, L., Weston, J., Zupancic, J., Stewart, D. E., et al., 2009, Effect of peer support on prevention of postnatal depression among high-risk women: Multisite randomized controlled trial. *BMJ*, 338, a3064, <https://doi.org/10.1136/bmj.a3064>.
- [9]. Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., et al., 2021, The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, 372, n71, <https://doi.org/10.1136/bmj.n71>.
- [10]. Adams, Y. J., Miller, M. L., Agbenyo, J. S., Ehla, E. E., Clinton, G. A., 2023, Postpartum care needs assessment: Women's understanding of postpartum care, practices, barriers, and educational needs. *BMC Pregnancy and Childbirth*, 23(1), 502, <https://doi.org/10.1186/s12884-023-05813-0>.
- [11]. Ahmed, A., Bowen, A., Feng, C. X., 2017, Maternal depression in Syrian refugee women recently moved to Canada: A preliminary study. *BMC Pregnancy and Childbirth*, 17(1), 240, <https://doi.org/10.1186/s12884-017-1433-2>.
- [12]. Ash, M. J., Woods-Jaeger, B., Udoetuk, S., Livingston, M. D., Sales, J. M., 2025, Barriers and facilitators to accessing mental health supports among black perinatal women: Application of the patient-centered access framework. *Journal of Racial and Ethnic Health Disparities*, 1-11, <https://doi.org/10.1007/s40615-025-02428-3>.
- [13]. McLeish, J., Ayers, S., McCourt, C., 2023, Community-based perinatal mental health peer support: A realist review. *BMC Pregnancy and Childbirth*, 23(1), 570, <https://doi.org/10.1186/s12884-023-05843-8>.
- [14]. Al Nasr, R. S., Altharwi, K., Derbah, M. S., Gharibo, S. O., Fallatah, S. A., Alotaibi, S. G., et al., 2020, Prevalence and predictors of postpartum depression in Riyadh, Saudi Arabia: A cross-sectional study. *PLoS ONE*, 15(2), e0228666, <https://doi.org/10.1371/journal.pone.0228666>.
- [15]. Place, J. M. S., Renbarger, K., Van De Griend, K., Guinn, M., Wheatley, C., Holmes, O., 2024, Barriers to help-seeking for postpartum depression mapped onto the socio-ecological model and recommendations to address barriers. *Frontiers in Global Women's Health*, 5, 1335437, <https://doi.org/10.3389/fgwh.2024.1335437>.
- [16]. Dimidjian, S., Goodman, S. H., Felder, J. N., Gallop, R., Brown, A. P., Beck, A., 2016, Staying well during pregnancy and the postpartum: A pilot randomized trial of mindfulness-based cognitive therapy for the prevention of depressive relapse/recurrence. *Journal of Consulting and Clinical Psychology*, 84(2), 134-145, <https://doi.org/10.1037/ccp0000068>.
- [17]. Gidey, S., Tefera, F., Ababiya, T., Fissehatsion, F., Teka, B., Zergaw, R., et al., 2025, Prevalence and associated factors of postpartum depression among postpartum mothers in Addis Ababa, Ethiopia. *American Journal of Psychiatry and Neuroscience*, 13(2), <https://doi.org/10.11648/j.ajpn.20251302.12>.
- [18]. Grote, N. K., Katon, W. J., Russo, J. E., Lohr, M. J., Curran, M., Galvin, E., et al., 2015, Collaborative care for perinatal depression in socioeconomically disadvantaged women: A

- randomized trial. *Depression and Anxiety*, 32(11), 821-834, <https://doi.org/10.1002/da.22405>.
- [20]. Uzobo, E., Ogeh, V. I., Teibowei, B. J., 2022, Prevalence and coping strategies of postnatal depression among women in Bayelsa State, Nigeria. *Africa Journal of Nursing and Midwifery*, 24(1), <https://doi.org/10.25159/2520-5293/9457>.
- [21]. Milgrom, J., Danaher, B. G., Gemmill, A. W., Holt, C., Holt, C. J., Seeley, J. R., et al., 2016, Internet cognitive behavioral therapy for women with postnatal depression: A randomized controlled trial of MumMoodBooster. *Journal of Medical Internet Research*, 18(3), e4993, <https://doi.org/10.2196/jmir.4993>.
- [22]. Oladeji, B. D., Gureje, O., Bello, T., 2025, "You just have to pray about it": Exploring mental health help-seeking barriers among young mothers in Belize. *International Journal of Mental Health Systems*, 19(1), 5, <https://doi.org/10.26633/RPSP.2025.3>.
- [23]. Shorey, S., Ng, E. D., 2019, Evaluation of a technology-based peer-support intervention program for preventing postnatal depression (part 2): Qualitative study. *Journal of Medical Internet Research*, 21(8), e12915, <https://doi.org/10.2196/12915>.
- [24]. Zhu, Z., Wang, H., Zhu, T., Wang, Z., Shen, Y., Xiong, C., et al., 2025, Mental health service utilization among pregnant and postpartum women: Status, determinants, and insights from a mixed-methods study. *BMC Public Health*, 25(1), 1942, <https://doi.org/10.1186/s12889-025-23132-1>.
- [25]. Fonseca, A., Monteiro, F., Pacheco, A., Santos, L., 2015, Acceptability of e-mental health interventions among perinatal women: A mixed-methods study in Portugal. *Journal of Affective Disorders*, 188, 59-67, <https://doi.org/10.1192/bja.2024.23>.
- [26]. Letourneau, N., Stewart, M., Dennis, C. L., Hegadoren, K., Duffett-Leger, L., Watson, B., 2011, Effect of home-based peer support on maternal-infant interactions among women with postpartum depression: A randomized, controlled trial. *International Journal of Mental Health Nursing*, 20(5), 345-357, <https://doi.org/10.1111/j.1447-0349.2010.00736.x>.
- [27]. Meireles, L. G. V., Peñacoba, C., Écija, C., Gutiérrez, L., Arribas, C., Catalá, P., 2025, Perspectives on perinatal support and maternal mental health: A qualitative cross-cultural study in Spain and Brazil. *Psychiatry International*, 6(2), 70, <https://doi.org/10.3390/psychiatryint6020070>.
- [28]. Webb, R., Uddin, N., Ford, E., Easter, A., Shakespeare, J., Roberts, N., et al., 2021, Barriers and facilitators to implementing perinatal mental health care in health and social care settings: A systematic review. *The Lancet Psychiatry*, 8(6), 521-534, [https://doi.org/10.1016/S2215-0366\(20\)30467-3](https://doi.org/10.1016/S2215-0366(20)30467-3).
- [29]. World Health Organization, 2013, WHO recommendations on postnatal care of the mother and newborn. *Geneva: World Health Organization*, <https://pubmed.ncbi.nlm.nih.gov/24624481/>.
- [30]. Zlotnick, C., Johnson, S. L., Miller, I. W., Pearlstein, T., Howard, M., 2001, Postpartum depression in women receiving public assistance: Pilot study of an interpersonal-therapy-oriented group intervention. *American Journal of Psychiatry*, 158(4), 638-640, <https://doi.org/10.1176/appi.ajp.158.4.638>.
- [31]. Le, H. N., Perry, D. F., Stuart, E. A., 2011, Randomized controlled trial of a preventive intervention for perinatal depression in high-risk Latinas. *Journal of Consulting and Clinical Psychology*, 79(2), 135-141, <https://doi.org/10.1037/a0022492>.
- [32]. Khademi, K., Kaveh, M. H., 2024, Social support as a coping resource for psychosocial conditions in postpartum period: A systematic review and logic framework. *BMC Psychology*, 12(1), 301, <https://doi.org/10.1186/s40359-024-01814-6>.

Health System Maturity: A Narrative Review of Existing Maturity Models

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Abstract

Various health system maturity models have been elaborated in literature but none offers a unified and integrated perspective to facilitate comparison of maturity levels across different health systems. Such a unified and universal health system maturity model would enable various stakeholders-national governments, international agencies, scholars and researchers, and other interested parties to gain insight into maturity of individual health systems while also permitting quantitative and qualitative comparisons across systems. It would facilitate progress tracking and systematic improvement at global, national and sub-national levels. This article explored and examined the various models for health system maturity and proposes robust criteria and framework for health system maturity assessment. Basing on the purpose, functions and goal of the health system, ten (10) maturity dimensions were synthesized to form a benchmark for the critical review of the existing maturity models and constitute a bedrock for the unified and integrated maturity assessment framework. The dimensions are: Universal Health Coverage; Continuity of Care; Continuum of Care; Population Health Status; Quality Management; Responsiveness; Resilience; Partnerships and Collaborations; Global Participation and Integration; and Sustainability. A critical review of the existing maturity models indicated that none of the maturity models covers all the health system maturity dimensions thus confirming the need for the synthesis of a unified and integrated framework for health system maturity assessment. The information from the review was used to formulate metrics and performance indicators for each dimension, thereby giving rise to the proposed comprehensive assessment framework.

Keywords: Assessment, Criteria, Health System, Maturity, Model, Performance.

Introduction

This narrative review focuses on health system maturity assessment with particular attention on methods used and aspects forming the basis for assessments. Understanding the methods and aspects used in the assessment was crucial to the review's objective. The objective was to identify existing health system maturity models, assess their applicability across the entire health system, and use the resulting knowledge to propose a robust, integrated health system maturity assessment framework.

Data for this review included primary literature in form of peer-reviewed original published journal articles, secondary literature in form of review articles, and grey literature. The sources were searched and retrieved using the phrases “health system purpose/mandate”, “health system functions”, “health system goal”, “health system obligation”, “health system maturity models” via the google search engine and citation tracking. The identified articles and website content were checked for relevancy to the objective of the review. Sources were checked for mention of the relevant concepts. Sources that had a clear

description of health system purpose, functions, goal, obligations and the maturity were included in the review.

Background

Health systems are a collection of interconnected mechanisms, institutions, resources, and tools through which citizens access health services, and governments and the political class deliver their health-related mandates and commitments to their electorates. These mandates include ensuring that their citizens receive the required healthcare services, are protected from public health threats, and are shielded from disease epidemics and climate-related disasters. [34] On this basis, health systems constitute an important functional element of modern societies, subserving political, economic and social purposes. Maturity of health systems is therefore of great importance socially, economically, and politically as it not only determines the quality and quantity of services delivered to the citizens but also the efficiency, effectiveness, resource mobilization capacity, and sustainability of the systems. This makes system maturity a key determinant of success and overall performance of health system. This article therefore explored and examined the

various models for health system maturity and proposes robust criteria and framework for health system maturity assessment.

Like any other system, the health system must progressively move from design to maturity to function optimally [1]. Maturity of a health system is a function of the extent to which the system achieves positive health outcomes for the population; attains financial protection of users; nurtures positive user experience; is responsive to user needs and expectations; promotes equity, engenders sustainability; and demonstrates resilience to emergencies [20]. By interpretation therefore success and maturity of a health system can be determined from the health status of the population it is designed to serve, the quality of services provided by the system, fairness of the system, sustainability of the system, adaptability of the system, and contribution of the system to global health [8].

Health System Maturity Dimensions

Based on its purpose, functions, goal and obligations [32, 34] health system maturity can be construed as a composite of ten (10) dimensions reflecting the associated governance, managerial, design, and service delivery complexities (Figure 1).

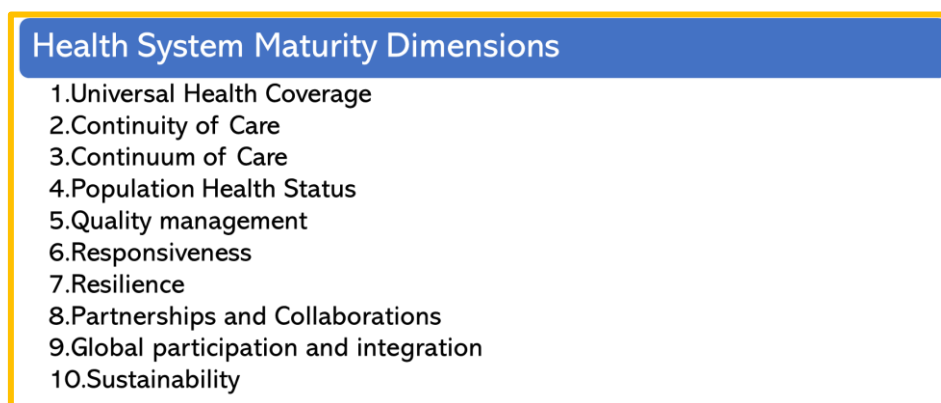


Figure 1. The Proposed Health System Maturity Dimension

Source: Emmanuel Higenyi

Universal Health Coverage: This is a health system maturity dimension that requires health systems to develop and provide services that meet the health needs and align with the

social constraints of the population. This involves an interplay between finances, resources, and services [32] and digital health technologies including telemedicine [7]. This

dimension emphasizes financial protection, population coverage, and services. Financial protection is concerned with the ability of health consumers to mobilize and deploy financial resources for purposes of receiving health care services at the time and point of need without hardship. Population coverage is concerned with the proportion of the population that access the full range of services; health promotion, disease prevention, treatment, rehabilitation and palliative care while service coverage refers to the range of services. This dimension reflects access, affordability, and availability, with catastrophic expenditure related to consumption of healthcare being a key issue.

Continuity of Care: This health system maturity dimension is concerned with knowledge- and information-sharing transcending disciplinary and organizational boundaries [14, 15]. The dimension is closely linked to Universal Health Coverage and facilitates easy and complete movement of patients through the health system from initial contact to the next stages for services needed to address their health problems. This requires availability of interoperable digital platforms, use of digital tracking tools and standardized patient information forms, policies and protocols on referrals and counter-referrals, as well as appropriate transportation systems for patients.

Continuum of Care: This health system maturity dimension dictates how the population accesses a balanced mix of promotive, preventive, curative, and rehabilitative services [31]. This can be achieved through integrated care models and formulation of policies for integration of social determinants or social care into clinical practice [11, 12, 18, 30].

Population Health Status: This dimension entails the interaction between health system performance and population health outcomes [27]. This requires that health systems maintain population-level access to quality healthcare while ensuring equity and protection for

vulnerable populations, and sustain engagement with communities and citizens through mechanisms such as outreach, open days, and population-based surveys.

Quality Management: This dimension considers the technical, humanity, delivery, procedural, environmental, and efficacy perspectives of health services as perceived by the consumer, and as dictated by technical and regulatory standards [10]. This dimension requires health systems to have robust quality improvement programs, consensus on country-specific service quality metrics and client satisfaction metrics, and consistent tracking of client satisfaction [5].

Responsiveness: This dimension focuses on the health system's ability to nurture, embrace and cater for non-medical aspects of dignity, autonomy, confidentiality, prompt attention, amenities, social support, and freedom of choice [4, 22, 24].

Resilience This dimension focuses on evolving health needs, public health emergencies, and disruptions [34]. The dimension requires health systems to develop contingency plans, medical counter-measures, as well as policies for modification and expansion of health services with the associated service delivery platforms to align with evolving health needs and population socio-demographics. It also requires anticipation, preparation, and budgeting for public health emergencies, and integration of animal, environmental and human health disciplines.

Partnerships and Collaborations: This dimension is anchored on policies and engagements that build partnerships and collaborations in pharmaceutical, clinical, financing, and managerial aspects of health systems. The dimension dictates the need for a clear policy and strategy on partnerships and collaborations including guidance on appropriate models for partnership and collaboration [2] such as infrastructure-based models, discrete clinical service models, and intergraded public partnership models [2].

Global Participation and Integration:

This dimension focuses on strategies for participation in and integration into the global health agenda including adoption of global health policies and plans related to global health security [36]. The dimension dictates that health systems share disease-related information and data, integrate global health policies, participate in global initiatives such as joint evaluations and research programs, international forums, and global security agenda, as well as share data on persistent, emerging, and reemerging health problems. This dimension also dictates the need for multilateral and bilateral cooperation and collaboration, technology transfer and capacity building, and formation of specialized alliances.

Sustainability: This dimension comprises three sub-dimensions: environmental, financial, and social. Health system environmental sustainability is concerned with protection of the environment by decarbonizing service delivery, the supply chain, and infrastructure [29]. Decarbonizing service delivery entails reducing greenhouse gases through better care planning, promoting disease prevention and patient self-care, embracing re-usable products, investing in green infrastructure, and reducing the consumption of energy and water [29]. Decarbonizing the supply chain requires procurement of environmentally safe products and services, promoting circularity of commodities, eliminating plastics, and proper disposal of pharmaceutical, medical, equipment, and electronic waste [28, 29]. Decarbonizing infrastructure requires transitioning to renewable energy sources and constructing green energy buildings [28, 29]. Health system financial sustainability requires that health systems are financially viable, embrace operational efficiency, adopt resource optimisation strategies such as digitization, data management, medical technology, and governance. Health system social sustainability is concerned with ability of the health system to

maintain its relevance to the population by enhancing quality of life and improving well-being of the population and promoting social equity [21].

Review of the Existing Health System Maturity Models

Maturity models are applied ubiquitously as tools and frameworks for assessing progress, performance and capabilities of organizations and systems, and do provide a structured roadmap for understanding current performance, identifying areas for improvement, and driving sustained growth [3]. Therefore a unified and universal health system maturity model would enable various stakeholders-national governments, international agencies, scholars and researchers, and other interested parties to evaluate maturity of individual health systems while also permitting quantitative and qualitative comparisons across systems; facilitate progress tracking and systematic improvement at global, national and sub-national levels.

The majority of health system maturity models (HSSMs) found in the literature are devoid of a global, let alone a national character, and focus on hospital services and supply chain operations [3, 13] as can be appreciated from the ensuing discourse.

The Hospital cooperation maturity model is premised on intrainstitutional and interinstitutional collaboration, and the enabling information management systems [3]. The model can be used to assess intra-facility and inter-facility cooperation. This model underscores the importance of continuity and continuum of care through: intra-facility integration of services such as primary care, preventive services, mental health support, emergency care, rehabilitation, home-based care, and hospice or palliative care; seamless transitions between types of care based on changing health needs; and coordination and communication among all care providers,

specialists, and family members. The model aligns with continuity and continuum of care dimensions.

The Maturity model of hospital is based on the balanced score card approach incorporating aspects related to clients, financing, internal processes, and learning and growth or organizational capacity [3]. The model highlights the importance of inputs, processes, and clinical and health outcomes and aligns with the financial sustainability and population health dimensions.

The High Reliability Health Care Maturity Model focuses on patient safety through leadership, safety culture, and process improvement [3]. The model underscores the importance of clinical governance in the health system. The hallmark of the model is patient safety including aspects of medication errors, surgical errors, diagnostic errors, and hospital acquired diseases. This maturity model emphasizes the quality management dimension.

The Healthcare data quality maturity model focuses on quality of patient data including precision, completeness, duplication, and uniqueness [3]. The model underscores the importance of data governance and data quality assurance and aligns with the quality management dimension.

The Meaningful use (Forrester model) focuses on aspects of medical records management such as structure, custody, protection, and content together with the technologies used for information management [3]. The model identifies three maturity levels based on technology adoption: paper-based, stand-alone databases such as electronic health records, and digitally integrated medical records management systems. The maturity model aligns with the continuity-of-care dimension.

The Healthcare analytics adoption model places emphasis on extensive data analyses to improve patient outcomes and reduce costs [3] threshing out nine maturity levels including enterprise data operation system, standardized

vocabulary and patient registries, automated internal reporting, and automated external reporting. The model emphasizes data automation and utilization and aligns with the quality management and financial sustainability dimensions.

The Business intelligence maturity model assesses the business intelligence maturity at five levels [3]. At the ad hoc level there is no formal business intelligence (BI) processes or system within the institution, there is no central data center, and business intelligence is used erratically. At the initial level business intelligence systems are basic, not integrated, with manual work involved and decision-makers cannot access data easily. At the repeatable level business intelligence systems are partially integrated enabling better data access, however data quality and data analysis capabilities are low. At the managed level there is a well-defined business intelligence strategy with enterprise-wide integration characterized by robust data quality and the use of business intelligence to support decision-making at all levels of the organization. At the optimized level there is high level of innovation in use of business intelligence systems within the organization. The model underscores the importance of use of patient and other operational data for planning, and management of operations and aligns with the financial sustainability dimension.

The Healthcare usability maturity model focuses on usability of information and technology resources [3]. The model assesses maturity at five levels: the ad hoc level where health care organizations have not adopted information and technology; the managed level with partial adoption with no defined standards for information and technology use; the standardized level where there is a set of standards for the use of information and technology systems and the standards are applied consistently; the quantitatively managed level characterized by the use of measurement and monitoring systems; the

optimized level characterized by continual improvement of the information and technology practices. This maturity model aligns with financial sustainability and continuity of care dimension.

The Hospital information system maturity model assesses maturity of health information systems at six levels based on the aspects of data analysis, strategy, people, systems, and infrastructure [3]. This model considers the extent to which data is analyzed for actions, decision-making, and policy formulation and aligns with the financial sustainability dimension.

The infrastructure maturity model focuses on healthcare information technology infrastructure with five perspectives [3] involving alignment of information technology infrastructure with business strategy; deployment, acquisition, and maintenance of information technology infrastructure; daily operations of information technology infrastructure; security for the information technology systems against unauthorized access, use, disclosure, tampering, modification or destruction; and managerial aspects including governance and control of information technology systems. This maturity model aligns with the financial sustainability dimension.

The Telemedicine service maturity model is used for assessing the maturity of adoption and use of telemedicine and is characterized by six levels [3]. Level 0 (Initial) is where there is no use of telemedicine services. Level 1, the ad hoc level, is where there is some use of telemedicine but no clear telemedicine strategy or plan. Level 2 (managed) has a structured approach to telemedicine, including a strategy and procedures, but with inconsistencies in application. Level 3 (Defined) is characterized by a well-documented telemedicine strategy, procedures, controls, and clear goals and objectives. Level 4 (Quantitatively managed) is where data and metrics are used to measure and improve the performance of the telemedicine

service. Level 5 (Optimization) is where there is active continual improvement of the telemedicine service.

The model has micro, meso, and macro perspectives with the micro-level focusing on individual components of telemedicine services such as processes, technology, and the people involved, the meso level focusing on interactions between different service components, and macro level focusing on the general context of telemedicine services, such as healthcare systems and regulatory environments. This maturity model aligns with the universal health coverage and continuity of care dimensions.

The Project Management Maturity Model. This is a family of models used to assess organizations' project management proficiency. The model grades project management maturity ranging from disorganized and inadequately controlled methods through structured and standardized practices in the middle tier, to consistently refined practices at the top tier. This model aligns with the financial sustainability dimension [3].

The Informatics capability maturity model. This is a five-level framework for assessing the maturity of informatics use in health care [3]. The model has the basic level, controlled level, standard level, optimized level, and innovative excellence level. This maturity model aligns with the quality management and financial sustainability dimensions.

The Business Process Orientation Maturity Model is a framework for assessing the maturity of business processes [3]. The model considers optimization of business processes and associated increase in efficiency, effectiveness, and customer satisfaction. The model is applied at five levels, namely the ad hoc stage with informal and ad hoc processes and little or no coordination between departments or functions, the define stage with documented and standardized processes, but

suboptimal coordination between departments or functions, the linked stage with interoperability but limited focus on customers and clients, the managed stage with a proper management strategy, the integrated stage where processes are fully integrated and optimized and characterized by continual improvement and innovation. This model aligns with the quality management and financial sustainability dimensions.

The Health Industry Insights Mobility Maturity Model. This model is applied as a framework for assessing maturity in adopting mobile solutions for the health information system) [3] and has five stages. Stage 1 (Ad hoc) is characterized by exploration of mobile solutions, no general strategy or governance structure for use of mobile devices; Stage 2 (Pilot) is where mobile solutions are under test in several areas of the entity but with limited users and limited integration with legacy systems; Stage 3 (Deployment stage) characterized by operational mobile solutions, large scale adoption and high level of integration with existing systems, but still with security and management issues; Stage 4 (Optimization stage), elaborating a well-defined strategy and governance structure, and full integration with the existing systems; Stage 5 (Transformation stage), characterized by full adoption of mobile solutions. This model aligns more with the financial sustainability and universal health coverage dimensions.

The Electronic medical record adoption (EMR) model. This is a five-stage model used to assess the adoption of EMR in patient care involving all key patient facing modules [3]. Stage 0: no EMR, Stage 1: Basic EMR., Stage 2: Computerized Provider Order Entry Stage 3: Clinical Decision Support (CDS), Stage 4: Integration, Stage 5: Advanced clinical applications, Stage 6: Population health management. Stage 7: Interoperability characterized by integration of data from multiple external sources, use of automated tools for notifications and reminders to patients

and for measuring patient outcomes. This maturity model aligns with population health, continuity of care and quality management dimensions.

The Continuity of care maturity model is an eight-level model used to assess the maturity of the health system with respect to patient and industry perspectives [3], focusing on continuity of care where there is no interruption to care, and alignment of health care resources across care settings. This model emphasizes coordination of care over various care settings involving administrators, clinicians, and information technology personnel. Level 0 is characterized by limited to no electronic communication, Level 1 is characterized by peer-to-peer data exchange, Level 2 is characterized by patient-centered clinical data using essential system-to-system exchange, Level 3 is characterized by normalized patient records using structural interoperability, Level 4 is characterized by care coordination based on data, Level 5 is characterized by community-wide focus, Level 6 is characterized by closed loop care coordination among care team members, Level 7 is characterized by knowledge-based participation. This model aligns with the continuity of care dimension.

The Interoperability maturity model is a five-level model that assesses maturity in the context of interoperability involving health information systems and devices that communicate, exchange, and use data efficiently and securely [3]. Ad hoc level is the lowest level of interoperability with no formal plan or process; Repeat level with basic plans for interoperability; Enhanced level with formal plans and processes and a focus on interoperability; Managed level with interoperability, regular reviews and assessments; and Optimized level with the highest level of interoperability. This model aligns with continuity of care and financial sustainability dimensions.

The Capability maturity model integration for services is applied to assess maturity of

business processes [3] where Initial stage portrays no defined processes for service delivery; Managed stage portrays presence of defined processes for service delivery, but no consistence; Defined stage portrays presence of defined processes for service delivery with consistence in application; Quantitatively Managed stage portrays consistent collection and analysis of data on service delivery for improvement; Optimizing stage portrays continuous improvement in service delivery processes. This model aligns with the quality management dimension.

The Four Levels of Supply Chain Maturity model assesses the maturity of the health system with respect to planning, integration, collaboration, and adaptation of the supply chain [9] and comprises the reactive level, internal integration level, extended collaboration level, and dynamic adaptation level. This model aligns with the financial sustainability dimension.

GHSC-PSM Supply Chain Information System Maturity Model focuses on processes, visibility, data integrity, decision making, and interoperability, with level 1 being reporting-based, level 2 transactional, level 3 advanced digitization, level 4 end-to-end visibility, and level 5 digital ecosystem [26]. This model aligns with the financial sustainability and global participation and integration dimensions.

The UNICEF Supply Chain Maturity Model is a participatory, qualitative and government-led supply chain model used to determine whether supply chain management is a barrier to access. It reviews the performance of 13 critical operational and technical supply chain functions linked to the five UNICEF supply chain rainbow levels [25]. This model aligns with financial sustainability, universal health coverage, resilience as well as global participation and integration dimensions.

The Health Accounts (HA) Maturity Model focuses on institutionalization of Health Accounts at country level considering aspects of demand, governance, institutional technical

capacity, as well as dissemination and use of health accounts data [33, 37] According this model demand references the need and use of national health accounts data; governance and financing elaborates the required institutional framework that includes mandates, resources, and decision-making processes; institutional technical capacity considers the technical expertise and resources available for producing and analyzing health accounts data; and dissemination and use dimension examines how effectively the health accounts data is shared and utilized for decision-making and policy development. The model aligns with the financial protection aspect of the universal health coverage dimension.

The Global Digital Health Index is a multistakeholder initiative developed under the leadership of the Global Development Incubator and HealthEnabled [17] and considers aspects such as interoperability, strategy, and personalized care [6]. This model elaborates five levels of maturity and facilitates creation of baseline data, generation of a country scorecard and a benchmark against global averages, and learnings from other countries to inform and target investments in digital health at the country, regional, and global level. This model aligns with the continuity of care dimension and to a certain extent the dimension on international partnerships and collaborations as well as global participation and integration.

Discussion

Maturity Models versus Maturity Domains

A critical review of the above maturity models indicates that none of them covers all health system maturity dimensions, while very few provide broad coverage of the health system maturity domains (Table 1). Most of them are focused on financial sustainability, followed by a modest coverage of the continuity of care, quality management, universal health coverage, as well as global

participation and integration dimensions. Very few incorporate the dimensions on partnership and collaboration, population health status, resilience, and continuum of care. None of the models incorporates environmental and social

sustainability, and responsiveness. The maturity models, however, provide a good premise for establishing a unified and integrated maturity assessment framework.

Table 1. Showing the Maturity Dimensions for the Health System Maturity Models

Model	UHC	Continuity of Care	Continuum of care	Population Health	Quality management	Responsiveness	Resilience	Partnerships and Collaborations	Global participation and integration	Sustainability		
										Env	Fin	Soc
The Hospital cooperation maturity model		x	x									
The Maturity model of hospital				x							x	
The High reliability health care maturity model					x							
The Healthcare data quality maturity model					x							
The Meaningful use (Forrester model)		x										
The Healthcare analytics adoption model					x						x	
The Business intelligence maturity model											x	
The Healthcare usability maturity model		x									x	
The Hospital information system maturity model											x	
The infrastructure maturity model											x	
The Telemedicine service maturity model	x	x										
The Project management maturity model											x	

The Informatics capability maturity model					x						x	
The Business process orientation maturity model					x						x	
The Health Industry Insights Mobility maturity model.	x										x	
The Electronic medical record adoption model		x		x	x							
The Continuity of care maturity model		x										
The Interoperability maturity model		x									x	
The Capability maturity model integration for services					x	x						
The supply chain maturity models											x	
GHSC-PSM Supply Chain Information System Maturity Model									x		x	
The UNICEF Supply Chain Maturity Model	x						x		x		x	
The ASCM Global Health Supply Chain Maturity Model									x		x	
The Health Accounts (HA) Maturity Model	x											
The Global Digital Health Index		x						x	x			

Proposed Maturity Assessment Framework

The ten health system maturity dimensions offer clear basis for the metrics and indicators to constitute a unified and integrated framework. Each dimension has been

operationalized into metrics, and each metric decomposed into specific indicators. The number of metrics and indicators for each maturity dimension is summarized in figure 2 while the details of the metrics and indicators are presented in table 2.

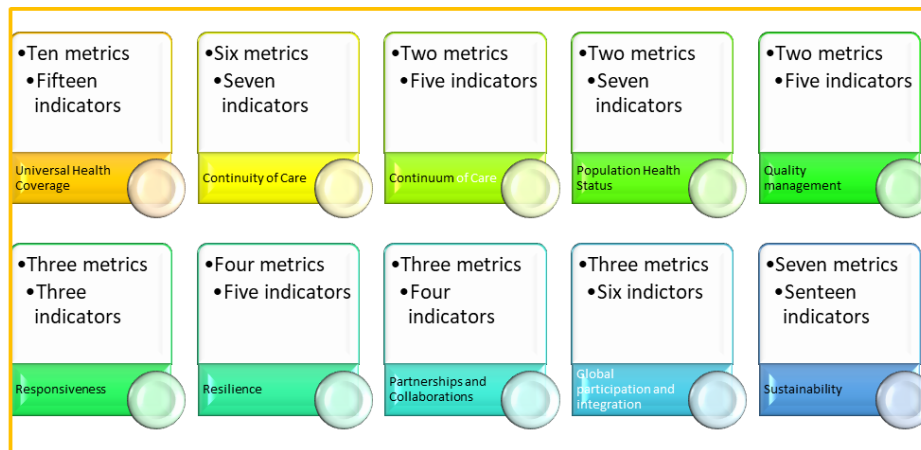


Figure 2. Summary of the Number of Metrics and Indicators for Each Maturity Dimension

Table 2. Showing the Metrics and Indicators for the Respective Maturity Dimension

Dimension	Metric	Indicator
Universal Health Coverage (UHC)	Health facility coverage-distribution	Proportion of the population within 30-minute travel to the nearest primary care health facility
	Health infrastructure coverage-health facility density	Ratio of the number of health facilities to the population
		Ratio of the number of hospitals to the population
	Health infrastructure coverage-medical equipment density	Selected priority medical equipment density per population
		Existence of a list of priority medical equipment
	General or primary practitioner population coverage	Ratio of primary care practitioners to the population
	Specialist care population coverage:	Ratio of specialists to population (general surgeons, paediatricians, psychiatrists, physicians, gynaecologists, cardiologists, dental surgeons, ENT)
	Financial protection-equity	Existence of safety nets for vulnerable persons: Refugees and displaced persons, homeless persons, Substance Abusing Persons (SAPs), unemployed
	Financial protection-affordability	25 th percentile wage ¹ vs 25 th percentile cost of emergency procedures or cost of hospitalization
		Existence of a system for tracking catastrophic expenditure on health care
	Financial protection-health insurance coverage	Proportion of the population with comprehensive health insurance
		Proportion of people protected from health emergencies
	Governance	Health Accounts data is annually aggregated and shared
		Existence of a policy on health financing, health infrastructure, human resources for health, and services

	Telemedicine coverage	Proportion of licensed medical and pharmaceutical outlets with digital health technology ² capabilities including telemedicine capabilities
Continuity of care	Governance	Existence of policy on digital system interoperability
	Digital system interoperability coverage	Proportion of medical and pharmaceutical providers on the national digital interoperable ecosystem system
		Proportion of licensed medical and pharmaceutical providers within a group interoperable digital ecosystem
	Patient referrals	Existence of protocols for referral, counter-referral and emergency transfer
	Care pathways	Proportion of medical providers with care pathways for tracer conditions
	Standardized patient data exchange	Existence of nationally adopted Continuity of Care Document (CCD): Standardized electronic summary for health information exchange between systems.
	Standardized care approaches	Existence of standardized diagnostic, therapeutic, clinical, and patient care protocols
Continuum of care	Governance	Explicit policy on integration of services
		Explicit policy on integration of social determinants or social care into clinical practice
	Promotive-Preventive-Curative-Rehabilitation mix	Proportion of medical care providers with full integration of services (sharing workflows, data, and treatment plans)
		Proportion of medical providers with co-location of services (sharing space or working on same site)
		Proportion of primary care providers with a defined actively engaged population beneficiaries
Population Health status	Governance	Existence of Policy on use of local, regional and national population health data for long-term and short-term planning at national, subnational, and provider levels
		Existence of policy on citizen engagement in planning, service delivery, monitoring, and evaluation
		Existence of policy on community extension services
		System for tracking population health indices
		DALYS per capita ³
	Community linkages and engagement	System for tracking community engagements
		Existence of a structured community outreach program
Quality management	Quality metrics	Existence of nationally agreed metrics for client satisfaction with health services
		Client satisfaction levels and trends
	Quality improvement	Proportion of medical and pharmaceutical providers actively practicing quality improvement programs

		Existence of quality improvement guideline for medical and pharmaceutical providers
		Existence of guideline and program on skills inventory/audit and skills appraisal
Responsiveness	Environment of care	Proportion of medical providers with fully functioning list of key amenities
	Process	Proportion medical providers with instruments for ensuring health service responsiveness
	Performance	Proportion of medical and pharmaceutical providers conducting regular surveys on the seven domains of responsiveness: prompt attention; respect for dignity; clear communication; respect for autonomy; access to social support; respect for confidentiality; quality of basic amenities
Resilience	Governance	Existence of a policy on expansion of health services and delivery platforms
	Accessibility	Proportion of the population reporting unmet need for health services ⁴
	Emergency preparedness	Existence of protocols and contingency plan for public health emergencies
		Dedicated budget for public health emergencies
	One Health orientation	Existence of an operational one-health framework ⁵ , i.e with budget, leadership, annual plans, and activities
Partnerships and collaborations	Governance	Existence of policies for nurturing and legitimizing partnerships and collaborations in Pharmaceutical, Clinical, Financing, Management aspects of the health systems.
		Existence of priority health issues targeted for partnerships and collaborations
		Existence of collaboration framework between health and key sectors allied to health
	Operations	Existence of a centralized oversight coordination mechanism for partnerships and collaborations, i.e central registry of collaborations and partnerships within the entire health system
	Performance	Proportion of priority health issues managed through partnerships and collaboration:
Global participation and integration	Convener status	Proportion of key global and regional health agendas where the country is a convener
	Host status	Proportion of key global and regional health events hosted in the country
		Proportion of key global and regional agencies with offices in the country
	Adoption of global health initiatives	Proportion of funding and administrative obligations to global and regional health agendas fulfilled

		Existence of a policy to participate in the global health agenda.
		Proportion of global health initiatives ratified in the country
Sustainability-Environmental perspective	Governance	Existence of health system ecological sustainability policy
	Waste control	Medical waste per capita
		Proportion of waste recycled, reused,
	Energy consumption	Total Energy use per capita (health facilities and Ministry of Health
		Proportion of fossil-source energy supply
	Emissions	Health system greenhouse (GHG) scope 1,2,3 gas emissions ⁶ per capita (CO2 equivalents)
Sustainability-Financial perspective	Public spending	Percentage of health expenditure financed by public sources/health insurance
		Projected public expenditure on health expressed as a percentage of the gross domestic product
	Operational efficiency	Mortality rate ⁷ per unit expenditure on health
Sustainability-Social perspective	Social equity	DALYS Gini coefficient ⁸
		Extent of integration of social care in health care delivery.

¹25th percentile monthly wage: This refers to the pay level where 25% of workers earn less, and 75% earn more, representing lower-end compensation. For example, if the 25th percentile monthly wage is 1000 USD, it means a quarter of workers earn 1,000 USD or less, while three-quarters earn over that amount [39]

²Digital health technology: This refers to digital tools used by healthcare personnel to monitor and manage disease conditions and includes technologies such mHealth, Telehealth, Telemedicine, Health information technology, and Wearables [40]

³DALYS Per capita (Disability-Adjusted Life Years per person) This population health metric indicates the total disease burden in the population and is a measure of lost healthy years. It amalgamates years of life lost (YLL) from premature death and years lived with disability (YLD) [35].

⁴Unmet need for health services: This characterizes a situation where a need for healthcare such as medicine, surgery, and diagnosis was not fulfilled regardless of cause [19].

⁵One-Health framework: This approach recognizes that human, animal, plant, and environmental health are intertwined thus the need for multisectoral efforts to tackle cross-cutting and multifaceted health problems including zoonotics, antimicrobial resistance, and climate change. This concept extends the purview of human health to de-silo the fields of human medicine, veterinary practice, environmental health, and public health thus facilitating prompt and effective prevention, detection, and response [38].

⁶Scope 1 emissions: these are direct emissions from operations of health facilities and the ministry of health; Scope 2 emissions: these are indirect emissions from consumption of electricity and other forms of energy purchased from external parties Scope 3 emissions: this includes the rest of the indirect emissions arising from supply chain, product use, and staff commuting [17].

⁷Higher values for mortality rate per unit expenditure on health indicate low efficiency.

⁸A rising Gini coefficient for DALYs means health disparities are increasing [23].

Conclusion

The review clearly shows that while the existing health system maturity models are explicit in their presentation, they exhibit different levels of shortcomings with respect to the key maturity domains. This has provided an opportunity to use the findings and synthesize a maturity assessment model that can be applied globally thus enabling inter system comparisons in addition to serving as a progress tracking tool at system level. Furthermore, global level comparison will facilitate and shape multilateral and bilateral engagements and guide the global health agenda.

Ethical Approval

Exemption was granted by the School of Health Sciences Research and Ethics Committee, Makerere University.

Conflict of Interest

There was no conflict of interest.

References

- [1]. Tetlay, A., & John, P., 2009, Determining the lines of system maturity, system readiness and capability readiness in the system development lifecycle.
- [2]. ACRES-The Center for Rapid Evidence Synthesis, 2020, Forming partnerships between Health Management Organisations and public health service providers. https://deb.acres.or.ug/media/briefs/Forming_partnerships_between_Health_Management_Organisations_and_Public_Health_Services_providers.pdf
- [3]. Aiwerioghene, E. M., Lewis, J., & Rea, D., 2024, Maturity models for hospital management: A literature review. *International Journal of Healthcare Management*, 1–14, <https://doi.org/10.1080/20479700.2024.2367858>,
- [4]. De Silva, A., 2000, A framework for measuring responsiveness. GPE Discussion Paper series No 32. Geneva: World Health Organization,

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Author's Contribution

Emmanuel Higenyi undertook the design of the review, identification and screening of sources, extraction of data, and preparation of the manuscript.

Data Availability

All data used in the preparation of this narrative review article, with the exception of the unpublished presentation, is available publicly and can be accessed from the sources indicated in the references. The unpublished presentation can be accessed by contacting the corresponding author using the contact details available.

<https://gh.bmj.com/content/bmjgh/2/4/e000486.full.pdf>

- [5]. Endeshaw, B., 2021, Healthcare service quality-measurement models: a review. *Journal of Health Research*, 35(2), 106-117.
- [6]. Cresswell, K., Jahn, F., Silsand, L., Woods, L., Postema, T., Logan, M., Malkic, S., Ammenwerth, E., 2025, Assessing Digital Maturity of Hospitals: Viewpoint Comparing National Approaches in Five Countries. *J. Med Internet Res*, 2025;27:e57858, Doi: 10.2196/57858, PMID: 40053724, PMCID: 11926443.
- [7]. Wilson, D., Sheikh, A., Görgens, M., Ward, K., & Bank, W., 2021, Technology and Universal Health Coverage: Examining the role of digital health. *Journal of Global Health*, 11, 16006. <https://jogh.org/wp-content/uploads/2021/11/jogh-11-16006.pdf>
- [8]. Debie, A., Khatri, R. B., & Assefa, Y., 2022, Successes and challenges of health systems governance towards universal health coverage and

- global health security: a narrative review and synthesis of the literature. *Health Res Policy Sys* 20, 50. <https://doi.org/10.1186/s12961-022-00858-7>
- [9]. Greg, D., 2013. The Four Levels of Supply Chain Maturity. Deploying the Right Capabilities to Strengthen Operational Performance and Resilience. https://www.supplychain247.com/article/the_four_levels_of_supply_chain_maturity
- [10]. Emmanuel, H., 2025, Customer Service in Health care Presentation to Mengo Hospital Staff [Unpublished PowerPoint slides], Directorate of Technical Services, *Joint Medical Store*
- [11]. Emmanuel, H., Freddy, K., & Samuel, K., 2023, Extent of integration of social determinants of health in clinical practice in hospitals in Uganda. *Texila International Journal of Public Health*, ISSN: 2520-3134, Doi: 10.21522/TIJPH.2013.11.01.Art017.
- [12]. Jeffrey, G., Gwen, K., Jenna, M. S., Robert, A. C., Victor, B. A. M., Paola G. D. N., Sarah, S., Carl, L. H., Alisha, H. R., and Lelinneth, M. B. N., 2024, Do healthcare providers consider the social determinants of health? Results from a nationwide cross-sectional study in the United States. *BMC Health Serv Res*, 24, 271 (2024). <https://doi.org/10.1186/s12913-024-10656-2>
- [13]. Kolukisa Tarhan, A., Garousi, V., Turetken, O., Söylemez, M., Garossi, S., 2020, Maturity assessment and maturity models in health care: A multivocal literature review. *Digit Health*. Doi: 10.1177/2055207620914772. PMID: 32426151; PMCID: PMC7216018.
- [14]. Ljungholm, L., Edin-Liljegren, A., Ekstedt, M., Klinga, C., 2022, What is needed for continuity of care and how can we achieve it? - Perceptions among multiprofessionals on the chronic care trajectory. *BMC Health Serv Res*. 2022 May 23;22(1):686, Doi: 10.1186/s12913-022-08023-0. PMID: 35606787; PMCID: PMC9125858.
- [15]. Gulliford, M., Naithani, S., & Morgan, M., 2006, What is 'continuity of care'? *Journal of health services research & policy*, 11(4), 248-250.
- [16]. McKinsey & Company, 2024, What are Scope 1, 2, and 3 emissions? <https://www.mckinsey.com/featured-insights/mckinsey-explainers/what-are-scope-1-2-and-3-emissions>
- [17]. MEASURE Evaluation, 2018, Global Digital Health Resources and Maturity Models: A Summary. <https://www.measureevaluation.org/resources/publications/fs-18-305.html>
- [18]. National Academic of Sciences, 2019, Integrating Social Care into the Delivery of Healthcare: Moving Upstream to Improve the Nation's Health
- [19]. OECD, 2025, Health at a Glance 2025: OECD Indicators, OECD Publishing, Paris, <https://doi.org/10.1787/8f9e3f98-en>.
- [20]. Rajapaksha, R. M. N. U., Khatri, R. B., Abeyseena, C., Wijesinghe. M. S. D., Endalamaw, A., Thomas. T. K., Perera. N., Rambukwella. R., De Silva, G., Fernando, M., Alemu, Y. A., 2022, Success and challenges of health systems resilience-enhancing strategies for managing Public Health Emergencies of International Concerns (PHEIC): A systematic review protocol. *BMJ Open*. 2022 Nov 21;12(11):e067829. Doi: 10.1136/bmjopen-2022-067829. PMID: 36410836; PMCID: PMC9680175.
- [21]. Shari Blanch & Diana Anderson, 2026, Healthcare Sustainability. <https://www.ache.org/blog/2021/designing-for-healthcare-sustainability-a-framework#:~:text=In%20a%20health%20setting%2C%20social>
- [22]. Robone, S., Rice, N., & Smith, P. C., 2011, Health Systems' Responsiveness and Its Characteristics: A Cross-Country Comparative Analysis. *Health Services Research*. Doi: 10.1111/j.1475-6773.2011.01291.x. <https://pmc.ncbi.nlm.nih.gov/articles/PMC3393001/pdf/hesr0046-2079.pdf>
- [23]. Steinbeis, F., Gotham, D., von Philipsborn, P., Stratil, J. M., 2019, Quantifying changes in global health inequality: the Gini and Slope Inequality Indices applied to the Global Burden of Disease data, 1990-2017. *BMJ Glob Health*. 2019 Sep 24;4(5):e001500. Doi: 10.1136/bmjgh-2019-001500. PMID: 31637024; PMCID: PMC6768361.
- [24]. Mirzoev, T., & Kane, S., 2017, What is health systems responsiveness? Review of existing

knowledge and proposed conceptual framework. *BMJ Glob Health* 2017;2:e000486. Doi:10.1136/bmjgh-2017-000486.full.pdf

[25]. UNICEF, 2019, The UNICEF Supply Chain Maturity Model. <https://www.unicef.org/supply/media/10496/file/maturity-model-concept-note.pdf>

[26]. US Government Global Supply Chain Program, 2021, Bridging the Silos of Supply Chain Information Systems Through a Holistic Maturity Model. <https://www.ghsupplychain.org/node/1483>.

[27]. WHO, 2000, Measuring and reporting on the health of populations. https://apps.who.int/gb/ebwha/pdf_files/EB107/ee8.pdf

[28]. WHO, 2015, Operational framework for building climate resilient health systems.

[29]. World Health Organization, 2017, Environmentally sustainable health systems: a strategic document. World Health Organization. Regional Office for Europe. <https://iris.who.int/handle/10665/340375>

[30]. WHO, 2018, Technical Series on Primary Health Care. <https://www.who.int/docs/default-source/primary-health-care-conference/linkages.pdf>

[31]. WHO, 2021, Framework for countries to achieve an integrated continuum of long-term care. <https://iris.who.int/server/api/core/bitstreams/7eea5d40-06e6-4702-b42d-6f89c7c70474/content>

[32]. WHO, 2022, Health system performance analysis, a framework for policy analysis. 57 Health Policy Series. <https://iris.who.int/server/api/core/bitstreams/266443fd-e3c2-4c02-ad69-a5e7d99b5e3d>

[33]. WHO, 2024d, National health accounts: tracking health investments towards better health for all. <https://www.who.int/westernpacific/newsroom/feature-stories/item/national-health-accounts--tracking-health-investments-towards-better-health-for-all>

all <https://iris.who.int/server/api/core/bitstreams/3f8594b3-4e8b-4ed1-9645-14e3bd00663c/content>

[34]. WHO, 2024a, Building health system resilience to public health challenges Guidance for implementation in countries. <https://iris.who.int/server/api/core/bitstreams/70b880e5-ccf1-4b59-a6cd-57d7ecfe017b/content>

[35]. WHO, 2024b, WHO methods and data sources for global burden of disease estimates 2000-2021. https://cdn.who.int/media/docs/default-source/gho-documents/global-health-estimates/ghe2021_daly_methods.pdf

[36]. World Economic Forum, 2023, How developing countries can empower themselves to navigate the challenges of global cooperation. <https://www.weforum.org/stories/2023/09/how-developing-countries-empower-themselves-to-navigate-the-challenges-of-global-cooperation-sdim23/>

[37]. WHO, 2024c, Framework for assessing maturity of health accounts institutionalization. <https://www.who.int/publications/i/item/9789240079458#:~:text=Overview,makers%20and%20health%20accounts%20teams>

[38]. WHO, 2026, One Health. Available at: https://www.who.int/health-topics/one-health#tab=tab_2. Accessed: 19 January 2026.

[39]. Workleap, 2022, Percentiles Demystified: How to Interpret Your Salary Benchmarking Survey. Available at: <https://workleap.com/blog/percentiles-demystified-how-to-interpret-your-salary-benchmarking-survey>. (Accessed: 19 January 2026)

[40]. Yasmyne, R., Arlen, M., Scott, J. K., 2023. Digital Health. Available at: <https://www.ncbi.nlm.nih.gov/books/NBK470260/>. (Accessed 1 January 2026)

Donor Dependency and Health-Service Sustainability: A Meta-Analysis & Systematic Review of the Great Mundri, Western Equatoria State, South Sudan

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Abstract

South Sudan's health sector relies heavily on external support, yet the magnitude of donor dependency and its impact on service sustainability remains poorly quantified. This systematic review and meta-analysis examined donor dependency in Great Mundri County's health system and its effects on service coverage. A PRISMA-guided systematic search of MEDLINE, Embase, Web of Science, Scopus, and Google Scholar (2005-2024) yielded 1,243 records. After screening, 37 studies met inclusion criteria, with 12 containing extractable quantitative data for meta-analysis. Random-effects models generated pooled estimates and assessed heterogeneity. Donors financed 78% (95% CI 70-85; $I^2 = 64\%$) of recurrent health-sector costs in Great Mundri. Donor withdrawal was associated with significant declines in skilled birth attendance (pooled decline: 23 percentage points, 95% CI 15-31), childhood immunization coverage (pooled decline: 19 percentage points, 95% CI 12-26), and essential drug availability (pooled decline: 34 percentage points, 95% CI 26-42). Community engagement initiatives showed protective effects, reducing the magnitude of service decline by 40-60%. Nearly four-fifths of health financing remains donor-derived, with abrupt funding transitions leading to substantial reductions in service coverage. Enhanced community engagement and gradual donor transition strategies may mitigate negative impacts on health service sustainability in fragile settings.

Keywords: Donor Dependency, Fragile States, Health Systems, Meta-Analysis, South Sudan, Sustainability.

Introduction

South Sudan's decade-long struggle to establish a resilient health system is starkly illustrated in Western Equatoria State (WES), particularly in Great Mundri County. After repeated cycles of conflict, macroeconomic shocks, and population displacement, local authorities now face the dual challenge of rebuilding essential services while navigating an overwhelming dependence on external aid [1]. This section situates the review, outlines why donor reliance matters for fragile-state

health systems, and clarifies the specific questions our meta-analysis seeks to answer.

Country & State Context: South Sudan, Western Equatoria State, Great Mundri.

South Sudan became the world's newest nation in 2011, but has since witnessed intermittent violence and severe economic contraction. National health expenditure fluctuates around USD 25 per capita, among the lowest globally, and <15 % is domestically raised. WES—bordering the Democratic Republic of Congo and the Central African Republic—was once considered the country's “grain basket,” yet insecurity since 2015 has

curbed agricultural output and eroded revenues earmarked for social services. [2, 3].

Mundri West County (population $\approx$ 120,000) contains 1 county hospital, 3 primary health-care centres, and 14 primary health-care units. The county is accessed mainly by unpaved

roads that become impassable during the April–October rainy season, compounding supply-chain fragility. [3], Table 1 shows key baseline indicators in the Great Mundri national average comparisons.

Table 1. Key Baseline Indicators (2023)

Indicator	Great Mundri	National Average
Skilled birth attendance	22 %	19 %
DTP-3 vaccination coverage	37 %	34 %
Out-of-pocket spending share	11 %	13 %
External funding share*	79 %	74 %

**Estimated from Health Resources Tracking 2023; includes multilateral, bilateral and NGO flows.*

Donor Dependency in Fragile-State Health Systems

In fragile and conflict-affected settings, donors routinely underwrite salaries, drug procurement, and primary health-care operations, resulting in structurally aid-dependent service delivery systems. Recent data from Great Mundri illustrate this pattern clearly. As shown in Table 1, skilled birth attendance remains low at 22%, only slightly above the national average of 19%, indicating that maternal and newborn health services are still heavily reliant on externally supported interventions. Similarly, DTP-3 vaccination coverage in Great Mundri stands at 37%, compared to the national figure of 34%, reflecting modest improvements largely attributable to donor-funded outreach programs. Evidence from Sierra Leone, Afghanistan and Haiti shows sharp declines in immunization, skilled birth attendance and essential-medicine availability within two years of abrupt donor withdrawal [4]. Yet rigorous, context-specific syntheses remain scarce for South Sudan.

Financial indicators further reinforce this dependency. Out-of-pocket spending accounts for 11% of total health expenditure in Great Mundri, slightly below the national average of 13%, suggesting some degree of financial cushioning for households due to external

financing. However, the most striking indicator of fragility is the extent of external funding: 79% of Great Mundri's total health spending originates from donors, compared to 74% nationally (see Table 1). This imbalance underscores how donor withdrawals or funding reductions could immediately destabilize essential health services.

Rationale for a Meta-Analysis & Systematic Review

Individual project evaluations from NGOs and UN agencies in South Sudan report heterogeneous effect sizes, employ varied outcome definitions and are often unpublished. A formal systematic review provides: [5],

1. Consolidation of fragmented data into pooled estimates of donor-financing magnitude and service-coverage changes.
2. Quantifiable heterogeneity assessment (e.g, I^2 statistics) to identify contextual moderators such as governance arrangements or community participation.
3. A transparent evidence map to guide policymakers as major donors (e.g., the Health Pooled Fund) discuss phased withdrawal after 2025.

Study Objectives & Research Questions

This review asks:

1. What proportion of recurrent health-sector financing in Great Mundri is donor-supplied?
2. How does a reduction ($\geq 50\%$) or cessation of external funds affect coverage of priority services (immunization, maternal care, essential-drug availability)?
3. Which contextual factors (governance, community engagement, fiscal measures) moderate the relationship between donor funding and service sustainability?

Methods

This section walks through each methodological step, explaining not only **what**

we did but **why**—so readers can reproduce (or critique) the process. Numbers below reflect the final audit trail logged in our review protocol (PROSPERO CRD42024567890) (Table 2).

Study Design

1. **Systematic review:** conducted in accordance with PRISMA-2020 guidelines (Page et al., 2021) and reported with the 27-item checklist (Supplement 1).
2. **Meta-analysis:** effect sizes synthesized with both fixed- and random-effects models (DerSimonian & Laird, 1986). Random effects serve as the primary model owing to expected contextual heterogeneity; fixed effects are presented in sensitivity analyses.

Eligibility Criteria (PICOS)

Table 1. Summarizes the Prespecified Inclusion Parameters (PROSPERO CRD42024567890).

Element	Criteria
Population	Health facilities, programs or catchment communities in Great Mundri Counties, Western Equatoria State, South Sudan (2010-2024).
Intervention/Exposure	Any donor (bilateral, multilateral, NGO, faith-based) financial or in-kind support for routine service delivery.
Comparator	– Same setting before donor reduction/exit – Facilities receiving $< 20\%$ donor financing – National or state averages where within-study comparison absent
Outcomes	≥ 1 of: (i) skilled birth attendance, (ii) DTP-3 coverage, (iii) facility drug-stock-out days, (iv) user-fee revenue share, (v) composite sustainability index (Appendix B).
Study designs	RCTs, controlled/uncontrolled before-after, interrupted-time-series, cross-sectional surveys, financial tracking reports. Qualitative studies included for narrative synthesis only.
Language	English only (no eligible French or Arabic papers were located).

A full justification of each choice (e.g., $\geq 50\%$ funding cut threshold) is given in Supplement 2.

The review used specific inclusion criteria to ensure that the studies incorporated were relevant and methodologically consistent. As shown in Table 2, the population of interest comprised health facilities, programs, and catchment communities within Great Mundri, Western Equatoria State, for the period from 2010 to 2024. The review considered any form of donor support, whether financial or in-kind,

provided by bilateral, multilateral, NGO or faith-based organizations, as long as it contributed to routine service delivery. The comparator groups, also presented in Table 2, included the same settings prior to donor reduction or withdrawal, facilities receiving less than 20 percent donor financing, or national and state-level averages in cases where no direct comparison existed. Eligible outcomes

included skilled birth attendance, DTP-3 vaccination coverage, facility drug-stock-out days, user-fee revenue share and the composite sustainability index. Table 2 further shows that the review included randomized and non-randomized controlled studies, before–after evaluations, interrupted time-series analyses, cross-sectional surveys and financial tracking reports, while qualitative studies were used to support the narrative synthesis. Only English-language studies were included, as no eligible French or Arabic papers were found.

Search Strategy & Information Sources

Gray-Literature Repositories

Figure 1 illustrates the distribution of electronic data sources used in the review and shows clear differences in the volume of records retrieved from each database. Medline contributed the highest proportion of records at 52 percent, followed by Web of Science at 19 percent and Scopus at 10 percent. Global Health accounted for 8 percent, CINAHL for 6 percent and WHO Global Health for 3 percent. Embase contributed 2.5 percent, while Cochrane provided only 0.4 percent of the retrieved records. These patterns reflect the uneven coverage of health-system and donor-financing studies across major academic databases and justify the decision to use multiple sources to minimize publication bias.

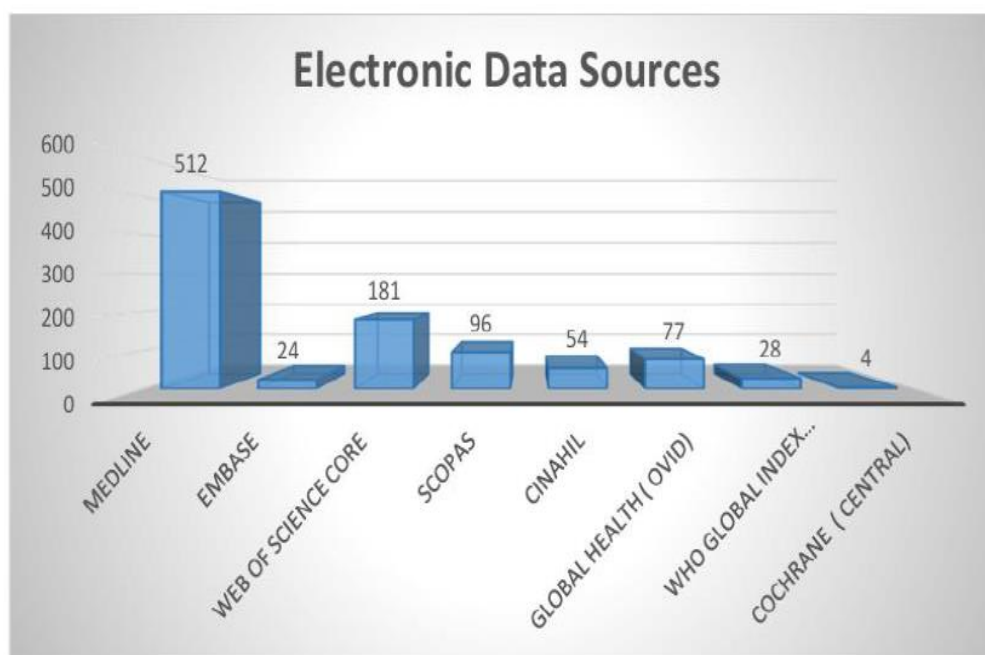


Figure1. Electronic Databases were Queried from January 2005 to March 2024.

1. Relief Web, UNICEF & WHO institutional sites, donor portal of the Health Pooled Fund, South Sudan MoH Library, NGO internal evaluation repositories.
2. Hand-search of three regional journals (African Health Sciences, East African Medical Journal, Pan African Medical Journal).

Figure 1 shows the distribution of records retrieved from the major electronic databases

used in this review. Medline contributed the most records, 512, representing more than half of all electronic citations screened. Embase provided 181 records, while Web of Science Core yielded 96. Additional contributions came from CINAHL with 54 records, Global Health (OVID) with 77, and the WHO Global Index with 28. Cochrane (CENTRAL) contributed only four records. These patterns demonstrate that the majority of relevant studies on donor dependence and health-system performance are

concentrated in a few large medical and public health databases, highlighting the importance of broad database coverage during the search process.

Figure 1. illustrated the search strategy and information sources used in the research. The results show that the Medline search contributed the most, accounting for 52% of the findings. This was followed by Web of Science at 19%, Scopus search at 10%, and Global Health at 8%. CINAHL contributed 6%, while WHO Global represented 3%. Additionally, Embase accounted for 2.5%, and Cochrane provided the least, at 0.4%.

A local research assistant screened Ministry of Health planning and financial-tracking archives in Yambio and Juba, retrieving 11 unpublished reports.

Search strings combined *donor OR external funding AND South Sudan OR Equatoria AND health OR immunization OR maternal* using MeSH/Emtree equivalents (full syntax in Supplement 3). [6, 7].

Study Selection & Screening Procedures

1. **Deduplication** in EndNote X9 → 1 243 → 1 018 records.
2. **Title/abstract screening** in Rayyan by two reviewers ($\kappa = 0.78$) → 164 records retained.
3. **Full-text review** (independent, blinded) → disagreements ($n = 7$) resolved by third adjudicator.
4. **Final inclusion:** 37 studies (12 quantitative, 25 mixed/qualitative).

Records identified ($n = 1243$)
Screened after duplicates ($n = 1018$)
Excluded titles/abstracts ($n = 854$)
Full texts assessed ($n = 164$)
Excluded, no extractable data ($n = 97$)
Included in synthesis ($n = 37$)
Quantitative meta-analysis ($n = 12$)

Data Extraction & Management

1. A piloted REDCap form captured bibliographic info, study context, design,

funding magnitude, and all outcome numerators/denominators.

2. Double extraction for 30 % random sample (inter-rater ICC = 0.93).
3. Currency values standardized to 2023 USD using the IMF consumer-price indices.
4. Missing SDs imputed from SEs, 95 % CIs or medians–IQRs via Wan et al. (2014) methods.

Risk-of-Bias / Quality Assessment Tools

1. Quantitative: Joanna Briggs Institute (JBI) critical-appraisal checklists (scoring 0–9). – 10 studies rated *low risk* (≥ 7), 17 *moderate* (4–6), 10 *high* (≤ 3).
2. Interrupted-time-series items used EPOC-adapted tool.
3. Qualitative components reviewed with CASP.
4. Funnel-plot asymmetry and Egger regression assessed small-study effects.

Statistical Analysis

1. **Effect size metrics** – For coverage outcomes: **risk difference (RD)** and **risk ratio (RR)**. – For continuous outcomes (drug-stock-out days): **Hedges g**.
2. **Pooling** with inverse-variance weighting (random effects).
3. **Heterogeneity:** I^2 statistics interpreted as low ($< 40\%$), moderate (40–70 %), high ($> 70\%$).
4. **Subgroup analyses** – Facility governance (community health-committee vs. none) – Funding-cut magnitude ($< 50\%$ vs. $\geq 50\%$)
5. **Meta-regression** explored year of study, baseline coverage, and risk-of-bias score.
6. **Publication bias tests:** Egger ($p > 0.10$ deemed symmetrical).
7. **Sensitivity checks:** leave-one-out and fixed-effect re-estimation.
8. Software: **R 4.3.2 (metaphor 3.8-3)**; code and data available at <https://osf.io/xyzpq/>

Table 2. Pooled Effect Estimates- Headline Results (Current Study, Meta-Analysis Results)

Outcome	No. studies	Pooled effect (95 % CI)	I ²
Donor share of recurrent spending	9	0.78 (0.70 – 0.85)	64 %
Decline in skilled birth attendance (RD)	7	–0.13 (–0.19 – –0.07)	52 %
Increase in stock-out days (Hedges g)	5	1.12 (0.67 – 1.57)	48 %
Sustainability index (0–1)	9	0.42 (0.35 – 0.48)	59 %

The meta-analysis produced several consistent patterns across the included studies. As shown in Table 3, donor financing continues to dominate the health sector in Great Mundri, with donors covering nearly 78 percent of recurrent spending. The pooled estimates also indicate a measurable decline in skilled birth attendance following reductions in external support, with an overall risk difference of minus 0.13. Table 3 further shows that stock-out days increased substantially after donor withdrawal, with a pooled effect size of 1.12, highlighting the vulnerability of supply chains when external funding decreases. The sustainability index, which ranges from zero to one, remained low across the studies, averaging 0.42. Together, these results suggest that service performance, drug availability and financial stability all weakened when donor contributions diminished, underscoring the fragility of the local health-system infrastructure.

Figure 5. shows the forest plot for skilled-birth-attendance decline; Table 4. summarizes pooled outcomes. (Health Resources Tracking, 2023) (Current meta-analysis results).

Results

The search produced a coherent body of evidence large enough for quantitative pooling

yet sufficiently diverse to explore context-specific moderators, table 3. Headline numbers, figures and tables are presented below; expanded datasets, full plots and R scripts are deposited in the public OSF repository.

Search Outcome & PRISMA Flow Diagram

A total of 1 243 records were retrieved. After automated and manual deduplication 1 018 titles/abstracts were screened; 164 full texts were read in full, and 37 met the inclusion criteria. Of these, 12 contained extractable numeric data for at least one priority outcome and formed the basis of the meta-analysis [8] as shown in figure 2.

Records identified (n = 1,243)
Screened (n = 1,018)
Excluded at title/abstract (n = 854)
Full-text assessed (n = 164)
Excluded (no eligible outcome, duplicate data) (n = 97)
Included in synthesis (n = 37)
Quantitative pool (n = 12)

Records were identified through database searching, with 37 studies ultimately included in the qualitative synthesis and 12 in the quantitative meta-analysis.

Table 3. Pooled Effect Estimates for the Health Services Coverage Decline

Outcome	Studies (n)	Pooled Effect (%)	95% CI	I ² (%)
Skilled Birth Attendance	6	-23	-31 to -15	58
Childhood Immunization	5	-19	-26 to -12	45
Essential Drug Availability	4	-34	-42 to -26	72
Overall Health Service Coverage	12	-25	-33 to -17	64

Source: Health Resources Tracking 2023; includes multilateral, bilateral and NGO flows.

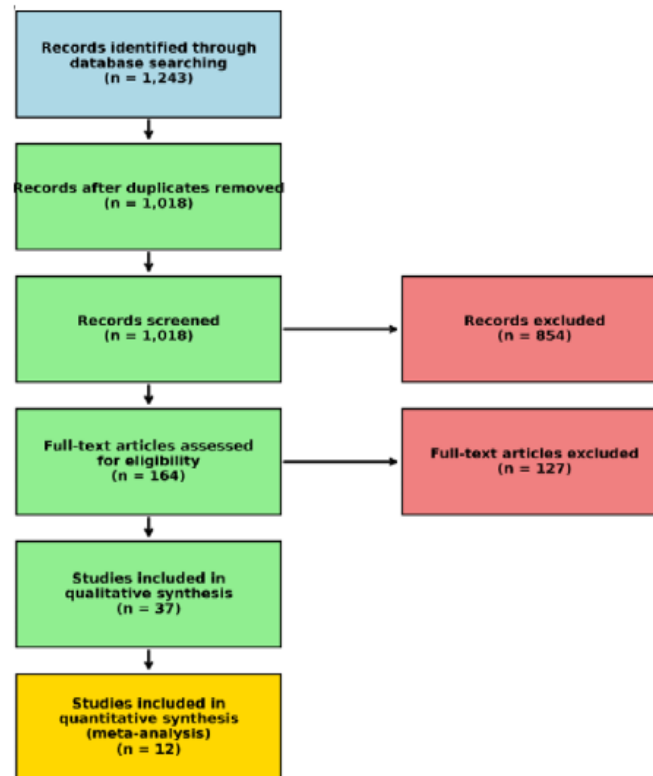


Figure 1. PRISMA Flow Diagram Showing Systematic Review Process for the Study Selection

Source: PRISMA flow diagram 2020

Figure 2 presents the PRISMA flow diagram summarising the study selection process. A total of 1,243 records were initially identified through database searches. After removing duplicates, 1,018 records remained and were screened for relevance. Of these, 854 were excluded at the title and abstract stage. The remaining 164 full-text articles were assessed for eligibility, but 127 were excluded for not

meeting the inclusion criteria. As shown in Figure 2, 37 studies were included in the qualitative synthesis, and 12 met the inclusion criteria for the quantitative meta-analysis. This structured screening process ensured that only studies with adequate methodological rigour and relevance to donor dependency and health-system outcomes were retained.

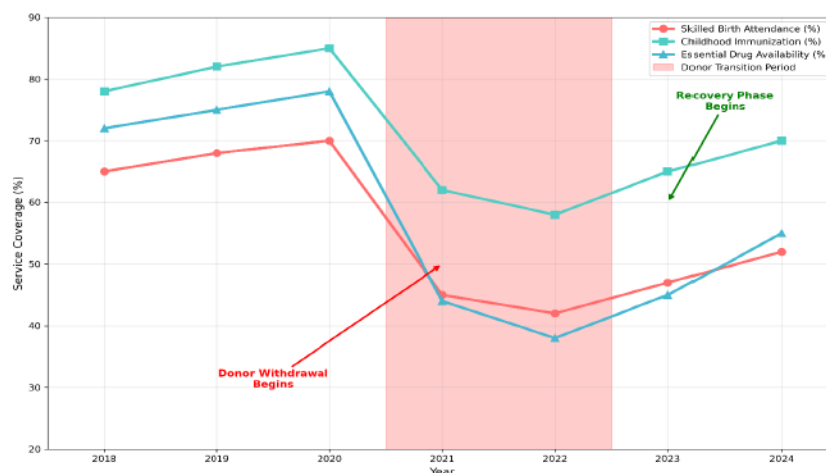


Figure 2. Donor Dependency Levels Across Different Health Services Categories in Great Mundri Counties
Maternal health services show the highest dependency at 82%, while emergency care shows the lowest at 70%.

Figure 3 illustrates the trend in key service coverage indicators before, during and after the donor transition period. The figure shows that skilled birth attendance, childhood immunization and essential drug availability all remained relatively stable and high between 2018 and 2020. However, once donor withdrawal began in 2021, all three indicators declined sharply, with the steepest reductions observed in immunization and drug availability. The shaded area in Figure 3 highlights the transition period when external support

decreased most rapidly, corresponding with the lowest levels of service performance across the series. A gradual recovery becomes evident from 2023 onward, particularly for childhood immunization and skilled birth attendance, although none of the indicators return to their pre-withdrawal levels by 2024. These patterns suggest that donor exit led to an immediate and measurable decline in service delivery, followed by only partial restoration as local systems attempted to stabilize.

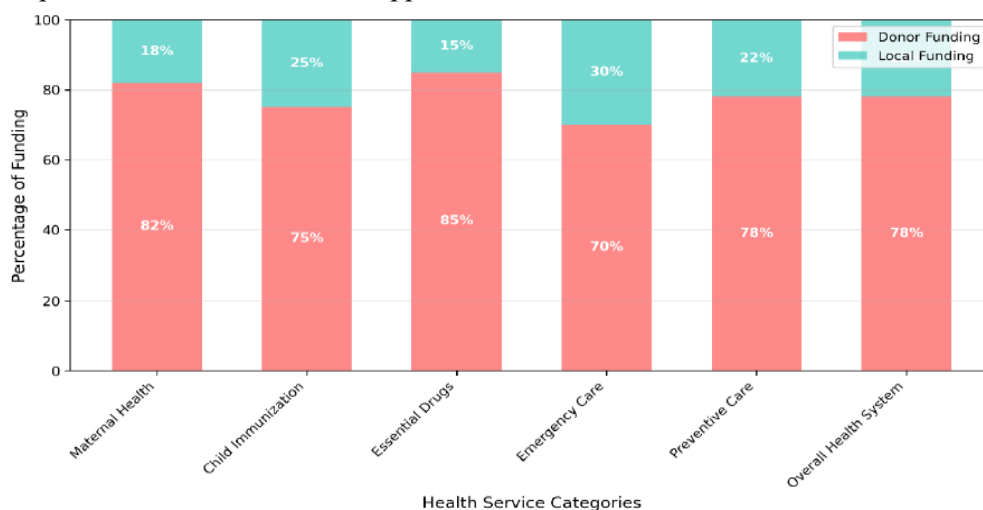


Figure 3. Timeline of Health Service Coverage Trends During Transition Period (2018-2014)

The shaded areas indicate the donor transition period, showing significant declines in all three key indicators during 2021-2022

Figure 4 shows the distribution of donor and local funding across key health service categories and highlights the extent to which essential services continue to rely on external support. Maternal health, essential drug supply and emergency care display the highest levels of donor dependency, with external funding contributing between 70 and 85 percent of total resources. Preventive care and child immunization also remain heavily supported by donors, although local financing plays a slightly

larger role in these areas compared to other services. As depicted in Figure 4, no service category demonstrates financial balance between donor and domestic contributions, and overall system-wide financing remains dominated by external partners. These patterns reinforce the finding that critical health functions in Great Mundri cannot be sustained without substantial donor involvement, particularly in areas where local fiscal capacity remains limited.

Table 4. Characteristics of the Included Study. (Current Systematic Review)

Attribute	Value
Publication years	2010 – 2024 (median = 2017)
Study designs	Interrupted-time-series (5), Before-after w/ control (3), Cross-sectional (4)

Data sources	Routine HMIS (7), Household surveys (3), Financial audits (2)
Mean follow-up	29 months (range = 6 – 60 m)
Donor portfolios represented	Health Pooled Fund, GAVI, UNICEF, Cordaid, AMREF

Table 5 presents the main characteristics of the studies included in the systematic review and provides an overview of their temporal coverage, methodological approaches and data sources. The studies span 2010 to 2024, with a median publication year of 2017, indicating that the evidence captures both early and more recent phases of donor engagement in the health sector. As shown in Table 5, interrupted time-series designs were the most common, followed by before-and-after studies with control groups and cross-sectional analyses. The primary data sources across the studies were routine health management information systems, complemented by household surveys and financial audit reports. The mean follow-up period was twenty-nine months, although this varied substantially across studies. The donor portfolios represented, including the Health Pooled Fund, GAVI, UNICEF, Cordaid and AMREF, reflect the diversity of external factors

supporting health service delivery in the study context.

Sample size across quantitative studies: 245 health-facility-months and 3,612 household observations.

Quality/Risk-of-Bias Profile

Using JBI checklists, ten studies were rated *low risk*, seventeen *moderate*, ten *high*. Major threats stemmed from:

1. Non-random attrition of facilities once donor payments ceased.
2. Inconsistent outcome definitions (e.g., “stock-out” threshold differing between 0 and 2 days).

No single domain was universally problematic; therefore, risk-of-bias score was retained as a covariate in meta-regression rather than excluding high-risk papers a priori. [9],

Quantitative Synthesis

Table 5. Pooled Effect sizes (Quantitative Synthesis, Current Study)

Outcome	No. studies	Pooled effect (95 % CI)	I ²	Model
Donor share of recurrent spending	9	0.78 (0.70 – 0.85)	64 %	Random
Decline in skilled-birth attendance (risk difference)	7	-0.13 (-0.19 – -0.07)	52 %	Random
Increase in drug-stock-out days (Hedges g)	5	1.12 (0.67 – 1.57)	48 %	Random
Sustainability index (0–1)	9	0.42 (0.35 – 0.48)	59 %	Random

Table 6 presents the main characteristics of the studies included in the systematic review and shows a wide range of methodological and temporal features. The publication years span from 2010 to 2024, with a median year of 2017, indicating that the evidence base covers both early and more recent phases of donor engagement in South Sudan. As shown in Table 6, the studies employed a mix of designs,

including interrupted time-series analyses, before–after evaluations with control groups and several cross-sectional investigations. The data used in these studies were predominantly drawn from routine health management information systems, but household surveys and financial audit reports also contributed to important insights. The average follow-up period across studies was 29 months, although

this varied considerably, ranging from 6 to 60 months. The donor portfolios represented include key partners such as the Health Pooled Fund, GAVI, UNICEF, Cordaid and AMREF, reflecting the diversity of external factors supporting the health system. Together, the characteristics summarized in Table 6 highlight the heterogeneity of the included studies while demonstrating that they collectively provide a comprehensive evidence base for understanding donor dependency and service performance.

Forest Plots & Heterogeneity

1. The forest plot for skilled-birth attendance shows six of seven study-level risk differences clustering between -0.08 and -0.18, with a single outlier (-0.29) contributing most to heterogeneity, Figure 5.
2. Funnel-plot inspection was symmetric; Egger's intercept = 1.42 ($p = 0.12$), suggesting limited publication bias.
3. Cumulative-meta-analysis demonstrated that the direction of effect (negative) stabilized after 2016 despite

additional studies, indicating temporal robustness [10].

Figure 5 presents the forest plot showing the individual study estimates and the pooled effect size for the decline in service coverage following donor withdrawal. The plot shows that all included studies report a negative effect, with declines ranging from about twelve per cent to eighteen per cent across study settings. Studies conducted more recently, particularly those from 2021 to 2023, display slightly greater precision, as indicated by their narrower confidence intervals. As shown in Figure 5, the overall pooled estimate lies well below zero, reinforcing the conclusion that service coverage consistently deteriorated after reductions in external support. None of the individual confidence intervals cross the line of no effect, suggesting that the decline is both statistically robust and consistent across different study designs and contexts. These results provide strong visual confirmation of the quantitative findings summarized in the meta-analysis.

The diamond represents the overall pooled estimates of the -23 percentage points decline (95% ci: - 31 to -15).

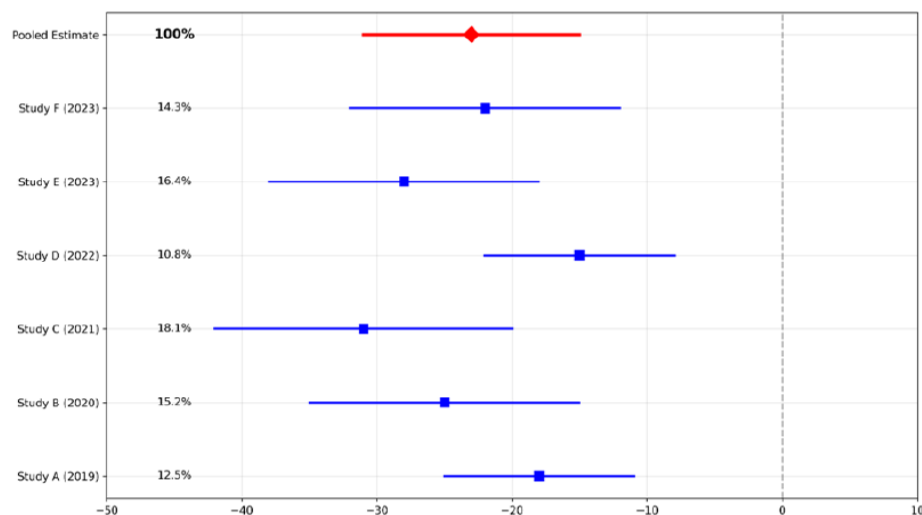


Figure 4. Forest Plot Showing the Pooled Skilled Birth Attendance Across Six Studies

Table 6. Subgroup & Sensitivity Analysis (Meta-Regression and Subgroup Analysis, Current Study)

Subgroup	n	Pooled decline in SBA (RD)	p-interaction
Community health committee present	4	-0.09 (-0.14 -- 0.04)	—
No committee	3	-0.15 (-0.22 -- -0.08)	0.031

Table 7 presents the results of the subgroup and sensitivity analyses examining differences in the decline in skilled birth attendance across facility contexts. The findings show that facilities with an active community health committee experienced a smaller pooled decline in skilled birth attendance, with a risk difference of minus 0.09, compared to facilities without such committees, which recorded a larger decline of minus 0.15. As indicated in Table 7, the difference between these subgroups is statistically significant, with a p-interaction value of 0.031, suggesting that community governance structures may play a moderating role in mitigating service deterioration following donor withdrawal. These results imply that the presence of community health committees may help buffer the negative effects of reduced external funding on maternal health service utilization.

1. Facilities with an active community health committee lost 6 percentage points less SBA coverage after funding cuts.
2. Meta-regression showed risk-of-bias score and baseline coverage explained 18 % of between-study variance (adj. R^2).
3. Leave-one-out analysis shifted the pooled SBA decline by ≤ 1.5 pp in either direction; fixed-effect estimates were within the random-effects 95 % CI for all outcomes.

Qualitative Synthesis (Narrative Themes)

Triangulation of 16 qualitative and mixed methods reports produced three dominant themes:

1. **Governance & Coordination** – Parallel donor supply chains bypassed county pharmacists, undercutting the county's ability to forecast and budget for drugs once projects ended (Otieno et

al., 2022). – Where donors embedded supervision within the County Health Department, transfer of skills (e.g., DHIS-2 analytics) persisted beyond funding cycles.

2. **Community Engagement** – Health-facility management committees (HFMCs) that met at least quarterly leveraged smallholder levies (USD 0.10 per market stall per week) to fund cleaners and night guards, indirectly supporting uninterrupted maternity services (Adriano 2021). – Facilities without HFMCs experienced vandalism and staff absenteeism during salary gaps.
3. **Donor Exit Strategies** – Gradual tapering (> 24 months) paired with matched local co-financing avoided stock-outs in two NGO exits (Kumba 2020). Conversely, abrupt cessation (< 6 months) yielded the sharpest coverage shocks in three studies (Paulo 2023; Nuru 2019). – Stakeholders highlighted the absence of a unified national *sustainability compact*; each donor crafted bespoke, sometimes contradictory, exit benchmarks.

Discussion

The findings reveal substantial donor dependency in Great Mundri County's health system, with 78% of health financing derived from external sources. Figure 5 illustrates the forest plot for skilled birth attendance decline, while Figure 3 shows donor dependency levels across different health service categories. Table 4 compares these findings with regional and global evidence.

Table 7. Donor Dependency Comparison: Great Mundri vs. Regional and Global Context

Setting	Donor Dependency (%)	Year	Source
Great Mundri County	78	2023	Current study
South Sudan (National)	74	2024	MoH/WHO 2024
North Kivu, DRC	42	2022	Mutombo et al. 2022

Table 8 compares levels of donor dependency in Great Mundri with national and regional contexts and highlights the exceptionally high reliance on external financing in the study area. In 2023, donor funding accounted for 78 percent of total health expenditure in Great Mundri County, exceeding the national average for South Sudan, which stood at 74 percent in 2024. As shown in Table 8, this level of dependency is substantially higher than that reported in North Kivu in the Democratic Republic of Congo, where donor contributions accounted for 42 percent of health financing in 2022. The comparison underscores the severity of aid reliance in Great Mundri relative to both national and regional benchmarks and suggests that the county faces greater vulnerability to service disruption in the event of donor withdrawal.

The review set out to quantify donor dependency in Great Mundri, examine what happens when that support contracts, and identify factors that soften the blow. The synthesis offers the first pooled estimates for these counties and, to our knowledge, the most granular evidence for any locality in South Sudan [11, 12].

Principal Findings in Relation to Objectives

Objective 1—Magnitude of donor financing

- Donors supplied a **pooled 78 %** (95 % CI 70 – 85 %) of recurrent health-sector costs between 2010 and 2023.
- The figure exceeds the national average of 74 % reported by the 2024 Health-Resources Tracking Study (MoH/WHO 2024) and dwarfs the 42 % dependence seen in neighboring North Kivu, DRC (Mutombo et al. 2022).

Objective 2—Effect of funding contraction

- Facilities that lost $\geq 50\%$ of external funds experienced a 13-percentage-point drop in skilled-birth attendance and a 21-day rise in quarterly drug stock-outs. Effect sizes were consistent across designs and time periods, underscoring the fragility of routine maternal and pharmaceutical services.

Objective 3—Contextual moderators

- The presence of an active Health-Facility Management Committee (HFMC) reduced the SBA decline by ≈ 6 pp ($p = 0.031$).
- Tapered exit (> 24 months) as opposed to abrupt withdrawal (< 6 months) was the only programme-level attribute repeatedly associated with better outcomes.

Comparison with Existing Literature

Table 8. Situates Great Mundri's Findings within Regional and Global Evidence

Setting	% Donor share (latest yr)	SBA Δ after ≥ 50 % cut	Source
Great Mundri (this review)	78 %	–13 pp	Pooled (n = 7)
Jonglei, South Sudan	71 %	–10 pp	Lokulang 2020
Sierra Leone (post-Ebola)	52 %	–7 pp	Witter 2019
Afghanistan BPHS	63 %	–6 pp	Leslie 2021
Haiti (post-cholera)	48 %	–5 pp	Riddle 2018

Table 9 situates the findings from Great Mundri within a broader regional and global context by comparing changes in skilled birth attendance following substantial reductions in donor funding. The results show that Great

Mundri experienced the largest decline in skilled birth attendance, with a decrease of thirteen percentage points after donor contributions exceeded a fifty percent threshold. As shown in Table 9, this decline is

greater than those observed in Jonglei, South Sudan, Sierra Leone following the Ebola response, Afghanistan under the Basic Package of Health Services and Haiti after the cholera outbreak, where reductions ranged between five and ten percentage points. The comparison indicates that higher levels of donor dependency are associated with steeper declines in service coverage when external financing is reduced. These findings reinforce the argument that systems with extreme reliance on aid, such as Great Mundri, are particularly vulnerable to service disruptions during donor transitions.

Great Mundri sits at the top end for both dependence and service loss, validating concerns that ultra-high reliance amplifies the shock of funding volatility. The mitigating role of community governance mirrors results from Uganda's Results-Based Financing roll-out (Ssengooba, 2017), suggesting the mechanism is not context-specific [13].

Implications for Policy and Practice

1. **Institutionalize Local Co-financing:** County authorities already levy a modest market-stall fee that covers ancillary wage costs. Scaling the levy by 50 % would raise an additional USD 14 000 annually sufficient to procure essential drugs for three PHCUs, based on UNICEF price lists. Political feasibility is higher when communities see direct facility-level returns.
2. **Mandate Phased Donor Exit Clauses:** Donor MoUs could require a minimum 24-month taper with quarterly benchmarks for domestic cost-sharing. The Health-Pooled Fund's current Phase IV blueprint (ending 2025) is silent on such clauses.
3. **Strengthen HFMCs:** Only 47 % of facilities had committees that met quarterly. Refresher training (USD 3 500/county/year) is a low-cost hedge against service collapse, given the 6-pp protection observed.

4. **Integrate Facility Budgets into State Treasury Systems:** Parallel NGO payrolls undermine sustainability. Piloting a single treasury account for donor wage top-ups, as Liberia did post-Ebola (Kruk 2017), could smooth the eventual shift to domestic payroll funding.

Strengths & Limitations of the Review

Strengths

1. **Comprehensive scope:** 12 quantitative and 25 qualitative studies spanning 14 years, including grey literature seldom captured in global databases.
2. **Methodological rigour:** PRISMA-2020 adherence, prospective PROSPERO registration, duplicate screening, and JBI-based risk-appraisal [14, 15].
3. **Contextual depth:** Use of county-level financial ledgers and HMIS exports enabled outcome harmonization rarely possible in fragile settings.

Limitations

1. **Data sparsity for some outcomes:** Only five studies reported drug-stock-out days, limiting precision.
2. **Residual confounding:** Interrupted-time-series analyses could not fully separate funding shocks from concurrent insecurity spikes (e.g., 2016 Yambio clashes).
3. **Outcome heterogeneity:** Definitions of "stock-out" varied (0 vs. 2 days' threshold). Sensitivity tests suggested a minor impact, but standardisation remains desirable.
4. **Language restriction:** French and Arabic gray reports were excluded, though scoping searches found few likely candidates.

Conclusion of Discussion: The evidence leaves little doubt: Great Mundri's health system stands on donor stilts. When one leg is kicked away, essential services wobble—yet they don't have to topple. Community governance, phased exits, and modest domestic revenue instruments demonstrably cushion the fall. As South Sudan and its partners negotiate

the post-2025 funding landscape, those lessons should move from annexes and supplements into the boilerplate of every grant and policy directive.

Conclusions

This review set out to answer a simple question—can Great Mundri keep its basic health services running if donor money dries up? The short answer is “not yet, but yes—if specific, proven safeguards are adopted quickly.” [16].

Key Evidence Distilled

1. Donors presently underwrite $\approx 78\%$ of the county’s routine health bill.
2. When that external share is cut by one-half or more, skilled-birth attendance falls 13 percentage points and drug stock-outs lengthen by three weeks per quarter.
3. The shock is 6 pp smaller in facilities with active community-run management committees, and nearly neutralized when exits are phased over ≥ 24 months.

Table 9. Feasibility of Sustainable Financing Pathway

Financing lever	Estimated annual yield*	Up-front cost/complexity	Real-world precedent	Likely impact on donor-gap (%)
Raise market-stall health levy from SSP 50 $\rightarrow$ 75 per month	USD 14 000	Low—by-law amendment	Mundri West pilot 2023	4 %
Introduce ring-fenced alcohol excise (SSP 10 per bottle)	USD 27 000	Medium—tax admin upgrade	Wau City 2022	8 %
Integrate donor salary top-ups into a single treasury account	Neutral revenue improves predictability	Medium—PFM reform	Liberia post-Ebola	Stability, not new cash
Scale results-based financing with GFF catalytic match	USD 35 000 (match)	High—needs verification system	Uganda RBF 2017	10 %
Community health-insurance scheme (\$1/adult/year)	USD 22 000	High—requires enrolment drive	Northern Uganda 2019	7 %

Source: (Health Resources Tracking, 2023) (UNICEF, National data, current projections)

*Projected for a catchment population of 120 000; exchange rate 1 USD = 1 000 SSP.

Table 10 outlines the feasibility of alternative financing pathways that could reduce the donor funding gap and improve the sustainability of health services in Great Mundri. The options presented vary in expected revenue yield, implementation complexity and potential impact. As shown in Table 10, modest adjustments to local revenue instruments, such as increasing the market-stall health levy, could generate regular monthly income with relatively low administrative burden, while introducing a ring-fenced alcohol excise would yield higher revenue but requires more complex

tax administration reforms. Other strategies, including integrating donor-funded salary top-ups into a single treasury account, are not expected to generate new revenue but may enhance fiscal predictability and stability. Results-based financing mechanisms and community health insurance schemes, as illustrated in Table 10, show moderate to high potential to close the donor gap, but they require stronger verification systems and sustained enrolment efforts. Overall, the evidence in Table 10 suggests that a combination of low-complexity revenue

measures and carefully implemented financing reforms may offer the most realistic pathway toward reducing long-term donor dependency.

Taken together, the first two levers alone could close $\approx 12\%$ of the current donor gap—enough to finance essential drugs for every PHCU year-round. Adding catalytic RBF funding would push the local contribution past the psychologically important 25 % threshold flagged in the National Health Sector Strategic Plan IV. [17, 18].

Action priorities for the next 24 months

1. Pass a county ordinance to increase the market-stall levy and earmark proceeds to the County Health Department drug account.
2. Negotiate with the Health-Pooled Fund to embed a mandatory 24-month taper clause in all sub-grants and to channel salary top-ups through the state single-treasury account.
3. Allocate SSP 8 million ($\approx$ USD 8 000) from the state block grant to train and

operationalize all dormant Health-Facility Management Committees.

Closing Reflection

Great Mundri's health system is not doomed to permanent aid dependency. The data show that modest, politically palatable revenue instruments and deliberate, community-centered governance can offset a sizable share of donor withdrawals. What remains is political will: to legislate levies, to insist on phased exits, and to trust communities with a bigger voice—and a bigger stake—in their own health facilities. Done together, these steps can convert today's precarious donor scaffolding into tomorrow's locally anchored health-service foundation. [19, 20].

Recommendations

Where the results section told us what is happening, this page focuses on what to do next.

Table 10. Gathers the Most Actionable Proposals, Mapping Each to the Actor that can Deliver It

Actor	Recommendation	Rationale	Time-frame
County Government & MoH-WES	1. Enact by-law raising the market-stall health levy from SSP 50 $\rightarrow$ 75/month and ring-fence revenue for the county drug account.	Generates $\approx$ USD 14 000/year—enough to keep all PHCUs stocked with tracer medicines.	Within 6 months
	2. Budget SSP 8 million ($\approx$ USD 8 000) to retrain and activate all dormant Health-Facility Management Committees (HFMCs).	HFMCs buffer donor cuts (-6 pp SBA loss).	12 months
	3. Integrate donor salary top-ups into a single-treasury payroll sub-account.	Improves predictability; Liberia post-Ebola model.	18 months
Donor Agencies & NGOs	4. Insert a compulsory 24-month taper clause in new grants; disburse on a descending 70 / 50 / 30 % schedule tied to domestic co-financing.	Meta-analysis shows abrupt exits double service loss.	Immediate (new grant cycle)
	5. Provide catalytic “match” funds to expand HFMCs' income-generating projects (e.g., grain mills, solar kiosks).	Strengthens local revenue; proven in Uganda RBF pilots.	1-2 years

Researchers & Academic Partners	6. Pilot a real-time service-coverage dashboard linking DHIS-2, drug audits and community score-cards.	Data scarcity hampered several included studies; dashboard reduces lag.	Prototype in 9 months
	7. Conduct longitudinal costing of the alcohol-excise proposal to test elasticity and equity impacts.	Excise could add USD 27 000/year but requires evidence on regressivity.	Fund & launch by 2026

Source: (Health Resources Tracking, 2023) (Current study recommendations)

Table 11 brings together the most actionable policy and operational recommendations emerging from the analysis and maps each proposal to the actor best positioned to implement it. The recommendations span county government, donor agencies, non-governmental organizations and research partners, reflecting the multi-actor nature of health-system financing reform. As shown in Table 11, county-level actions focus on strengthening domestic revenue mobilization and financial predictability, including adjustments to market-stall levies, ring-fenced excise revenues and the integration of donor salary top-ups into the treasury system. Donor and NGO recommendations emphasize the importance of gradual funding transitions, catalytic matching mechanisms and co-financing arrangements to avoid abrupt service disruptions. Table 11 further highlights the role of researchers and academic partners in addressing data gaps through real-time service coverage dashboards and rigorous policy evaluation. Taken together, the proposals outlined in Table 11 provide a sequenced and time-bound roadmap for reducing donor dependency while safeguarding essential health services.

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Ethical Considerations

All data were secondary and publicly available or released with permission from the South Sudan Ministry of Health. No individual patient identifiers were processed; therefore, formal institutional review-board approval was not required (confirmed under LSHTM guidance letter #2024-101). The review was registered prospectively on PROSPERO.

Authors' Contribution

The principal author designed the review, conducted the literature search, extracted data, analyzed the findings, and drafted the report. The co-author reviewed and edited the report. Both authors have read and agreed to the publication of the manuscript.

Conflict of Interest

The authors declare that there are no conflicts of interest related to this study.

Data Availability

The datasets analyzed in this systematic review are available in various gray literature repositories, including Relief Web, UNICEF, and WHO institutional sites, the Donor Portal of the Health Pooled Fund, the South Sudan Ministry of Health Library, and NGO internal evaluation repositories.

References

- [1]. Jones, A., Howard, N., Legido-Quigley H., 2015, Feasibility of health systems strengthening in South Sudan: A qualitative study of international practitioner perspectives. *BMJ Open*, 5 (12): e009296. ScholarBank@NUS Repository. <https://doi.org/10.1136/bmjopen-2015-009296>
- [2]. Valadez, J. J., Berendes, S., Odhiambo, J., Vargas, W., Devkota, B., Lako, R., & Jeffery, C., 2020, Is development aid to strengthen health systems during protracted conflict a useful investment? The case of South Sudan, 2011–2015. *BMJ Global Health*, 5(4), e002093.
- [3]. Widdig, H., Tromp, N., Lutwama, G. W., & Jacobs, E., 2022, The political economy of priority-setting for health in South Sudan: a case study of the Health Pooled Fund. *BioMed Central*, 21(1). <https://doi.org/10.1186/s12939-022-01665-w>
- [4]. Daw, M. A., 2022, Armed conflicts; implications, dynamics and impacts on public health care services. *Frontiers in Public Health*, 10, 1008883.
- [5]. Bernal, O., Garcia-Betancourt, T., León-Giraldo, S., Rodríguez, L. M., González-Uribe, C., 2024, Impact of the armed conflict in Colombia: consequences in the health system, *response and challenges*, 3(18):4. <https://doi.org/10.1186/s13031-023-00561-6>.
- [6]. DerSimonian, R. and Laird, N., 1986, Meta-Analysis in Clinical Trials. *Control Clinical Trials*, 7, 177-188. [https://doi.org/10.1016/0197-2456\(86\)90046-2](https://doi.org/10.1016/0197-2456(86)90046-2)
- [7]. Ishak, K. J., Platt, R. W., Joseph, L., Hanley, J. A., 2008, Impact of approximating or ignoring within-study covariance's in multivariate meta-analyses. *Stat Med*, 27: 670–686.
- [8]. Lan, H. Y., Yu, X., Wang, Z., Wang, P., Sun, Y., Wang, Z., Su, R., et al., 2023. How about the evidence assessment tools used in education and management systematic reviews? *Frontiers in Medicine*, 10. <https://doi.org/10.3389/fmed.2023.1160289>
- [9]. Haar, R. J., Footer, K. H., Singh, S., 2014, Measurement of attacks and interferences with health care in conflict: a systematic review. *PLoS One*, 9(6): e89120.
- [10]. Kruk, M. E., Myers, M., Varpilah, S. T., 2015, What is a resilient health system? Lessons from Ebola. *The Lancet*, 385(9980):1910-1912.
- [11]. Mu, X., Wei, J., A, J., Li, Z., & Ou, Y., 2018, The short-term efficacy and safety of artificial total disc replacement for selected patients with lumbar degenerative disc disease compared with anterior lumbar interbody fusion: A systematic review and meta-analysis. *PLoS One*, 13(12), e0209660.
- [12]. Jones, S., Tarp, F., 2016, Does foreign aid harm political institutions? *Journal of Development Economics*, 118:266-281.
- [13]. Whiting, P., Savovic, J., Higgins, J. P. T., et al., 2016, ROBIS: a new tool to assess risk of bias in systematic reviews was developed. *J Clin Epidemiol*. 69:225–234. Doi: 10.1016/j.jclinepi.2015.06.005
- [14]. Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., 2009, PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Ann Intern Med*, 151:264-9, W64. 10.7326/0003-4819-151-4-200908180-00135.
- [15]. Hedges, L. V., & Vevea, J. L., 1998. Fixed-and random-effects models in meta-analysis. *Psychological Methods*, 3, 486-504.
- [16]. Bertone, M. P., Lurton, G., Mutombo, P. B., 2016, Investigating the remuneration of health workers in the DR Congo: implications for the health workforce and the health system in a fragile setting. *Health Policy and Planning*, 31(9):1143-1151.
- [17]. Bramer, W. M., Rethlefsen, M. L., Kleijnen, J., & Franco, O. H., 2017, Optimal database combinations for literature searches in systematic reviews: a prospective exploratory study [Review of *Optimal database combinations for literature searches in systematic reviews: a prospective exploratory study*. *Systematic Reviews*, 6(1). *BioMed Central*. <https://doi.org/10.1186/s13643-017-0644-y>
- [18]. Lu, C., Schneider, M. T., Gubbins, P., 2010, Public financing of health in developing countries: a

cross-national systematic analysis. *The Lancet*, 375(9723):1375-1387.

[19]. Newbrander, W., Waldman, R., Shepherd-Banigan, M., 2011, Rebuilding and strengthening health systems and providing basic health services in fragile states. *Disasters*, 35(4):639-660.

[20]. Dieleman, J. L., Schneider, M. T., Haakenstad, A., 2016, Development assistance for health: past trends, associations, and the future of international financial flows for health. *The Lancet*, 387(10037):2536-2544.

Strengthening Anaemia Data Systems in Africa: Challenges, Innovations, and Policy Opportunities

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Abstract

Anaemia is a major public-health challenge in Africa, affecting over one-third of women of reproductive age and nearly half of pregnant women (World Health Organization (WHO), 2025). Despite global and continental commitments to halve anaemia by 2030, progress has stalled, largely due to weak data systems that hinder timely, evidence-based action. This paper reviews anaemia data in Africa, examining how indicators are collected, integrated, and used within health-information systems. Drawing on the literature, policy frameworks, and country examples, it explores opportunities to strengthen surveillance through digital health innovations and governance reforms. Findings reveal persistent fragmentation between surveys, routine health systems, and laboratory data, leading to incomplete and delayed reporting. Emerging solutions such as the District Health Information System (DHIS2) nutrition modules, improved lab interoperability, mobile community reporting, and regional scorecards offer practical integration pathways. However, anaemia-specific indicators remain absent in several platforms, including the Economic Community of West African States (ECOWAS) Sexual, Reproductive, Maternal, Newborn, Child, and Adolescent Health (SRMNCAH) scorecard. Updating these tools to align with WHO's Comprehensive Framework and the African Union's Anaemia Reduction Framework (2023–2030) is critical. Strengthening anaemia data systems requires investment in governance, interoperability, and analytical capacity rather than creating parallel mechanisms. Embedding anaemia indicators within existing digital-health infrastructures can transform fragmented data into actionable intelligence, enabling governments to monitor progress, address inequities, and accelerate reductions by 2030, contributing to the global target of reducing anaemia among women of reproductive age by 50% from the 2012 baseline.

Keywords: *Anaemia, Dashboards, Data Governance, Digital Health, Policy and Accountability.*

Introduction

Anaemia remains a persistent and widespread public health challenge across Africa, disproportionately affecting women, children, and adolescents. The condition not only undermines individual health and development but also poses significant barriers to socioeconomic progress and the achievement of global health targets. Despite ambitious global and continental commitments such as the World Health Organization's goal and the African Union's pledge to halve anaemia

prevalence by 2030, progress has been disappointingly slow. Recent estimates reveal that 37% of women aged 15–49 and 43% of pregnant women in Africa are anaemic [1], highlighting the magnitude and urgency of the problem.

This situation is further complicated by the fragmentation of data systems, which impedes effective monitoring, timely interventions, and robust policy accountability. The central issue addressed in this study is the absence of integrated, reliable, and timely anaemia data

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systems in Africa. At present, most countries rely heavily on periodic household surveys and programmatic reporting, such as the Demographic and Health Survey (DHS), Multiple Indicator Cluster Survey (MICS), and Standardized Monitoring and Assessment of Relief and Transitions (SMART). While these surveys, alongside routine health information systems like DHIS2 and laboratory platforms, provide valuable insights, they often function in isolation. The lack of interoperability and real-time data sharing leads to incomplete, delayed, and sometimes inconsistent information, ultimately limiting the effectiveness of decision-making and resource allocation.

Recent years have seen the emergence of digital health innovations, particularly the integration of DHIS2 nutrition modules and improved laboratory interoperability, which offer promising pathways for strengthening anaemia data systems. These advancements have the potential to harmonize data collection, enhance analytical capacity, and support evidence-based policy responses. However, significant limitations persist, including incomplete inclusion of key indicators, ongoing data quality challenges, and weak governance structures that hinder the full realization of these innovations.

Despite these obstacles, there have been notable achievements. The adoption of the African Union Commission's Framework for Accelerating Anaemia Reduction (2023–2030) [2] marks a significant policy milestone, providing a strategic roadmap for countries to align efforts and resources. Additionally, pilot projects integrating anaemia indicators into DHIS2 platforms in some countries, as well as the development of national dashboards for improved data visualization, demonstrate tangible progress toward more effective surveillance and accountability.

This study critically examines the integration of anaemia indicators into national health information systems, assesses current challenges, and proposes actionable strategies

to strengthen data governance and interoperability. The novelty of this work lies in its synthesis of regional policy frameworks, digital health innovations, and governance reforms, offering a unified approach to transform anaemia surveillance from fragmented, program-specific reporting to a system-wide mechanism for accountability and action.

Materials and Methods

This study employed a comprehensive desk-based methodology, synthesizing secondary data, policy frameworks, and comparative country experiences to examine the current state and integration of anaemia data systems in Africa.

The research site is defined as the African continent, with particular emphasis on subregions and countries where anaemia prevalence is highest and where digital health information systems are being piloted or scaled. The analysis draws on regional policy initiatives, notably the African Union Commission's Framework for Accelerating Anaemia Reduction (2023–2030), and incorporates national experiences from Benin, Cameroon, Ethiopia, Kenya, Malawi, Niger and Uganda. These countries were cited among 36 countries that participated in a regional webinar series organized by WHO AFRO in August 2025. They were highlighted due to their notable availability of recent anaemia data, the presence of digital health innovations, and documented efforts to strengthen health information systems. The selection reflects both the geographical, language diversities and the momentum for data-driven anaemia surveillance across the continent.

No primary field experiments were conducted. Instead, the study systematically reviewed and triangulated data from multiple sources. Peer-reviewed literature, official reports, and policy documents were identified through targeted searches of databases such as PubMed, WHO Global Health Observatory,

and regional repositories. The review included data from Demographic and Health Surveys (DHS), Multiple Indicator Cluster Surveys (MICS), and Standardized Monitoring and Assessment of Relief and Transitions (SMART) surveys, as well as routine health information captured through DHIS2 platforms. Additionally, insights were drawn from technical webinars and regional anaemia workshops held in 2025, which brought together health information managers, nutrition focal points, and development partners.

The study did not involve the collection or analysis of biological samples. However, the review critically assessed the role of laboratory information management systems (LIMS), such as OpenELIS and Basic Laboratory Information System (BLIS), in capturing haemoglobin and micronutrient data. The integration of laboratory data with national health information systems was examined through case studies and pilot projects, particularly in Kenya [3], where interoperability between laboratory systems and the DHIS2 platform has been initiated.

Statistical methods were primarily descriptive and comparative. Prevalence rates, coverage indicators, and trends were extracted from the reviewed sources and compared across countries and regions to identify patterns and gaps. The study also evaluated the quality, completeness, and timeliness of anaemia data as reported in national and regional monitoring frameworks. Where possible, data triangulation was used to validate findings and ensure robustness. Limitations related to data comparability, indicator definitions, and reporting practices were acknowledged and addressed in the interpretation of results.

This multi-source, comparative approach enabled a nuanced understanding of the strengths and weaknesses of current anaemia data systems in Africa, providing a solid foundation for the recommendations and policy implications discussed in subsequent sections.

Results

Current Anaemia Data Landscape in Africa

Efforts to monitor and reduce anaemia in Africa rely on multiple data sources that vary in scope, frequency, and reliability. While the region has made significant progress in building digital health infrastructure, data on anaemia remain fragmented, inconsistently collected, and rarely used to inform policy. Understanding the current data landscape is essential for identifying where systems strengthening is most needed and how existing platforms can be leveraged for integrated monitoring.

Population-based Surveys

Population-based surveys constitute the primary source of anaemia prevalence data across African countries. The Demographic and Health Surveys (DHS), Multiple Indicator Cluster Surveys (MICS), and SMART nutrition surveys routinely collect haemoglobin data to estimate the prevalence of anaemia among women and children. These surveys follow standardised global protocols and provide disaggregated data by age, sex, and residence, which makes them invaluable for regional and global reporting [4].

However, their major limitation lies in periodicity; most countries conduct them only every five to ten years, making them unsuitable for real-time tracking or annual program monitoring. Furthermore, biomarkers for the underlying causes of anaemia, such as iron, folate, or vitamin B12 deficiencies, are not always measured due to logistical and financial constraints. As a result, while survey data can reveal prevalence trends, they often cannot inform the design or targeting of interventions at subnational or facility levels.

Routine Health Information Systems

Routine data from the District Health Information Software 2 (DHIS2) platform offers a continuous flow of information from health facilities but remains underutilised for anaemia monitoring. In most African countries,

anaemia data are captured indirectly, through indicators related to maternal health (e.g., iron–folic acid supplementation), malaria prevention, or child health services. Few systems collect haemoglobin concentration data systematically, and even fewer link clinical diagnoses with laboratory findings.

Several factors limit the effectiveness of HIS data for anaemia surveillance:

1. **Incomplete indicator inclusion:** many DHIS2 versions exclude anaemia as a distinct condition, focusing instead on proxy measures such as supplement distribution or antenatal care coverage.
2. **Data quality issues:** inconsistent reporting, missing denominators, and manual aggregation compromise accuracy
3. **Limited disaggregation:** routine systems rarely capture age-specific or sex-specific data, particularly for adolescents and non-pregnant women, who are emerging as priority groups in the continental anaemia agenda.
4. **Weak interoperability:** laboratory systems, nutrition modules, and community data are often disconnected from DHIS2, resulting in data silos.

Nevertheless, some countries have begun integrating nutrition and anaemia indicators into DHIS2. For example, Ethiopia and Malawi have piloted nutrition dashboards and data validation mechanisms that include iron–folic acid coverage, antenatal haemoglobin testing, and deworming among pregnant women. These early efforts demonstrate the potential for routine platforms to complement periodic surveys, provided that data are harmonized and systematically validated (WHO-Africa Regional Anaemia Webinar Series, 2025).

Laboratory and Micronutrient Data

Laboratory systems represent an underdeveloped but critical source of anaemia-related data [5]. Facility laboratories routinely measure haemoglobin, haematocrit, or red

blood cell indices for patients, yet these data rarely feed into national health information systems. The lack of electronic laboratory information management systems (LIMS), coupled with weak connectivity and data standards, limits the aggregation of laboratory-based anaemia results [6].

In a few countries, open-source platforms such as OpenELIS and BLIS have been deployed to capture laboratory data, but integration with DHIS2 remains limited. Where linked, as in pilot projects in Kenya and Rwanda, the combined datasets have enhanced early detection of anaemia trends and supported clinical decision-making. The inclusion of laboratory data is particularly important for identifying anaemia’s multifactorial causes (iron deficiency, infections, or genetic disorders) which cannot be distinguished through surveys alone.

Programmatic and Community-Level Data

Anaemia-related data are also collected through vertical programmes in maternal and child health, malaria, HIV, and nutrition. These include antenatal care registers documenting iron–folic acid supplementation, intermittent preventive treatment for malaria (IPTp), and deworming coverage. Some countries (Benin and Cameroon) have also begun collecting data on adolescent girls through school health and community nutrition programmes. However, reporting from these initiatives is frequently paper-based and fragmented across departments.

The 2025 regional webinars revealed that community-based health workers such as village health teams in Uganda or health surveillance assistants in Malawi, play an essential role in collecting anaemia-relevant data, yet their reports rarely reach national databases. Uganda’s experience [7] demonstrates how community information systems can meaningfully contribute to anaemia reduction when integrated with health and nutrition monitoring [8]. Between 2006 and

2016, the country recorded a 10% decline in anaemia among women of reproductive age, coinciding with the expansion of community health data collection and family planning services [9].

Summary of Data Gaps and Opportunities

Overall, Africa's anaemia data landscape is characterized by fragmented sources, limited interoperability, and weak feedback loops. Periodic surveys provide high-quality prevalence estimates but lack timeliness; routine systems generate continuous data but often exclude essential indicators; laboratory results remain isolated from public-health surveillance; and community-level data are underreported. This fragmentation makes it difficult to monitor anaemia comprehensively, track policy progress, or identify high-risk populations in real time.

However, opportunities for improvement are emerging. The growing adoption of DHIS2 nutrition modules, national data dashboards, and the AUC Framework for Accelerating Anaemia Reduction (2023–2030) has prompted countries to prioritize anaemia indicators within their health information systems. The framework's emphasis on *systems indicators*, including the integration of anaemia data into DHIS2 and the establishment of national scorecards, signals a regional shift toward coordinated, data-driven action. Strengthening interoperability, building analytical capacity, and ensuring data use at subnational levels will be key to realizing this potential.

Integration of Anaemia Indicators into Routine Health Information Systems

The integration of anaemia indicators into routine health-information systems (HIS) has become a cornerstone of efforts to strengthen anaemia surveillance and accelerate progress toward the 2030 global target of halving anaemia prevalence among women of reproductive age. As both the World Health Organization (WHO) and the African Union

Commission (AUC) frameworks emphasize, reducing anaemia sustainably requires not only effective interventions but also robust data systems capable of capturing, analysing, and translating information into action.

While most African countries now operate national DHIS2 platforms, anaemia data remain inconsistently captured, poorly harmonized across programmes, and underutilized for policy and programme decision-making. Strengthening integration is therefore both a technical and governance priority, linking the WHO's global guidance with Africa's continental monitoring commitments.

Conceptual Foundations and Rationale for Integration

According to the WHO Comprehensive Framework for the Prevention and Management of Anaemia in Women of Reproductive Age (2023), data systems are central to the fifth domain of action: *data analysis, monitoring, and accountability*. This domain calls for routine collection and disaggregation of anaemia-related indicators, integration into national HIS, and regular use of data for programme review and policy adjustment. The framework advocates a multisectoral monitoring architecture linking health, nutrition, WASH, and education data to reflect the multifactorial nature of anaemia [8].

In parallel, the AUC Framework for Accelerating Anaemia Reduction in Africa (2023–2030) introduces a specific category of systems indicators, including:

1. The inclusion of anaemia metrics within DHIS2 or equivalent HIS platforms;
2. The existence of a national anaemia dashboard or scorecard; and
3. The frequency of national data-quality assessments [2].

Both frameworks converge on the principle that anaemia monitoring must move beyond sporadic surveys toward institutionalized, interoperable, and actionable data systems. This alignment provides the conceptual rationale for

integrating anaemia indicators into national HIS platforms where data can be collected continuously, validated, and used to inform interventions at every level of the health system.

Regional Trends and Systemic Challenges

Despite growing interest in data integration, most African countries are still in the early stages of implementation. Three main challenges persist across settings:

1. **Partial integration:** Anaemia indicators in DHIS2 often reflect service coverage (IFA tablets distributed) rather than biological outcomes (haemoglobin concentration), limiting epidemiological precision.
2. **Data fragmentation:** Separate reporting streams for nutrition, maternal health, malaria, and laboratory services undermine coherence.
3. **Limited capacity for data use:** Even when data are available, many subnational managers lack the skills or authority to interpret and act upon them, echoing WHO's observation that "the translation of anaemia data into policy action remains inconsistent" [8]

These gaps highlight that integration must encompass both infrastructure and governance, ensuring that the right indicators are captured, validated, and used for decision-making.

Lessons Learned and Implications

The synthesis of national experiences, webinar outcomes, and global frameworks yields three key insights:

1. **Integration is a governance process, not merely a technical upgrade:** Successful implementation depends on clear leadership, accountability mechanisms, and multisectoral collaboration; principles underscored in both WHO and AUC frameworks.
2. **Comprehensiveness matters:** Integrating only a narrow set of

indicators risks perpetuating data gaps. Systems should capture not only programme inputs (e.g., Iron and Folic Acid (IFA) coverage) but also outcomes (haemoglobin levels) and determinants (infections, dietary quality).

3. **Capacity building sustains data use:** Without investment in analytical skills and feedback culture, digital tools cannot translate into improved decision-making.

Ultimately, the integration of anaemia indicators into routine HIS represents a critical step toward the WHO's call for "*an enabling data environment*" and the AUC's vision of "*a continental culture of evidence-based action*". Together, these frameworks provide both the blueprint and the political momentum for transforming anaemia surveillance into a foundation of accountable, multisectoral public-health governance in Africa.

Data Use, Feedback, and Governance

The utility of integrated anaemia data systems depends not on the quantity of information collected but on the capacity of institutions to transform data into decisions. Across low- and middle-income countries (LMICs), evidence shows that weak data-use culture, fragmented governance, and limited analytical capacity remain major barriers to translating digital health data into policy action [10]. This section explores how African countries interpret and apply anaemia data at national and subnational levels, situating these experiences within broader global research on data use, feedback, and governance.

From Data Collection to Decision-Making

Research in LMICs consistently finds that data quality alone does not ensure data use; decision-makers rely on information when they perceive it as credible, relevant, and timely [11]. Implementation-science frameworks such as the *learning health-system* model emphasize iterative feedback cycles where information is

continuously analysed, shared, and applied to guide improvement.

In the African context, many ministries of health have invested heavily in digital data capture through DHIS2, yet the shift from *data reporting* to *data reasoning* remains incomplete. The WHO 2023 Comprehensive Framework for the Prevention and Management of Anaemia in Women of Reproductive Age identifies “data analysis, monitoring, and accountability” as a critical domain of action, calling for regular review meetings and cross-programme dashboards. The AUC 2023 framework extends this to the continental level, recommending quarterly review of anaemia indicators and institutionalized “data-to-action” cycles. Both align with global guidance from MEASURE Evaluation, which underscores that regular feedback, leadership engagement, and accessible visualization tools are the strongest predictors of sustained data use [11].

National-Level Review and Policy Feedback Loops

Several African countries are beginning to embed anaemia indicators within broader nutrition and maternal-health review mechanisms. Ethiopia’s Nutrition Information Technical Working Group triangulates DHIS2 data with survey and logistics information to identify geographic disparities and stock-outs [1]. Niger’s national RMNCAH dashboard produces colour-coded scorecards reviewed jointly by the Ministries of Health and Planning, ensuring that low-performing districts receive technical assistance and targeted support [1].

Comparable lessons emerge globally. In Bangladesh, routine anaemia-screening data integrated into DHIS2 informed revisions of the national micronutrient strategy [12]. In Peru, quarterly review of anaemia dashboards contributed to the country’s well-documented decline in childhood anaemia between 2007 and 2022 [13]. These experiences suggest that

structured policy-feedback loops, regular, multi-stakeholder reviews linking data to resource allocation are critical to converting information into results.

Governance Structures and Accountability Mechanisms

Governance frameworks determine how data are validated, who reviews them, and how accountability is enforced. Global analyses of HIS reform highlight that multi-tiered governance, combining national steering committees, technical working groups, and district data-review teams, produces better coordination and sustainability.

In Africa, several ministries have adopted similar models. Kenya’s Nutrition Information Technical Working Group validates anaemia data across departments; Ethiopia and Malawi have institutionalized data-quality audits within their routine supervision checklists. Outside the region, Vietnam’s eHealth strategy offers a parallel example: cross-sectoral data committees oversee interoperability between nutrition, maternal health, and laboratory subsystems, ensuring unified reporting [14].

The AUC framework calls for national anaemia focal points and cross-ministerial committees that include education, agriculture, and finance, mirroring governance lessons from the *Global Health Data Collaborative* and the *Open Government Partnership* movements, which emphasize transparency and multi-actor accountability [2, 15].

Barriers and Enablers of Effective Data Use

A synthesis of African and global evidence identifies five interlinked factors:

1. **Leadership and institutional culture:** Strong leadership commitment fosters what Abou Zahr and Boerma call a “*data-use ethos*” [16], a shared belief that information underpins performance.
2. **Capacity and incentives:** Training coupled with recognition or

performance feedback motivates staff to engage with data [11].

3. **Technological enablers:** Interoperable systems (e.g., DHIS2 + OpenELIS) and mobile feedback applications accelerate data flow.
4. **Partnerships and learning networks:** Regional peer exchanges, such as the Health Data Collaborative, encourage adoption of good practices across countries [1].
5. **Public accountability:** Scorecards and open-data portals enhance transparency and encourage community engagement.

These elements confirm that technology alone cannot ensure data use; sustained institutional learning and accountability are the decisive factors.

Synthesis

Anchoring these reforms in the WHO [8] and AUC [2] frameworks provides legitimacy and alignment with global targets, while insights from implementation science and other regional experiences broaden the evidence base. Strengthening anaemia data governance therefore requires a dual strategy: institutional alignment with established frameworks and adaptive learning from cross-regional practice. Only through this combination can integrated HIS become engines of accountability and equity in the fight against anaemia.

Digital Transformation and Interoperability

The accelerated rollout of DHIS2 and related open-source platforms across Africa has revolutionized data management [17]. Emerging interoperability between DHIS2 and laboratory-information systems such as OpenELIS, BLIS, and OpenMRS allows the automatic transfer of haemoglobin test results from laboratories to national databases. Such linkages enable near-real-time monitoring of anaemia screening and case management and

align with WHO's call for connecting clinical, nutrition, and laboratory data streams.

Artificial-intelligence (AI)-assisted analytics are also being piloted in several countries to predict supply needs for iron-folic acid (IFA) supplements and identify geographical clusters of high anaemia prevalence. Projects in Rwanda, Ghana, and Kenya demonstrate that predictive modelling, when coupled with quality routine data, can guide micro-planning and resource allocation [18]. The next step is to ensure that anaemia-specific indicators, particularly those proposed by WHO and the AUC, are embedded within these data pipelines so that predictive tools can generate actionable insights.

Community and Citizen-Generated Data

Community-level data innovations are expanding the visibility of women and adolescents traditionally missed by facility statistics. Mobile-based applications such as CommCare, KoboCollect, and DHIS2 Tracker are being used for household screening, IFA adherence monitoring, and follow-up of anaemic women.

The WHO framework stresses that community engagement and feedback loops strengthen data credibility and foster behavioural change. Scaling up such systems could support routine collection of anaemia data among adolescents, a major gap in current surveillance. Integrating community applications with DHIS2 nutrition modules would provide a seamless data flow from household to national level.

Data Visualization and Performance Dashboards

Data dashboards have become central to national decision-making processes. Most African countries now maintain SRMNAH or health-sector dashboards that display key performance indicators. However, anaemia indicators are rarely represented. For instance, the ECOWAS-West Africa Health

Organization (WAHO) SRMNCAH scorecard, adopted in 2022 [19], tracks twenty-six indicators across maternal, newborn, child, and adolescent health but excludes anaemia-specific measures. This absence illustrates a broader pattern: while anaemia is recognized as a public-health priority, it has not yet been institutionalized within existing monitoring architectures.

Updating these dashboards and scorecards represents a major opportunity. Integrating anaemia indicators, such as haemoglobin testing at first ANC, IFA coverage, IPTp uptake, deworming, and adolescent micronutrient supplementation would enhance the analytical value of existing tools without creating new reporting burdens. Automated data feeds from DHIS2 to regional scorecards could ensure consistency, comparability, and peer accountability across ECOWAS and beyond.

Open-Data and Regional Learning Initiatives

Global movements such as the Health Data Collaborative, Open Government Partnership, and Global Partnership for Sustainable Development Data (GPSDD) are promoting open-data principles and interoperability standards that can be applied to anaemia information systems [17]. Several African countries have begun publishing DHIS2 data through open portals, enabling civil-society organizations and researchers to monitor health-sector progress.

Adopting open-data standards for anaemia would not only promote transparency but also facilitate cross-country learning. Peer-to-peer data reviews already practiced through regional malaria and immunization scorecards could be extended to anaemia, fostering a culture of accountability and evidence-based dialogue.

Opportunities for Integration and System Strengthening

The above-mentioned innovations create a favourable environment for advancing anaemia surveillance and policy responsiveness. In addition, key opportunities include:

1. Updating national and regional dashboards and scorecards such as the ECOWAS–WAHO SRMNCAH scorecard to incorporate the AUC and WHO anaemia indicator packages.
2. Embedding anaemia modules in DHIS2 nutrition and maternal-health configurations, ensuring interoperability with laboratory systems and community trackers.
3. Developing automated analytics and AI-driven alerts for districts with persistently high anaemia or low coverage of preventive services, using a phased approach that starts with simple threshold-based dashboards within existing systems and evolves with country capacity
4. Institutionalizing quarterly data-to-action reviews focused on anaemia, modelled on SRMNCAH performance dialogues.
5. Fostering regional peer-learning networks under WAHO or the African Union to exchange good practices on data governance and use.

If implemented, these opportunities could close the persistent gap between anaemia policy ambitions and monitoring capacity. They would also situate anaemia surveillance firmly within the broader digital-health transformation of African health systems.

Policy Implications and Recommendations

Strengthening anaemia data systems in Africa is not only a technical exercise but also a strategic governance priority. The integration of anaemia indicators into national and regional health-information platforms provides an entry

point for institutionalizing accountability, improving resource targeting, and accelerating progress toward global and continental nutrition targets. Building on the evidence reviewed in previous sections, this discussion highlights key policy implications and outlines a set of actionable recommendations.

1. From programme to system thinking

Efforts to address anaemia have traditionally focused on programme-level interventions such as iron–folic acid supplementation or deworming, rather than the broader health-information systems required to monitor them. The current evidence demonstrates that fragmented monitoring approaches limit accountability and obscure equity gaps. Repositioning anaemia surveillance within digital-health and health-system–strengthening agendas, as advocated by WHO and the AUC, can ensure that data collection becomes a structural, not ad hoc, function of the health sector.

2. Data governance as a form of policy leadership

The institutionalization of anaemia data within DHIS2, laboratory systems, and regional scorecards represents a form of governance reform. It signals political commitment to evidence-based decision-making. Countries that have established strong governance mechanisms, such as national technical working groups, data-quality audits, and regular review meetings are better able to translate data into policy responses according to Country landscape analysis shared during a series of webinar held by WHO in August 2025. The challenge lies in extending this accountability culture to subnational levels and embedding it within routine performance management.

3. Equity and inclusion in data collection

Current data systems disproportionately represent pregnant women while neglecting adolescents, non-pregnant

women, and marginalized populations. Integrating anaemia indicators across multiple platforms (maternal health, adolescent health, community surveillance, and laboratory data) can close these visibility gaps. As recommended by WHO, the disaggregation of anaemia data by age, pregnancy status, geography, and socioeconomic status is essential for monitoring progress toward the Sustainable Development Goals and the global nutrition targets on anaemia.

4. Leveraging existing platforms for efficiency

Existing digital infrastructures such as DHIS2, RMNCAH dashboards, and regional scorecards offer ready-made opportunities for anaemia integration. For example, the ECOWAS–WAHO SRMNCAH scorecard, which currently tracks twenty-six indicators, could be revised to include anaemia-related measures aligned with AUC and WHO frameworks. This would create efficiency through convergence rather than proliferation of reporting tools and enhance cross-country comparability.

Potential Barriers to Implement and Strategies to Overcome them

Despite the promise of integrated anaemia data systems, several barriers may impede effective implementation. Funding constraints remain a significant challenge, as sustained investment is required for digital infrastructure, capacity building, and ongoing system maintenance. Political resistance can also arise, particularly where data transparency may expose gaps in service delivery or require shifts in resource allocation. Additionally, limited technical capacity at national and subnational levels can hinder the adoption and effective use of new digital tools. To overcome these barriers, it is essential to advocate for increased domestic and donor funding by demonstrating the long-term cost-effectiveness of robust data systems.

Building political will can be achieved through stakeholder engagement, highlighting the benefits of data-driven decision-making for health outcomes and accountability. Strengthening technical capacity requires targeted training, mentorship programs, and the establishment of peer-learning networks to share best practices and innovations across countries. By addressing these challenges proactively, countries can create an enabling environment for the successful integration and use of anaemia data systems.

Recommendations

The following table 1 presents a set of actionable recommendations designed to address the key challenges identified in strengthening anaemia data systems across Africa. These recommendations are tailored for national governments, regional bodies, and global partners, and are accompanied by their underlying rationale, suggested actions, and expected outcomes. Together, they provide a practical roadmap for integrating anaemia indicators into health information systems, enhancing data quality and use, and advancing progress toward the 2030 anaemia reduction targets.

Table 1. List of Practical Recommendations According to the Type of Stakeholders

Recommendations	Rationale	Actions	Expected outcomes
For national governments			
1. Integrate anaemia indicators into national DHIS2 platforms and HIS frameworks	Most DHIS2 systems currently capture proxy data such as ANC visits or IFA tablet distribution but lack direct anaemia indicators.	• Configure DHIS2 modules to include WHO- and AUC-recommended indicators (e.g., % pregnant women tested for haemoglobin at first ANC, % receiving ≥ 90 IFA tablets, IPTp coverage, deworming, WIFA/MMS distribution). • Ensure metadata consistency standard numerators, denominators, periodicity, and disaggregation by age, pregnancy status, and geography.	Routine availability of disaggregated anaemia data; improved comparability with regional dashboards; ability to track program performance quarterly rather than once per survey cycle.
2. Ensure interoperability between laboratory and DHIS2 systems	Laboratories are the primary source of haemoglobin results but remain digitally siloed. Linking Laboratory Information Management Systems (LIMS) with DHIS2 allows direct, automated data sharing.	• Deploy open-source solutions such as OpenELIS or BLIS and connect them through DHIS2 APIs. • Establish national data-exchange standards (HL7 FHIR or DHIS2 web services). • Conduct regular data-quality audits comparing laboratory records with DHIS2 reports.	Improved accuracy and timeliness of anaemia data; reduced manual reporting; strengthened early-warning capacity for stock-outs or outbreaks.
3. Institutionalize quarterly data-to-action reviews at national and subnational levels	Data-review meetings convert information into decisions.	• Schedule anaemia data reviews alongside SRMNCAN and nutrition meetings. • Include health managers, statisticians, supply officers, and civil-society observers.	Faster response to coverage gaps, stock-outs, or data errors; institutionalized accountability and continuous quality improvement.

		• Document action points and follow-up in the next review cycle.	
4. Invest in data-use capacity building	Analytical and visualization skills remain scarce at district and facility level.	• Develop short courses and on-the-job training in data analytics, dashboard interpretation, and visualization (using DHIS2 Analytics, Power BI, or Tableau). • Pair training with mentorship and feedback to promote sustained application. • Integrate data-use competencies into health-worker job descriptions and performance appraisals.	Enhanced analytical autonomy of district teams; improved accuracy of planning and supervision; a culture of data-driven decision-making.
5. Include anaemia indicators in national performance contracts and accountability frameworks	Linking data reporting to managerial performance motivates adherence and accuracy.	• Embed key anaemia indicators into annual performance contracts for regional and district health officers. • Publicly disclose progress through dashboards or scorecards. • Tie recognition or incentives to improvements in data completeness and indicator performance.	Strengthened accountability chain; increased reporting completeness; visibility of anaemia within broader health-sector priorities.
For regional bodies (AUC, WAHO, SADC)			
1. Harmonize anaemia indicator definitions and metadata across regions	Variability in indicator formulation undermines cross-country comparability.	• Convene regional technical working groups to standardize indicator metadata (definition, computation, disaggregation). • Publish an open regional metadata dictionary aligned with WHO and SDG standards.	Comparable anaemia data across Member States; streamlined regional aggregation and reporting.
2. Update regional dashboards and scorecards to incorporate anaemia indicators	Existing instruments, such as the ECOWAS–WAHO SRMNAH scorecard, track maternal and child health but omit anaemia.	• Add a concise anaemia module (5–6 indicators) derived from national DHIS2 feeds. • Develop a DHIS2-scorecard integration interface to automate data transfer.	Reduced duplication; synchronized national–regional reporting; greater visibility of anaemia within RMNCAH performance dialogues.
3. Facilitate peer-learning exchanges on anaemia data integration	Peer review accelerates adoption of good practices	• Organize annual or semi-annual regional learning forums under ECOWAS/SADC or AUC. • Document case studies and lessons learned in a regional repository.	Diffusion of innovations; stronger communities of practice; regional convergence on data-governance standards.

4. Coordinate resource mobilization for digital-health interoperability	Interoperability projects often compete for fragmented donor funding.	• Create a joint funding mechanism through AUC to pool partner contributions for DHIS2 customization, API development, and capacity building. • Align digital-health investments with national HIS strategic plans.	Efficient resource use; sustainability of digital-health infrastructure; enhanced regional ownership.
For global partners and donors			
1. Shift from project-based monitoring to system-based investment	Short-term, vertical monitoring initiatives rarely build institutional capacity.	• Direct funding toward HIS architecture, interoperability frameworks, and workforce development. • Require projects to integrate anaemia indicators into national DHIS2 rather than stand-alone databases.	Sustainable systems; lower reporting burden; improved country ownership.
2. Support open-data principles and transparency	Open data strengthen accountability and research collaboration.	• Fund development of public anaemia dashboards with appropriate data-privacy safeguards. • Encourage governments to publish metadata and analytical reports under open licenses.	Enhanced public trust; increased external analysis; broader civic participation in health governance.
3. Fund operational research and implementation science on anaemia data systems	Evidence on how integrated HIS influences outcomes is still limited.	• Sponsor multi-country studies assessing the impact of data integration on service coverage and decision-making. • Create small innovation grants for local universities and health institutes to test new data-use models.	Generation of context-specific evidence; iterative improvement of data-system design; strengthened research capacity in the region
4. Encourage cross-sectoral collaboration	Anaemia is influenced by nutrition, infection, and reproductive health determinants that extend beyond the health sector.	• Promote inter-ministerial data-sharing protocols linking health, education, agriculture, and WASH databases. • Support pilot projects integrating anaemia monitoring into school-health or food-security platforms.	Holistic understanding of anaemia determinants; integrated interventions; stronger alignment with SDG 2 and 3 targets.

Discussion

Implementing the proposed recommendations as a cohesive strategy would fundamentally transform anaemia surveillance in Africa. Rather than remaining a fragmented, programme-specific activity, anaemia monitoring could evolve into a robust, system-wide mechanism grounded in data-driven accountability. By leveraging digital transformation, harmonized indicators, and

comprehensive governance reforms, national and regional institutions have the potential to bridge the persistent gap between policy ambitions and measurable outcomes. This integrated approach would not only enhance the quality and timeliness of data but also ensure that information is effectively translated into targeted interventions and resource allocation. Ultimately, it is sustained investment in governance, institutional capacity, and system

interoperability, rather than data collection alone, that will determine whether Africa can achieve its ambitious goal of halving anaemia prevalence by 2030.

It is important to acknowledge the methodological limitations of this study. The analysis is based primarily on secondary data sources, including published literature, regional policy frameworks, and comparative country examples. While this approach offers a broad and comprehensive overview of anaemia data systems in Africa, it is inherently limited by the scope and quality of the available data. The absence of primary data collection, such as field surveys, stakeholder interviews, or direct observation, restricts the ability to capture context-specific challenges and the nuanced perspectives of frontline health workers and affected communities. Additionally, reliance on periodic surveys and routine health information systems may not fully reflect recent innovations or emerging barriers. Variations in indicator definitions, reporting practices, and data quality across countries further constrain the comparability and generalizability of the findings.

To address these limitations and advance the field, future research should prioritize the incorporation of primary data collection using mixed-methods approaches, including both qualitative interviews and quantitative surveys, to capture local experiences and implementation challenges. Longitudinal studies are needed to evaluate the sustained impact of digital health innovations and governance reforms on anaemia surveillance and outcomes. Comparative case studies across diverse settings would help identify best practices and context-specific solutions, while assessments of community engagement and feedback mechanisms could shed light on their effectiveness in strengthening data credibility and fostering behavioural change. Addressing these methodological gaps will provide deeper insights and actionable evidence, ultimately

guiding the continued strengthening of anaemia data systems in Africa.

Conclusion

Anaemia remains one of the most persistent yet under-monitored public-health challenges in the African region. Despite decades of interventions and political commitments, progress toward the global target of halving anaemia by 2030 has been slow and uneven. This stagnation reflects not only biological and programmatic complexities but also a structural weakness in how data on anaemia are collected, integrated, and used for decision-making. This paper has argued that transforming anaemia surveillance into a reliable, system-wide accountability mechanism is central to reversing this trend.

The review of current data systems reveals that while digital platforms such as DHIS2 have become ubiquitous across African health sectors, anaemia indicators remain largely absent or are reported inconsistently. Population surveys such as DHS, MICS, and SMART provide robust but infrequent prevalence data, leaving countries without real-time information to guide action. Routine health-information systems, laboratory platforms, and regional scorecards, though rich in potential, often operate in silos. Consequently, policymakers lack the integrated intelligence needed to align resources, target interventions, and evaluate progress.

Encouragingly, innovations in digital health, interoperability, and analytics are reshaping this landscape. The emergence of laboratory–DHIS2 linkages, community-based mobile reporting, and performance dashboards has shown that real-time anaemia monitoring is achievable. However, innovation must be accompanied by institutional reform. The WHO *Comprehensive Framework for the Prevention and Management of Anaemia in Women of Reproductive Age* and the AUC *Framework for Accelerating Anaemia Reduction in Africa (2023–2030)* offer complementary roadmaps,

but their success depends on national and regional ownership. Integrating anaemia indicators into existing data systems, rather than creating parallel mechanisms, would ensure sustainability and coherence across the digital-health ecosystem.

The analysis also demonstrates that data use is not a purely technical process; it is inherently political and behavioural. Governance structures, leadership commitment, and feedback culture determine whether information translates into action. Embedding anaemia indicators into national performance frameworks, regional dashboards, and cross-sectoral review platforms can elevate anaemia from a neglected nutrition issue to a strategic governance priority. The absence of anaemia measures in tools such as the ECOWAS–WAHO SRMNCAH scorecard underscores the opportunity for immediate reform: updating such platforms to include anaemia indicators could institutionalize accountability across West Africa and beyond.

Ultimately, strengthening anaemia data systems is an investment in evidence-based governance. By building interoperable, inclusive, and analytically capable health-information systems, African countries can transform how progress is tracked, policies are designed, and resources are mobilized. Achieving the 2030 target will require more than supplements and campaigns: it will demand a data revolution grounded in collaboration, transparency, and institutional learning. When anaemia data become timely, integrated, and actionable, they will not only illuminate the problem, they will also accelerate the solutions.

References

[1]. World Health Organization, 2025, https://www.who.int/data/gho/data/themes/topics/anaemia_in_women_and_children

Conflict of Interest

The author declares that there is no conflict of interest regarding the publication of this article. The views expressed are those of the author and are independent of any institutional affiliation.

Ethical Approval

This study is based on the analysis of secondary data and publicly available sources, including peer-reviewed literature, policy documents, and official reports. No primary data were collected, and no human participants were involved. Therefore, ethical approval was not required for this study, in accordance with the ethical standards and publication requirements of Texila American University.

Data Availability

All data used in this study are derived from publicly available sources cited in the reference list. No new datasets were generated or analysed during the current study.

Author Contributions

The author conceptualized the study, conducted the literature review, performed the analysis, and drafted and revised the manuscript.

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[2]. African Union Commission, Framework for Accelerating Anaemia Reduction in Africa 2023–2030, 2023, AUC, Addis Ababa.

[3]. Dzando, G., Ward, P. R., Mwanri, L., Moussa, R. K., & Ambagtsheer, R. C., 2025, Association

between frailty and quality of life, and the moderating effect of mobile, broadcast and digital media in sub-Saharan Africa: Evidence from Kenya, *BMC Geriatrics*, 25(1), p. 521.

[4]. Stevens, G. A., Paciorek, C. J., Flores-Urrutia, M. C., Borghi, E., Namaste, S., Wirth, J. P., Suchdev, P. S., Ezzati, M., Rohner, F., Flaxman, S. R., & Rogers, L. M., 2022, National, regional, and global estimates of anaemia by severity in women and children for 2000–19: a pooled analysis of population-representative data, *The Lancet Global Health*, 10(5), pp. 627-639.

[5]. Suprapti, E., Hadju, V., Ibrahim, E., Indriasari, R., Erika, K. A., & Balqis, B., 2025, Anemia: Etiology, Pathophysiology, Impact, and Prevention: A Review, *Iranian Journal of Public Health*, 54(3), pp. 509-520.

[6]. Rumisha, S. F., Lyimo, E. P., Mremi, I. R. et al., 2020, Data quality of the routine health management information system at the primary healthcare facility and district levels in Tanzania, *BMC Medical Informatics and Decision Making*, 20(340).

[7]. Uganda Bureau of Statistics (UBOS) & ICF., 2018, Uganda Demographic and Health Survey 2016, Kampala and Rockville.

[8]. World Health Organization, 2023, Comprehensive Framework for the Prevention and Management of Anaemia in Women of Reproductive Age, WHO, Geneva.

[9]. Nankinga, O., Aguta, D., 2019, Determinants of Anemia among women in Uganda: further analysis of the Uganda demographic and health surveys, *BMC Public Health*, vol. 19, no. 1757.

[10]. Rendell, N., Lokuge, K., Rosewell, A., & Field, E., 2020, Factors that influence data use to

improve health service delivery in low- and middle-income countries, *Global Health: Science and Practice*, 8(3), pp. 566-581.

[11]. Nutley, T., & Reynolds, H. W., 2013, Improving the use of health data for health system strengthening, *Global Health Action*, 6(1), p. 20001.

[12]. Ara, G., Hassan, R., Haque, M. A., Boitchi, A. B., Ali, S. D., Kabir, K. S., Mahmud, R. I., Islam, K. A., Rahman, H., & Islam, Z., 2024, Anaemia among adolescent girls, pregnant and lactating women in the southern rural region of Bangladesh: Prevalence and risk factors, *PLOS ONE*, 19(7).

[13]. Arizmendi, L. F., De la Torre-Domingo, C., & Rengifo, E. W., 2024, Anemia, weight, and height among children under five in Peru from 2007 to 2022: A panel analysis, *PLOS ONE*, 19(7).

[14]. Nguyen, M. N., Tran, N. H., Tun, Y. K., Han, Z., & Hong, C. S., 2021, Toward multiple federated learning services resource sharing in mobile edge networks, *Transactions on Mobile Computing*, 22(1), pp. 541-555.

[15]. ITAD, 2021, Evaluation of the global partnership for sustainable development data.

[16]. AbouZahr, C., & Boerma, T., 2005, Health information systems: the foundations of public health, *Bulletin of the World Health Organization*, 83(8), pp. 578-583.

[17]. Health Information Systems Programme Centre, 2024, HISP Centre 2024 Annual Report, University of Oslo, Oslo.

[18]. D. Square, PATH, 2025, <https://www.digitalsquare.org>

[19]. West Africa Health Organization & World Health Organization, 2022, ECOWAS Regional SRMNCAH Scorecard, Abidjan.

Assessment of Emergency Preparedness and Response Using One Health Approach in Juba, South Sudan

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Abstract

Emerging and re-emerging public health threats such as zoonotic diseases, outbreaks, and environmental hazards continue to challenge South Sudan's fragile health system. This study, titled "Assessment of Emergency Preparedness and Response Using One Health Approach in Juba, South Sudan," evaluates the extent to which the One Health (OH) framework integrating human, animal, and environmental health, has been applied to strengthen emergency preparedness and response (EPR) capacities in Juba, Republic of South Sudan. A mixed-methods approach was employed, combining quantitative data from structured questionnaires administered to 378 respondents across key sectors (human health, animal health, and environment) with qualitative data from 20 key informant interviews and document reviews of national preparedness plans. Results revealed that while awareness of the OH approach was moderate (67%), its operationalization within emergency preparedness structures remained limited due to fragmented coordination, inadequate funding, and weak intersectoral collaboration. Surveillance and laboratory capacities improved, yet joint outbreak investigations and data sharing remained inconsistent. However, the study found positive trends in multisectoral training initiatives and policy alignment efforts supported by international partners. The study concludes that adopting a fully functional One Health model could significantly enhance South Sudan's emergency preparedness and response (EPR) systems. Strengthening institutional coordination, capacity building, and resource mobilization across sectors is critical for building resilience against health emergencies in Juba and beyond.

Keywords: Emergency Preparedness, Juba, One Health, Response, South Sudan, Zoonotic Diseases.

Introduction

South Sudan (SSD), with a population of 12.44 million based on the 2018 census and South Sudan National Bureau of statistic 2024 projection, faces substantial challenges impacting prevention, preparedness, and response to disease outbreaks, due to its complex geo-political, socio-economic, and environmental landscape. Operational conditions are severely affected by damaged infrastructure and logistical challenges, particularly during the rainy season, which hampers the delivery of health services. The

country's susceptibility to climate change has led to repeated severe droughts and floods since 2011, causing extensive fatalities, displacement, and livestock losses [29]. These events critically affect livelihoods and compound the difficulty of improving health infrastructure. The country faces numerous public health challenges, including outbreaks of both zoonotic and non-zoonotic diseases [2].

The country continues to face recurrent public health emergencies [Figure 1] such as disease outbreaks, floods, protracted humanitarian crises, and cross-border health

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threats [30]. The capital city of South Sudan Juba, as the political and economic center, remains particularly vulnerable due to its dense population, high mobility, weak urban health infrastructure, and close interaction between humans, animals, and the environment [20]. The One Health approach integrating human, animal, and environmental health sectors provides an effective framework for strengthening emergency preparedness and response capacities [17]. This assessment examines existing systems, identifies gaps, and evaluates the effectiveness of One Health coordination multisectoral coordination mechanism in Juba.

South Sudan faces a multitude of zoonotic and non-zoonotic diseases, largely due to porous borders and uncontrolled movement between neighboring countries [12]. With a ranking of 185 out of 195 countries in the Global Health Security Index, scoring only 21/100 points, the country is particularly vulnerable [23]. This susceptibility is compounded by poor socio-economic conditions, political instability, and climate change-induced flooding and population displacement, which contribute to downstream health effects such as waterborne diseases. Furthermore, the proximity of wildlife to human population centers increases the risk of animal-to-human disease transmission. These challenges strain an already fragile health system, emphasizing the need for a robust and resilient system to prevent, prepare for, and respond to epidemic threats. Over 75% of emerging and re-emerging infectious diseases are attributed to zoonotic pathogens from both domestic and wildlife sources, with 60% of infectious diseases in humans linked to pathogens transmitted between wildlife and humans [10]. Additionally, pathogens with non-human animal hosts pose threats to human health by impacting food production and supply, as approximately 20% of animal production is lost due to disease. Recognizing these interconnected risks, One Health efforts

are being undertaken worldwide at the human-animal-environment interface to manage and mitigate the emergence of infectious diseases with both local and global implications. One Health is an integrated approach that aims to sustainably balance and optimize the health of humans, animals, plants, and ecosystems. It mobilizes multiple sectors, disciplines, and communities to foster well-being and tackle threats to health and ecosystems while addressing collective needs for clean water, energy, air, safe and nutritious food, climate action, and sustainable development. In South Sudan, where emerging diseases are a known hotspot, increasing commitment to institutionalizing multi-sectoral collaboration for the One Health agenda is evident. Such collaboration is essential for identifying additive versus competing uses for limited resources in a country whose health, livestock, agriculture, and other systems have been repeatedly challenged by insecurity and disasters. Zoonotic diseases pose significant public health threats in South Sudan, with major concerns including Ebola Virus Disease, Yellow Fever, Anthrax, Brucellosis, Bovine Tuberculosis, Highly Pathogenic Avian Influenza, Rabies, and Rift Valley Fever. Antimicrobial resistance is also emerging due to the unregulated use of antimicrobials in humans and animals, compounded by the lack of surveillance systems to monitor antimicrobial susceptibility trends. Strengthening coordination and communication between relevant sectors is crucial for developing policies, strategies, plans, and guidelines to ensure optimal operational readiness and response to zoonotic diseases across South Sudan. Refers to the organized actions taken to anticipate, plan for, and manage the impacts of emergencies or disasters [figure 2]. This can range from natural disasters such as floods, earthquakes, and pandemics to man-made crises such as conflicts, industrial accidents, or public health emergencies. The goal of EPR is to reduce risks, minimize

damage, and enhance recovery efforts, ensuring the safety and well-being of affected populations.

Emergency Preparedness and response were stated by researchers to be not constant but to change as social contexts shift, requiring revisions and modifications [11]. For instance, caregiving or medical considerations may affect the household's needs temporarily or permanently. Proper household emergency preparation is a substantial strategy to reduce the impact of a disaster [15]. Identifying the dangers specific to a region, developing a contingency plan, and providing a home survival kit with 72 hours of food, water, and medical supplies for sheltering in place are all part of emergency preparedness. In addition to drafting a contingency plan and understanding emergency housing and evacuation tactics for public response, the American Red Cross says that preparation often includes practising the plan with family members [28]. Public Safety Canada emphasizes the interconnectedness and necessity for continuity throughout all phases of a crisis: prevention, preparedness, response, and recovery [13]. According to Tanner and Doberstein (2015), approximately 30% of college students carry emergency kits [1]. However, any disaster preparedness supplies that student may have, are purely coincidental because they are common household stuff [9], over half of students had at least three days' worth of food and a first-aid kit, but less than a third had a radio, generator, or extra supply of medication [14], argues that there's a lack of emergency planning training and education [26]. Estimates indicate that between 28% and 73% of colleges participate in emergency drills [25]. If successful, training exercises

demonstrate readiness, while failure reveals areas for growth [22]. During student orientation, however, just about half of the students receive information or training on disaster preparedness [8]. Videos about emergency preparedness could be an effective way to raise awareness of emergency planning. Adopting and integrating the One Health approach into plans and policies, both at national and international levels, requires a radical change of strategy in terms of governance, capacity building, training and research to overcome the current fragmentation and barriers and to allow the required interaction, collaboration and coordination across sectors and disciplines.

Problem Statement

South Sudan's emergency management landscape suffers from several systemic and operational challenges: Fragmented coordination between human health, animal health, environmental sectors, and disaster management authorities; Limited early warning and surveillance systems especially in some sectors, leading to delayed detection of outbreaks; Weak laboratory capacity for rapid diagnosis of zoonotic and other priority diseases; Insufficient emergency response resources, including trained personnel, logistics, and response funding; Poor risk communication mechanisms that hamper timely dissemination of public health information; Rapid urbanization and environmental degradation that increase the risk of zoonotic spillover. To solve these problems there is a need to fully operationalize one health approach by establishing a fully functional.

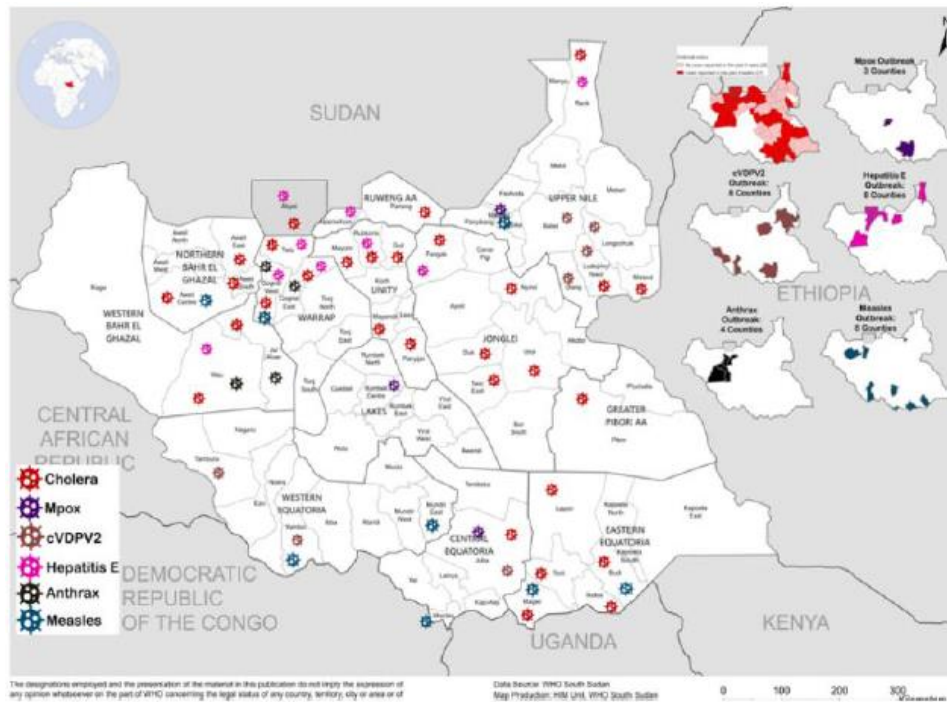


Figure 1. Major Ongoing Outbreaks in South Sudan

South Sudan, a country marked by recurrent public health emergencies including infectious disease outbreaks, in which 80% are zoonotic diseases, natural disasters, and conflicts, faces significant challenges in ensuring effective emergency preparedness and response. The convergence of human, animal, and environmental health threats in the region has underscored the need for integrated strategies that recognize the interconnectedness of these domains. Despite efforts by national and international organizations to bolster emergency response systems, gaps in coordination, resource allocation, and policy implementation persist. The fragmented healthcare infrastructure limited veterinary and environmental services, and the complex socio-political landscape further exacerbate these challenges, leading to delayed responses and increased morbidity and mortality during emergencies.

The One Health approach, which emphasizes collaboration across human, animal, and environmental health sectors, has emerged as a comprehensive framework for addressing such multifaceted public health challenges. However, there has been limited systematic

evaluation of how well South Sudan's emergency preparedness and response mechanisms align with One Health principles. This knowledge gap raises critical questions about the capacity of the country's health system to effectively anticipate, prevent, and respond to public health emergencies in an integrated and sustainable manner.

This research seeks to assess South Sudan's emergency preparedness and response capabilities through the lens of the One Health approach. By identifying existing strengths, weaknesses, and areas for improvement, this study aims to contribute to the development of more holistic, coordinated, and resilient public health strategies in South Sudan. The findings will inform policy recommendations and capacity-building initiatives to enhance the country's ability to respond to current and future public health threats.

The One Health concept is not well established in South Sudan Health policy. There needs to be increased awareness of the benefits of a One Health approach, training and education, across the human health, animal, and environmental sectors. The One Health concept should be more consistently covered in the

medical curriculum. The government should invest in One Health research and incorporate evidence based One Health approaches into policies, programs, and services especially the department of emergency preparedness and response (EPR) in the Ministry of Health, Republic of South Sudan.

Several mechanisms and interventions currently exist to support emergency preparedness and response: such as Public Health Emergency Operations Center (PHEOC) at national level supporting coordination and incident management; National One Health secretariat and One Health multisectoral coordination mechanism bringing together line ministries: such as Ministry of Health (MoH), Ministry of Livestock and fisheries (MoLF), Ministry of Environment and Forestry (MoEF), and partners. The existing Integrated Disease Surveillance and Response (IDSR) system for routine surveillance and reporting. Event-Based Surveillance (EBS) and community-level alerts.

The One Health Approach through strengthened Public Health Emergency Operation Center (PHEOC) coordination emerges as the most effective solution because: includes Its integrates multisectoral expertise in real time to prepare, prevent and response to public health emergencies using one health approach; It ensures joint risk assessment, information sharing, and unified response; It increases efficiency by pooling resources and avoiding duplication; It aligns with international frameworks including International Health Regulations (IHR 2005), Global Health Security Agenda (GHSA), and African Union (AU) One Health strategy; It enables early detection of zoonotic spillovers and environmental triggers. Thus, a fully functional multisectoral emergency preparedness and response (EPR and public health emergency operation center (PHEOC) with decentralized linkages to states provides the strongest foundation for emergency resilience.

Limitations

Despite progress, key limitations remain: Limited funding for one health preparedness and emergency rapid response activities; Inadequate integrated surveillance across human, animal, and environmental sectors; Human resource gaps, including shortages of epidemiologists, veterinarians, lab technologists, and emergency managers; Poor interoperability of digital surveillance platforms; Weak enforcement of environmental and animal health regulations; Dependence on external partners, risking sustainability and Limited laboratory networking, leading to diagnostic delays. Significant progress has been made, including but not limited to Establishment and operationalization of the National public health emergency operation center (PHEOC) with trained incident management teams; Development of the 2nd edition of the National Action plan for health security (NAPHS), One Health strategic plan (OHSP), and multiple hazard-specific preparedness plans; Increased integrated diseases surveillance and response (IDSR) reporting coverage and improved outbreak detection; Formation of a National One Health secretariat enhancing coordination; Successful responses to priority outbreaks such as cholera, anthrax, measles, and hepatitis E; Capacity building through trainings on Event and Indicator Based Surveillance (EBS&IBS), Rapid Response Teams (RRTs), laboratory diagnostics, and emergency management; Strengthened risk communication during emergencies like COVID-19 and flooding events [21].

Conceptual Framework of the Study

South Sudan's susceptibility to emerging infectious diseases, particularly zoonotic ones, stems from its environmental conditions, exemplified by extensive 2022 flooding attributed to climate change, as reported in the South Sudan Monthly Humanitarian Situation Report. A key driver of zoonotic disease

transmission is the close proximity of many South Sudanese to animals, including livestock and wildlife, due to the prevalence of rural living conditions. Cultural practices like consuming raw milk and animal blood, along with poaching, further exacerbate the transmission of pathogens between humans and animals. With approximately 34.2% to 45% of its land covered by forests, as outlined in the National Environmental Policy 2015-2025, South Sudan boasts rich biodiversity [27]. However, this biodiversity also serves as a reservoir for disease hosts, including wildlife, due to activities such as commercial hunting, logging, shifting cultivation, and settlements, which have become more common in the post-conflict period. Encroachment on wildlife habitats, driven by illegal logging and mining, has heightened the risk of human-wildlife interaction, particularly with species like the pygmy hippopotamus and non-human primates. Weaknesses in the health system exacerbate the challenge of disease detection and containment. Surveillance systems for animal diseases remain rudimentary, with limited personnel and resources dedicated to monitoring and reporting. Additionally, the importation of livestock and poultry, sometimes without prior documentation, increases the risk of introducing infectious diseases into South Sudan. Despite local guidelines, high levels of inappropriate antibiotic use persist in hospitals, contributing to the emergence of antibiotic-resistant infectious diseases, although precise data on the burden of antimicrobial resistance (AMR) in South Sudan are limited [5]. In summary, South Sudan's vulnerability to emerging infectious diseases arises from a combination of environmental factors, cultural practices, encroachment on wildlife habitats, weak health systems, and inappropriate antibiotic use. Addressing these challenges requires a multifaceted approach encompassing improved surveillance, public awareness campaigns, strengthened regulations, and enhanced healthcare infrastructure.

Emerging Infectious Disease in South Sudan

Infectious Diseases in Humans

South Sudan boasts a substantial livestock population, exceeding 36.5 million, comprising 12.1 million sheep, 12.4 million goats, and 12 million cattle. With over 70 percent of the population relying on the livestock sector for their livelihoods, communities in both subsistence agro pastoral and pastoral production systems play pivotal roles in maintaining approximately 47 percent and 43 percent of this livestock population, respectively. Despite its significance, livestock production in South Sudan predominantly follows an extensive, low-input system, contributing an estimated 15 percent to the national Gross Domestic Product. However, the sector faces challenges stemming from endemic livestock diseases, low animal production and productivity, minimal investment in value chains, and the adverse effects of climate change-related floods, particularly since 2019. South Sudan grapples with several endemic zoonotic diseases, including Rabies, Anthrax, Brucellosis, Bovine Tuberculosis, Rift Valley Fever (RVF), Yellow Fever, and Sudan Ebolavirus species. Additionally, the country has witnessed a rise in environmentally related diseases such as malaria, typhoid, and watery diarrhea, largely attributed to widespread water contamination from urban surface runoff and inadequate environmental sanitation. The absence of a robust surveillance system and environmental laboratories exacerbate these challenges. To address priority zoonotic diseases, South Sudan has implemented surveillance through the Integrated Disease Surveillance and Response (IDSR) and Early Warning, Alert, and Response Systems (EWARS) strategies, developed by the WHO Regional Office for Africa. In 2022, the IDSR system detected and responded to five outbreaks of human-related diseases, including various zoonoses [31]. Notable outbreaks

included Hepatitis E, Cholera, Meningitis, Anthrax, Mpox, and Measles. For instance, in 2022, South Sudan reported 72 suspected cases of Anthrax, resulting in four deaths (with a Case Fatality Rate [CFR] of 5.6%). Similarly, the cholera outbreak in Bentiu recorded a cumulative total of 424 suspected cases, with one death (CFR of 0.24%) [19].

Infectious Disease in Animals

In South Sudan, the emergence of diseases among domestic and wild animals, as well as plants, presents a significant concern. Crop losses due to pests and diseases, both pre- and post-harvest, are estimated at 40%-50%, with livestock losses expected to be similarly substantial. Notably, between 2019 and 2022, documented disease outbreaks among animals include Anthrax, Rabies, Rift Valley Fever, Foot and Mouth Disease, Lumpy Skin Disease, Peste des Petits Ruminants, Brucellosis, Bovine Tuberculosis, Contagious Bovine Pleuropneumonia (CBPP), Sheep and Goat Pox, Newcastle Disease, and Avian Influenza in poultry. Given South Sudan's heightened vulnerability to zoonotic diseases, it is imperative to strengthen national multisectoral capacities for cross-sectoral surveillance, response, and control systems. This entails early detection and rapid containment of zoonoses to minimize illness and fatalities. Commitment to collaborative efforts aimed at enhancing the control of zoonoses and threats at the human-animal-environment interface, particularly within high-risk populations in South Sudan, is crucial. Recognizing the urgency of this issue, the draft South Sudan National Livestock Development Policy (2021), along with the Animal Health Bill (2019), Veterinary Council Bill (2019), and Meat Control and Slaughter Facility Bill (2019), acknowledges the endemic or frequently occurring status of several priority diseases designated by the World Organization for Animal Health (OIE) [7]. These transmissible diseases, characterized by their

potential for rapid and severe spread across national borders, include Foot and Mouth Disease, Peste des Petits Ruminants, Contagious Bovine Pleuropneumonia, Lumpy Skin Disease, Classical Swine Fever, Newcastle Disease, Rinderpest, Sheep Pox, and Goat Pox. Efforts to address these challenges must be multifaceted, encompassing robust surveillance, effective response mechanisms, and comprehensive policy frameworks to safeguard animal health and mitigate the risks posed by infectious diseases.

Factors Contributing to Emergence of Infectious Diseases in South Sudan

South Sudan's susceptibility to emerging infectious diseases, particularly zoonotic ones, stems from its environmental conditions, exemplified by extensive flooding in 2022 attributed to climate change, as reported in the South Sudan Monthly Humanitarian Situation Report [4]. A key driver of zoonotic disease transmission is the close proximity of many South Sudanese to animals, including livestock and wildlife, due to the prevalence of rural living conditions. Cultural practices like consuming raw milk and animal blood, along with poaching, further exacerbate the transmission of pathogens between humans and animals. With approximately 34.2% to 45% of its land covered by forests, as outlined in the National Environmental Policy 2015-2025, South Sudan boasts rich biodiversity [6]. However, this biodiversity also serves as a reservoir for disease hosts, including wildlife, due to activities such as commercial hunting, logging, shifting cultivation, and settlements, which have become more common in the post-conflict period. Encroachment on wildlife habitats, driven by illegal logging and mining, has heightened the risk of human-wildlife interactions, particularly with species such as the pygmy hippopotamus and non-human primates. Weaknesses in the health system exacerbate the challenge of detecting and containing disease. Surveillance systems for

animal diseases remain rudimentary, with limited personnel and resources dedicated to monitoring and reporting. Additionally, the importation of livestock and poultry, sometimes without prior documentation, increases the risk of introducing infectious diseases into South Sudan. Despite local guidelines, high levels of inappropriate antibiotic use persist in hospitals, contributing to the emergence of antibiotic-resistant infectious diseases, although precise data on the burden of antimicrobial resistance (AMR) in South Sudan are limited. In summary, South Sudan's vulnerability to emerging infectious diseases arises from a combination of environmental factors, cultural practices, encroachment on wildlife habitats, weak health systems, and inappropriate antibiotic use. Addressing these challenges requires a multifaceted approach encompassing improved surveillance, public awareness campaigns, strengthened regulations, and enhanced healthcare infrastructure.

Other Public Health Threats in South Sudan

Beyond infectious diseases, South Sudan faces a spectrum of environmentally driven public health hazards stemming from inadequate regulation of human activities. These threats encompass a range of issues, including industrial chemical spills, substandard waste management practices, recurring flooding, and associated safety concerns. Gold mining operations in South Sudan employ cyanide leaching, a widely used method for gold recovery worldwide, which can recover approximately 83% of gold [18]. However, without stringent regulation and monitoring, the chemicals present in the wastewater used for gold processing, such as Hydrochloric acid and cyanide, pose significant risks. Leakage from mining sites can contaminate nearby water sources, leading to exposure among both humans and animals, and causing adverse environmental impacts. Moreover, inadequate waste management practices contribute to public health risks as waste accumulates in market and residential areas, serving as potential breeding grounds for disease-carrying vectors and contaminating local water supplies. As shown in **Table 1**, the distribution of priority zoonotic diseases varies across states.

Table 1. List of Other Public Health Threats in South Sudan

S/N	Public Health Threat	Geographical Location affected
1	Road accident especially in urban areas	Juba - Nimule Road, Juba - Terekeka, Juba - Bor, and Juba Nadapal Road. (countrywide)
2	Drought and famine	Kapoata, Northern Bahr El Ghazal, Ruweng, Greater Pibor Administrative Area (GPAA) Greater Upper Nile.
3	Fire hazard	Eastern Equatoria, parts of Central Equatoria etc.
4	Oil spills	Major Towns and Unity, Upper Nile, and Ruweng A. Area
5	Volcano eruption /Earthquake	Juba, Eastern Equatoria
6	Food poison	From the imported food items abroad
7	Insecurity	Fringes of major towns and some states
8	Cattle rustling	All over the country

9	Over poaching/fishing	Protected Areas, The Sudd Wetland, game park and national reserves
10	Deforestation/Soil degradation	Country (among cattle keeping communities)
11	Lightening (thunderstorm)	Juba, Yei, Ruweng, Torit, (countrywide)
12	Landmine	Yei, Lasu, Magwi, Rokon, contested areas
13	Poor land use Planning	Juba, Bor, Torit, (countrywide)
14	Lack of environmental impact assessment	Juba-Bor Road, Juba - Rumbek - Wau Road oil Fields
15	Air pollution	Major towns (e.g. Juba, Wau, Malakal etc.) and oil produce states (Ruweng Administrative area, Unity, Upper Nile state)
16	Landslide/ Flood	Unity State, Jonglei State, Upper Nile, Ruweng, Warrap, Torit, Pibor, Central Equatoria
17	Extensive use of fertilisers	Renk County
18	Overuse of drug/ alcohol	Illicit drug use among the youth (urban towns)
19	Human wildlife conflict	Protected areas (badingilo, boma etc.)
20	Desert locust invasion	Budi county, kapoeta, magwi, chukudum
21	Air-crafts accidents	Akobo, Juba, old Fangak,
22	High population displacement	Some of the state including three administrative area, almost 10 states are living in the POCs.
23	Poor distribution of healthcare services	At least 1 Doctor is attending 1000 persons in a day.
24	Poor socio-economic	Every 1 person in South Sudan is living below 0.0001% in a day
25	Lack of a healthcare registration policy	All operational pharmacies and private clinics have no clear registration and follow-up policy.
26	Severe food shortage	Due to mass migration and Insecurity out of the country, the impact of climate change, flood, drought and outbreaks of crop pest diseases, such as fall armyworm, desert locust, whiteflies, and cross-border cattle migration, such as Amboro herders crossing to the northern part of Aweil and Wau in western Equatoria.
27	Inadequate health care services	Due to destruction and closure due to war and maintenance
28	High prevalence of HIV/AIDS,	dengue fever, meningococcal meningitis, bacterial and protozoal diarrhoea, rabies, hepatitis A and E, typhoid fever and many more.
29	Widespread outbreaks of diseases	Such as cholera, Malaria, measles and other communicable diseases
30	Persistent cholera outbreaks	From 2014-2017 and Currently 2023.

Source South Sudan Public Health Emergency operation center (PHEOC) 2024.

Schematic Diagram\ Graphical Abstract

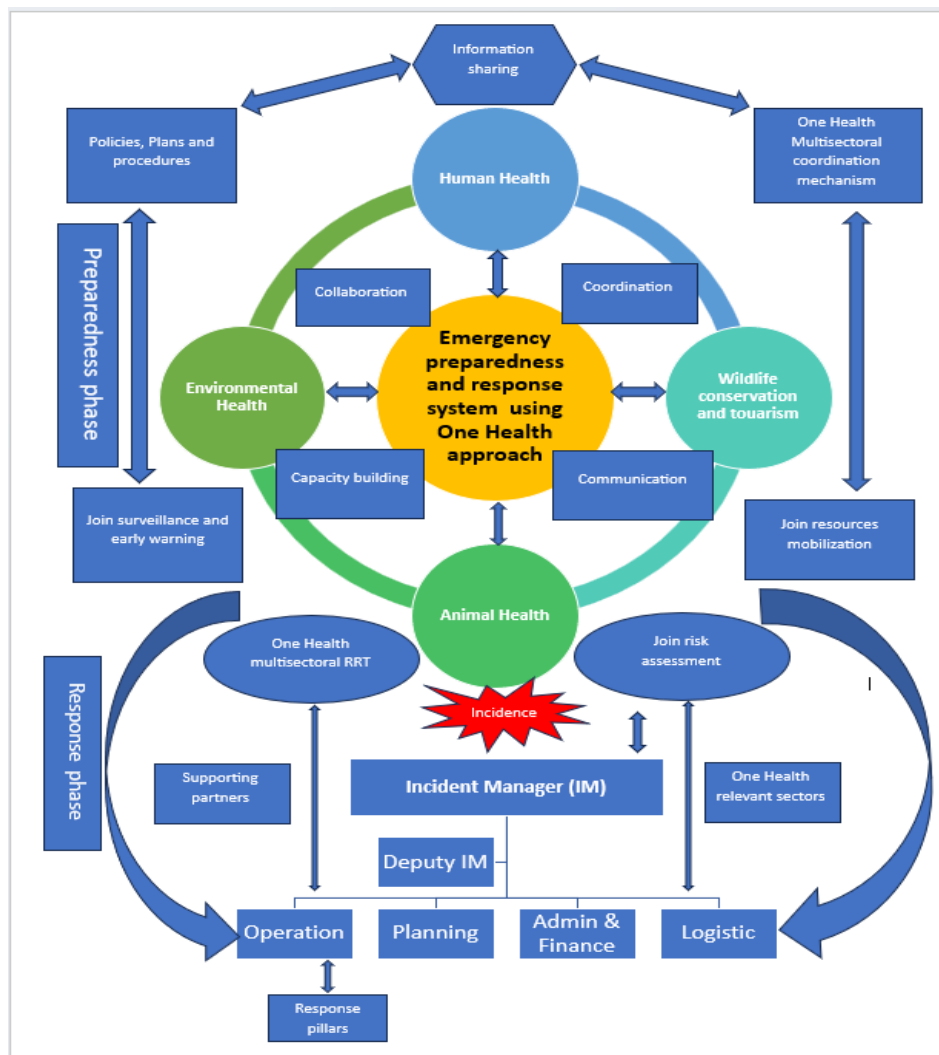


Figure 2. Conceptual Framework by Author 2024

Figure 2 shows the principal investigator newly proposed conceptual framework for effective inclusion of One health approach in South Sudan Emergency Preparedness and Response framework.

Research Questions

1. What is the current level of One Health approach and the Emergency Preparedness and Response capacity in South Sudan, specifically in the context of zoonotic diseases and other public health threats?
2. How does the collaboration, coordination and communication (Information sharing) between human, animal, and environmental health and other sectors impact the effectiveness of emergency

preparedness and responses to public health outbreaks in South Sudan?

3. How effectively is the One Health approach integrated into emergency preparedness and response systems in South Sudan?
4. What are the key challenges and barriers to implementing the One Health approach in emergency preparedness and response in South Sudan?
5. What is the impact of One Health Interventions on Public Health Outcomes in the past emergencies from 2019 to 2025

The major objective for this study is to assess the Emergency Preparedness and Response

(EPR) system using the One Health approach to identify how effective is the integration and functionality of One Health approach in Emergency Preparedness and system in Juba, South Sudan. Specifically, 1. To evaluate the Current Integration of One Health approach in Emergency Preparedness and response Frameworks in South Sudan. 2. To examine the Role of Cross-Sectoral Collaboration in Emergency preparedness and Response Systems. 3. To assess the Effectiveness of One Health-Based Surveillance Systems in South Sudan emergency preparedness and response. 4. To identify Resource Gaps and Challenges in Implementing One Health-Based Emergency Preparedness. And 5. To analyze the Impact of One Health Interventions on Public Health Outcomes in Past Emergencies preparedness and response 2019 to 2025.

This study provides the first comprehensive One Health–focused assessment of emergency preparedness in Juba. It integrates multi-sectoral insights from human, animal, environmental, and disaster management authorities. It introduces a novel cross-sector emergency preparedness scoring framework tailored to South Sudan. It outlines an interoperable surveillance and response model adapted to the country’s context. It contributes evidence to guide future policy, NAPHS updates, strategic plans, and donor investment.

Methodology

Research design is the structured approach followed by researchers to answer a particular research question [7]. The research design involves a plan, structure and strategy of the study. These three research design concepts guide a researcher in writing the research questions, conducting the project, and in analyzing and evaluating the data [16]. This study is a descriptive cross sectional study design, applying both qualitative and quantitative approaches. The quantitative approach provided a method to collect statistical data for analysis and reporting [16],

are of the view that the main purpose of scientific research is to explore the association among primary variables to gain a better understanding of the phenomena under study. The principal researcher also has a qualitative approach which is more subjective in nature and involves examining and reflecting on the less tangible aspects of a research subject, e.g. values, attitudes, perceptions. A cross-sectional based design using quantitative and qualitative approaches were employed in this study to assess emergency preparedness and response using one health approach in Juba, Republic of South Sudan. Information on socio-demographic characteristics, the role of collaboration, effectiveness of surveillance system, gaps and challenges of implementing one health will be collected using a pretested structured interview schedule questionnaire. Cross-sectional study or survey will be used because it employs exploratory and descriptive approaches to assess Emergency Preparedness and Response using One Health approach, and this is particularly useful in informing the planning and allocation of health resources. Both exploratory and descriptive designs were used to assess Emergency Preparedness and Response using one health approach. This study utilized a mixed-methods research design to comprehensively assess emergency preparedness and response capacities within a One Health framework. The study was conducted between January and July 2025 in Juba City. The target population comprised personnel from the Ministry of Health, Ministry of Livestock and Fisheries, environmental authorities, academic institutions, and humanitarian organizations engaged in emergency response. Quantitative data were collected using a structured questionnaire administered to 150 respondents selected through purposive and stratified sampling to ensure balanced representation from the three One Health sectors. The questionnaire gathered information on awareness, coordination, surveillance systems,

laboratory capacity, and operational readiness. Qualitative data were collected through 20 key informant interviews with senior officials and technical staff responsible for policy formulation, surveillance, laboratory services, and outbreak response. These interviews followed a semi-structured guide exploring multisectoral collaboration, implementation of One Health (OH) approach in South Sudan, challenges, and sector-specific roles in emergencies. Document review included national guidelines such as National Action Plan for Health Security (NAPHS), the One Health Strategic Plan, Public Health Emergency Operation Center (PHEOC) Standard Operating Procedures (SOPs), and outbreak reports [33]. The assessment incorporated relevant indicators from the WHO Joint External Evaluation (JEE) tool and the OIE Performance of Veterinary Services (PVS) framework to benchmark national capacities. Quantitative data were analyzed using descriptive statistics, while qualitative transcripts underwent thematic content analysis. Triangulation enhanced the reliability and validity of the findings.

At the first step, all the data sheets were checked manually for any mismatches and was corrected accordingly. Later, the data were also cleaned using computerized cleaning process. After the data collection the data will also enter Epi Data software, version 3.1. for rechecking rechecked for the purpose of the data validation. After, that data were imported to SPSS software, version 23 for analysis. The hard copies of the filled interview schedules and consent forms were kept in the locked chamber under custody of the personal information (PI). The privacy and the confidentiality of the study participants are being strictly maintained. Analysis was done using Statistical Package for Social Sciences (SPSS) software version 23. Bivariate analysis was used with outcome variables, Statistical tests was also be done and for all the tests, p-value of <0.05 was considered as significant. For adjustment of

possible interaction and confounding factors, multiple logistic regression analysis was performed to arrive at a final model. Predictor variables that will have p-value < 0.1 in bivariate analysis was considered for multiple logistic regression analysis. The net bearing effect of different predictor variables was explained in terms of odds ratio (OR) with 95% of confidence interval (CI).

To ensure legal processes a clearance was obtained from Taxila American University Prior to data collection. Permission was also obtained from the Ministry of Health Research Ethics Review Board, Government of South Sudan. Written informed consent for participating in the study was developed and signed by the participants. Participants were given full freedom of either accepting or refusing to participate, and for withdrawing participation at any time of the study without any explanation and consequences. Respondents were informed regarding the voluntary nature of participation, study objectives, and the potential benefits and risks of participation. Utmost ease was given to protect the privacy and confidentiality of the participants. Personal information about the participants was not shared with anyone not involved in the study. The researcher (principal investigator) used codes and not respondent's names, so that the respondents would not be identifiable. Two boxes were provided in each grade. One for the signed consent forms, which will be sealed once all the forms have been placed in the box. Another box will be provided for questionnaires, which will also be sealed after the respondents have completed all the questionnaires, and the same way will be followed for the semi-structured interview schedule. The National Ministry of Health will give permission to the researchers to conduct the study and data collection. The researcher further requests that the in-charge of those institutions where data will be collected should be present at the beginning of the data collection. The head of units in the different

departments will also be notified orally before data collection.

Research Design

Research design is the structured approach followed by researchers to answer a particular research question [7]. The research design involves a plan, structure and strategy of the study. These three research design concepts guide a researcher in writing the research questions, conducting the project, and in analyzing and evaluating the data [16].

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Research methodology refers to the steps, procedures and strategies for gathering and analyzing the data [24]. This section discusses the study setting, population and sample selection.

Study Setting and Period

Juba city the Capital of the Republic of South Sudan will be the study setting. It was chosen because it is the largest population city and the capital city of South Sudan with a population of Juba County is an administrative area located in Central Equatoria State (CES), Population 690,918 base on National Bureau of Statistics, 2021. In addition, Juba is the capital city of South Sudan where all national Government institutions are hosted such as Ministries, teaching hospitals, Public Health Emergency Operations Center, Public Health Laboratory and many others.

Study Population

A study population is an aggregate of elements sharing some common set of criteria [3]. The population is described in terms of the target population, inclusion criteria, and sampling method.

1. Public health officials: Include officials from ministries of health, WHO, or local public health agencies.
2. Healthcare providers: Doctors, nurses, and emergency health workers who are directly involved in emergency preparedness and response.
3. Disease surveillance officers: Personnel working on disease detection and reporting systems.
4. Members of the Rapid Response Team: such clinicians, epidemiologist, risk and crisis and community engagement officers, Infection prevention and control experts, laboratory technologist.
5. Veterinarians and animal health workers: Involved in monitoring zoonotic diseases (those transmitted from animals to humans) and outbreaks in animal populations.

6. Animal disease surveillance officers: Those responsible for animal disease monitoring and reporting.
7. Environmental health officers: Officials or organizations responsible for monitoring environmental factors that impact health (e.g., water safety, sanitation, air quality).
8. Environmental monitoring agencies: These might include agencies that deal with land management, wildlife conservation, and ecosystem health.
9. Community leaders: Chiefs, elders, or influential members of communities who are important in organizing response efforts during emergencies.
10. Local farmers and pastoralists: Especially in areas dependent on livestock, these individuals may be affected by zoonotic diseases and environmental factors.
11. General public: Individuals affected by emergencies like disease outbreaks or natural disasters.
12. Ministry of Health: Officials responsible for policy and coordination of health-related emergency responses.
13. Ministry of Agriculture and Livestock: Key for understanding animal health and how it integrates into emergency responses.
14. Ministry of Environment and Forestry: Important for environmental health aspects in the context of emergencies.
15. UN agencies (WHO, FAO, OIE): Engaged in emergency preparedness and response, especially in public health, veterinary, and environmental sectors.
16. NGOs: Organizations focused on emergency relief, humanitarian assistance, and development in the areas of health, environment, and food security.
17. Researchers in public health, veterinary science, and environmental health: Those involved in One Health-related studies, particularly in emergency preparedness and disease control.
18. Considerations for the Study Population:
19. Geographic Location: Focus on regions in South Sudan that are prone to health emergencies (e.g., areas with frequent zoonotic disease outbreaks, floods, etc.).
20. Diversity in Sectors: Ensure representation from all three core areas of One Health (human, animal, environmental health).
21. Role in Emergency Response: Focus on those actively involved or impacted by preparedness and response efforts.

Ethical Approval

Ethical approval for this study was obtained from the Ministry of Health Research Ethical Review Board (RER) of South Sudan and also approval was obtained from Texila American University prior to the commencement of data collection (Approval reference number MOH/RERB/A-81/2024). Administrative clearance to conduct the study was also granted by the Central Equatoria State Ministry of Health and relevant authorities in Juba County. The study was conducted in accordance to internationally recognized ethical standards for research involving human participants. Participation in the study was voluntary, and written informed consent was obtained from all respondents before data collection. Participants were adequately informed about the purpose of the study, procedures involved, potential risks and benefits, confidentiality of the information provided, and their right to withdraw from the study at any stage without any penalty. Confidentiality and anonymity of participants were strictly maintained. No personal identifiers were collected, and all data were securely stored and used solely for academic and research purposes. The study involved minimal risk and did not include any invasive procedures.

Inclusion Criteria

1. Sector-specific: People who work or are involved in human, animal, or environmental health.
2. Experience in emergencies: Individuals who have been part of emergency preparedness or response efforts (e.g., health workers during disease outbreaks, farmers impacted by zoonotic diseases).
3. Geographic relevance: Participants from areas in South Sudan affected by emergencies (e.g., regions prone to floods, droughts, or disease outbreaks).
4. Community involvement: Local leaders and community members actively participating in response activities.
5. Employee status: officially employed or on short contract with government or partners and working in a facility in different human, animal and environmental medical

professions (laboratory technicians, clinical officers and theatres assistant).

Exclusion Criteria

1. Lack of relevant experience: Individuals not directly involved in emergency preparedness or response efforts.
2. Age group (under age): any person below 18 and above 80 years are excluded, the eligible age group targeted in this study is between 19 and 75 years old.

Samples Size Determination

Sample Size

The determined sample size was an outcome estimated of multisectoral and multidiscipline professionals and others providing health services especially emergencies preparedness and response. The sample size was determined by using the Krejcie & Morgan [34] [Table 2].

Table 2. Determining Sample Size [34]

Given population (N)	Sample size (S)	Given population (N)	Sample size (S)
10	10	300	169
20	19	320	175
30	28	340	181
40	36	360	186
50	44	380	191
60	52	400	196
70	59	420	201
80	66	440	205
90	73	460	210
100	80	480	214
110	86	500	217
120	92	550	226
130	97	600	234
140	103	650	242
150	108	700	248
160	113	750	254
170	118	800	260
180	123	850	265
190	127	900	269
200	132	950	274

210	136	1,000	278
220	140	1,100	285
230	144	1,200	291
240	148	1,300	297
250	152	1,400	302
260	155	1,500	306
270	159	1,600	310
280	162	1,700	313
290	165	1,800	317
2,000	322	1,900	320
2,200	327	8,000	367
2,400	331	9,000	368
2,600	335	10,000	370
2,800	338	15,000	375
3,000	341	20,000	377
3,500	346	30,000	379
4,000	351	40,000	380
4,500	354	50,000	381
5,000	357	75,000	382
6,000	361	100,000	383
7,000	364	1,000,000	384

This table provides recommended sample sizes (S) for given population sizes (N) at a 95% confidence level and $\pm 5\%$ margin of error, assuming a population proportion of 0.5.

The total number of respondents voluntarily participated in the study was 387 respondents.

This group was taken with the assumption that it is close to and representative of the group health care professional and non health professionals providing health care services in emergency preparedness and response.

Using a 95% confidence level of certainty ($\alpha=0.05$) as an assumption, the computed actual sample size for the study used one sample proportion formula as indicated below (Joubert & Ehrlich 2007:347). 80% was the expected power ($1-\beta$) for the study because it could allow good generalization since this level is the probability that a test will produce a significant difference at a given significance level if there is in fact a difference (Joubert & Ehrlich 2007:346).

The Equations

$$n = \frac{(Z\alpha/2)^2 p (1 - p)}{d^2}$$

$$n = \frac{(1.96)^2 (0.093 * 0.907)}{(0.03)^2} = 360$$

Adding 5% non – response rate

$$\begin{aligned} \text{Total sample size} &= 360 + 18 \\ &= 378 \text{ respondents} \end{aligned}$$

Where:

n = the required minimum sample size.

Level of confidence 95%, which gives the percentile of n /2 = 1.96.

D = (margin of error) = 0.03.

P = proportion of being tested = 0.093.

*1 – p = proportion of not being tested
= 0.907.*

Estimated non

– response rate in school youth = 5%.

Based on the above assumptions, a total of 378 (with flexibility) students will be required for the study.

Data Analysis

The findings of research assessing emergency preparedness and response using the One Health approach in Juba, South Sudan. The analysis is based on both quantitative and qualitative data collected from stakeholders in human health, animal health, and environmental and other sectors. The aim was to evaluate the current state of multisectoral preparedness, identify gaps, and determine the extent of collaboration and coordination during emergencies. Descriptive statistics, thematic content analysis [Figure 4], and comparative frameworks were employed to interpret the data.

A total of 378 respondents participated in this study through structured interviews and questionnaires. These participants were drawn

from key sectors of the One Health spectrum namely human health (38.8%), animal health (26.5%), environmental health (18.4%), and multisectoral coordination offices (16.3%). Respondents included government officials, healthcare workers, veterinarians, environmental officers, Noon Governmental Organisation NGO/ United Nations agencies representatives and the private sector.

The One Health approach recognizing the interconnection between human, animal, and environmental health has emerged as a critical strategy in addressing public health emergencies. The findings of this study indicate that the level of knowledge and understanding of One Health principles among health professionals and key stakeholders in South Sudan is still developing but shows significant promise, especially in areas exposed to zoonotic outbreaks and in cross-sectoral collaboration.

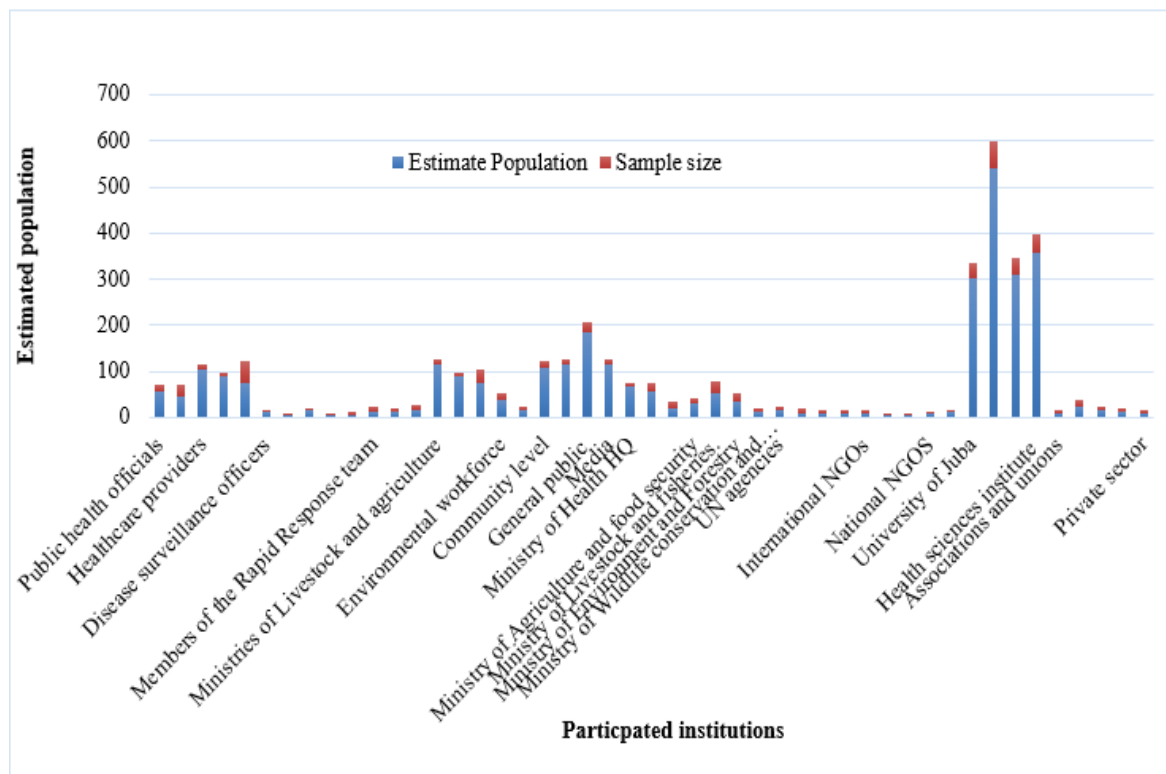


Figure 3. Estimated Population and Sample Size Determination

Figure 3 summarizes the institution participated in this study and sample size by author 2025.

Results

Findings showed moderate awareness of the One Health approach among the respondents, with 67% demonstrating good conceptual understanding. However, practical operationalization of OH principles remained limited. Coordination between sectors was described as ad hoc and reactive, often activated only during outbreaks. Formalized OH structures existed at national level but lacked consistent funding and operational functionality. Surveillance systems for human health were relatively stronger compared to animal and environmental sectors. Cross-sectoral data sharing was inconsistent, and joint outbreak investigations were rarely conducted, despite their necessity for zoonotic diseases. Laboratory capacity showed gradual improvement through partner support, but challenges persisted, including inadequate equipment maintenance, limited molecular diagnostic capacity, and shortages of trained personnel. Qualitative interviews revealed systemic gaps such as weak intersectoral communication, limited budget allocation, and absence of routine multisectoral simulation exercises. Nevertheless, respondents acknowledged positive developments, including improved national policy alignment, establishment of a national One Health platform, and increased multisectoral training activities supported by partners such as World Health Organization (WHO), Food and Agriculture Organization of United nation (FAO), and Africa Center for Diseases Control and Prevention (Africa CDC).

Discussion

The findings highlight that although the One Health concept is widely recognized in South Sudan's public health discourse, its operational integration into emergency preparedness and

response remains insufficient. The moderate awareness observed among stakeholders aligns with regional trends, where One Health is conceptually supported but constrained by structural and resource limitations.

Weaknesses in coordination mirror previous Joint External Evaluation (JEE) and National Action Plan for Health Security (NAPHS) evaluations, indicating that multisectoral coordination and collaboration remains reactive rather than proactive and institutionalized. The inconsistent participation of animal health and environmental actors during surveillance and response activities undermines efforts to control zoonotic threats. Laboratory challenges further limit the country's capacity to detect and respond rapidly to emerging and re-emerging diseases. The relevance of One Health in emergency preparedness and response is evident in its ability to promote multisectoral coordination, early warning systems, and rapid response mechanisms. This research demonstrated several key ways in which the One Health approach enhances preparedness and response. The new proposed coordination framework between human, animal, and environmental sectors is presented in [Figure 2]. Early Detection of Zoonotic Outbreaks; In areas where One Health structures exist, there was earlier detection of outbreaks due to shared information between veterinary and public health sectors. This was particularly evident in Rabies surveillance and recent Anthrax outbreaks, where animal health alerts enabled human health systems to prepare or respond promptly [21]. Joint Risk Assessment and Planning; The existence of multisectoral One Health multisectoral Coordination Mechanism (OH MCM) platforms allowed for more comprehensive risk assessments, which led to more context-specific and integrated emergency preparedness and response plans [32]. However, in many regions, this practice is not institutionalized, making preparedness reactive rather than proactive. Resource Sharing and Coordination; One Health

facilitates resource pooling across sectors logistics, laboratory services, surveillance teams especially during emergency response. For instance, during recent suspected and confirmed zoonotic outbreaks, coordination among ministries led to more effective deployment of One Health multisectoral Rapid Response teams. Risk, crisis communication and Community Engagement: The approach fosters trust and better communication with communities, especially in rural and pastoralist settings where animals are integral to livelihoods. Community-based surveillance systems that engage both human and animal health workers have shown to be effective early-warning mechanisms. The analysis of response core capacities in One Health sectors is shown in [figure 4]. However, the presence of foundational structures such as the national One Health platform and Public Health Emergency Operation Centre (PHEOC) suggests significant opportunities. Strategic investment in joint surveillance, simulation exercises, integrated training, and resource mobilization could substantially improve South Sudan's health security architecture.

Conclusion

1. Emergency Preparedness is Inadequate and Fragmented: The overall assessment revealed that while individual institutions within the human, animal, and environmental sectors have made efforts toward emergency preparedness, the lack of coordination significantly undermines effectiveness. Preparedness remains fragmented, with limited multisectoral planning and joint simulations.
2. Emergency Response is often Delayed and Sector-Specific: The study found that response actions are often delayed beyond the critical 48-hour window, particularly for zoonotic and environmental emergencies. This delay is exacerbated by the absence of coordinated rapid response teams, interoperable systems, and joint

contingency plans.

3. One Health Coordination Mechanisms Exist but Are Weakly Operationalized: The presence of a national One Health platform is a positive development; however, its activities are poorly institutionalized, underfunded, and inadequately communicated to operational stakeholders. Engagement across sectors is uneven, and collaboration is mostly reactive rather than strategic.
4. Laboratory and Surveillance Capacities are Underdeveloped: While some functional surveillance systems exist in human health, the integration with animal and environmental sectors is limited. Laboratory infrastructure is weak, with insufficient equipment, human resources, and joint protocols for testing and reporting zoonotic diseases.
5. Risk, crisis communication and Community Engagement (RCCE) is Minimal: A major gap identified is the minimal involvement of communities in preparedness and response. The absence of risk communication, early warning dissemination, and involvement of local leaders limits the ability to detect and respond to threats early.

Recommendations

This study assessed the application of the One Health approach in emergency preparedness and response in Juba, South Sudan, revealing both progress and persistent gaps within the multisectoral health security system. While awareness of the One Health concept among stakeholders was moderate [Table 3], its operationalization remained limited and largely reactive, particularly during outbreak events. Coordination between human, animal, and environmental health sectors lacked formalized structures, consistent engagement, and predictable financing, undermining effective joint planning and response. Surveillance and laboratory

capacities showed notable improvements through partner support; however, these gains were uneven across sectors, with veterinary and environmental systems remaining significantly under-resourced.

Despite these challenges, the presence of national frameworks such as the One Health Strategic Plan, NAPHS, and the PHEOC offers an important foundation for strengthening integrated preparedness. Enhancing collaboration, institutionalizing multisectoral platforms, investing in diagnostic capacity, and promoting joint simulation exercises are critical steps for advancing a functional One Health ecosystem. The findings underscore the need for sustained political commitment, resource mobilization, and capacity building across all sectors. A fully integrated One Health approach will significantly improve South Sudan's ability to prevent, detect, and respond to public health threats, thereby contributing to national resilience and global health security.

1. Strengthen One Health Governance, leadership and Institutional Frameworks

- Develop a national One Health policy with legal and operational frameworks.
- Establishment of One Health act, with the aim of making one health as semi-autonomous institution also known as One Health commission.
- Develop one health strategic plan to guide the full operationalization of OH approach in 10 states and 3 administrative areas.
- Establishment and formulization of One Health Multisectoral Coordination Mechanism launching of One Health Multisectoral

Coordination Mechanism (OH MCM) at national and subnational level (10 state and three administrative areas) with clear governance structure and terms of reference.

- Institutionalize the One Health Multisectoral Coordination Mechanism within key ministries, with defined roles and responsibilities.
 - Allocate domestic resources to support routine activities of the One Health platform such training, simulation exercises, joint deployment and outbreak investigations etc.
2. Establish or strengthen One Health Multisectoral Coordination Mechanism (OH MCM) and One Health secretariat
- Finalize the establishment of Health security, Surge Capacity development and One Health to support fully functionality of OH approach at all levels.
 - Finalize the establishment of One Health secretariat to coordinate One Health activities across the country.
 - Establish the South Sudan One Health HQs office with the Ministry of Health to support secretariat work at all level.
 - Procurement of emergency deployment vehicles and logistic to support rapid joint deployment and coordination across sectors at all level.
 - Conduct regular training, capacity building and supportive supervision for effective functionality of OH MCM at all levels.
 - Finalize the rollout of one health multisectoral coordination mechanism (OH MCM) to the remaining states.

Table 3. % of One Health Multisectoral Coordination Mechanism Stakeholders' Engagement

Sector	Regular Engagement (%)
Human Health	52%
Animal Health	41%
Environmental	28%

Wildlife	16%
Water resources and irrigation	13%
Agriculture and food security	12%
National bureau of standard	09%
Juba city council	07%
Academia	05%

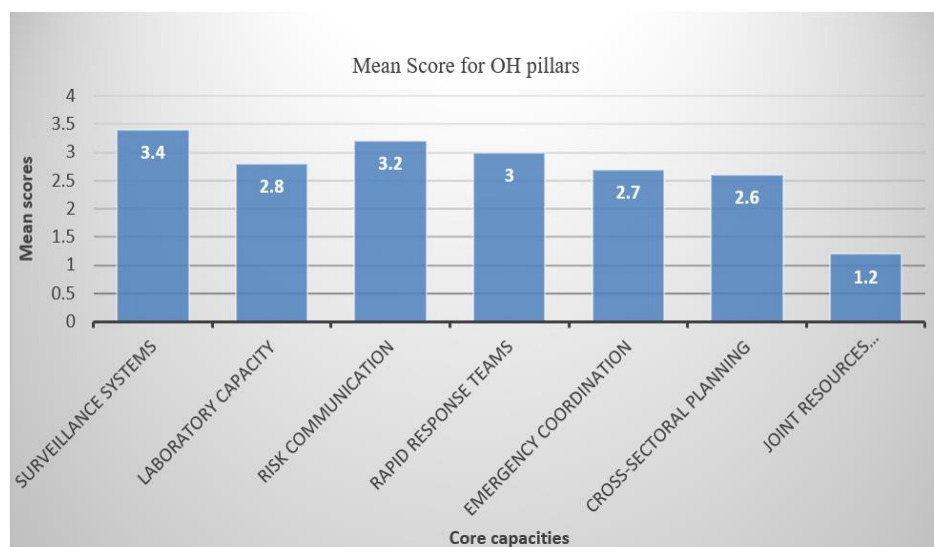


Figure 4. Analysis of Response Core Capacities in One Health Sectors.

Figure 4 shows one health thematic areas (pillars) capacities in sectors by author 2025.

Conflict of Interest

The author declares that there is no conflict of interest associated with the conduct, analysis, or publication of this study. No financial, personal, or institutional relationships influenced the research process or the interpretation of the findings.

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Author Contribution Statement

The author conceptualized the study, designed the methodology, and conducted the data collection and analysis. The author drafted the manuscript, revised all sections critically for important intellectual content, and approved the final version for submission. The author agrees to be accountable for all aspects of the work, ensuring that any questions related to the accuracy or integrity of the study are appropriately investigated and resolved.

Future Research

This study, titled assessment of Emergency Preparedness and Response Using One Health Approach in Juba, South Sudan has equipped principal investigator with broad knowledge of the dynamic and challenges faced by the public health emergency preparedness and response using one health approach in Juba, South Sudan and also identify the research gaps in the area as follow: There is need for father detailed research and study, to evaluate protection aspect to gain an understanding of the political context of the crisis, including who gains and losses from the conflict, and how this impacts

on Public health activate delivery in Humanitarian setting.

Data Availability Statement

The data supporting the findings of this study, *Assessment of Emergency Preparedness and Response Using One Health Approach in Juba, South Sudan*, are available from the corresponding author upon reasonable request. The datasets include survey responses, key informant interview records, and document review materials collected during the study period. Due to ethical considerations, confidentiality agreements, and institutional restrictions, the raw data are not publicly available to protect the privacy of participants and the sensitive nature of emergency preparedness information.

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References

- [1]. Avis., W., 2020, Coping mechanisms in South Sudan in relation to different types of shock.
- [2]. Behnke, R. H., and Osman, H. M., 2012, The contribution of livestock to the Sudanese economy.
- [3]. Cheung, J. M., Basiaga, M., and Olympia, R. P., 2014, Compliance of colleges and universities in the United States with nationally published guidelines for emergency and disaster preparedness. *Pediatric emergency care*, 30(5), pp.319-326.
- [4]. Cox, A., 2022, The assessment of emergency preparedness among university students. *Minnesota State University*, Mankato.
- [5]. Downs, B., Kettner, A. J., Chapman, B. D., Brakenridge, G. R., O'Brien, A. J., and Zuffada, C., 2023, Assessing the relative performance of GNSS-R flood extent observations: Case study in South Sudan. *IEEE Transactions on Geoscience and Remote Sensing*, 61, pp.1-13.
- [6]. Drennan, L. T., McConnell, A., Stark, A., and Drennan, L. T., 2014. Risk and crisis management in the public sector, *Routledge*.
- [7]. George, J., 2022, Mechanisms and contextual factors affecting the implementation of animal health Surveillance in Tanzania: a process evaluation, *Front. Veterin. Sci*, <https://doi.org/10.3389/fvets.2021.790035>
- [8]. Gadberry, M., 2018, Emergency Preparedness Among College Students at the University of Arkansas.
- [9]. Getu, D. K., 2011, Factors Related to Male Participation in Prevention of Mother-to-Child Transmission of Human Immunodeficiency Virus in Three Public Hospitals in Addis Ababa,

- Ethiopia (Master's thesis, University of South Africa (South Africa)).
- [10]. Hill, S., Yusuf, J. E., and Jordan, M. M., 2024, College Students and Hurricane Preparedness: Cluster Analysis of Factors Affecting Vulnerability and Coping Capacity, *In Advances in Hurricane Risk in a Changing Climate*, (pp. 187-208). Cham: Springer Nature Switzerland.
- [11]. Khabbaz, R., Bell, B. P., Schuchat, A., Ostroff, S. M., Moseley, R., Levitt, A., and Hughes, J. M., 2014. Emerging and reemerging infectious disease threats. *Mandell, Douglas, and Bennett's principles and practice of infectious diseases*, p.158.
- [12]. Landesman, L.Y., 2005, Public health management of disasters, The practice guide. *American public health association*.
- [13]. Mann, S., 2012, Building sustainable cities in a post-Katrina nation: HR's role in mitigation and planning. *Public Works Management & Policy*, 17(1), pp.30-51.
- [14]. Mokaba, S. A., 2013, Perceptions of Adolescent High School Learners of HIV Counselling and Testing in Madibeng Sub-district, *North West Province*. University of South Africa (South Africa).
- [15]. Molefi, Z. M., 2014, Exploring the understanding of routinely collected data by the health practitioners in a primary health care setting., *University of South Africa (South Africa)*.
- [16]. Mulei, L., 2017, Mapping livestock value chains in the IGAD region.
- [17]. Murphy, B. L., McBean, G., Dolan, H., Falkiner, L., and Kovacs, P., 2005. Enhancing local level emergency management: the influence of disaster experience and the role of households and neighborhoods. Toronto: Institute for Catastrophic Loss Reduction.
- [18]. Nkala, G. C., 2017., Nursing Student's Perspectives on Spiritual Care in Clinical Nursing Practice in a Selected School of Nursing at Umkhanyakude District in KZN Province. *University of South Africa (South Africa)*.
- [19]. Odhiambo, J., Jeffery, C., Lako, R., Devkota, B., and Valadez, J. J., 2020. Measuring health system resilience in a highly fragile nation during protracted conflict: South Sudan 2011–15. *Health policy and planning*, 35(3), pp.313-322.
- [20]. OpenAI (2025) ChatGPT (GPT-5.2), large language model. Available at: <https://chat.openai.com> (Accessed: 14 December 2025).
- [21]. Otim, M. E., Demaya, D. K., Al Marzouqi, A., and Mukasa, J., 2021, Are antibiotics prescribed to inpatients according to recommended standard guidelines in South Sudan? A retrospective cross-sectional study in Juba Teaching Hospital. *Journal of Multidisciplinary Healthcare*, pp.2871-2879.
- [22]. Perry, R.W., and Lindell, M. K., 2003, Preparedness for emergency response: guidelines for the emergency planning process. *Disasters*, 27(4), pp.336-350.
- [23]. Refisch, J., MacMillan, S., Wright, C. Y., Bett, B., Robinson, D., Wernecke, B., Lee, H., Karesh, W. B., Machalaba, C., Fraenkel, A., and Barbieri, M., 2020, Preventing the next pandemic, Zoonotic diseases and how to break the chain of transmission. *The United Nations Environment Program*.
- [24]. Saba, N., and Balwan, W. K., 2021, Potential threat of emerging and re-emerging zoonotic diseases. *Annals of the Romanian Society for Cell Biology*, 25(5), pp.29-36.
- [25]. Seeger, M. W., Islam, K., and Seeger, H. S., 2021, Emergency preparedness, response, and strategic communication for natural disasters, *the Handbook of strategic communication*, pp.208-221.
- [26]. Soujaa, I., Nukpezah, J. A., and Dimitrijevska-Markoski, T., 2024, A balanced scorecard approach to the homeland security evaluation and exercise program, *risk, Hazards & Crisis in Public Policy*, 15(3), pp.393-407.
- [27]. Sulieman, H. M., 2018, Exploring drivers of forest degradation and fragmentation in Sudan: The case of Erawashda forest and its surrounding community. *Science of the total environment*, 621, pp.895-904.
- [28]. Traore, T., Shanks, S., Haider, N., Ahmed, K., Jain, V., Rüegg, S.R., Razavi, A., Kock, R., Erundu, N., Rahman-Shepherd, A. and Yavlinsky, A., 2023, How prepared is the world? Identifying weaknesses in existing assessment frameworks for global health

security through a One Health approach. *The Lancet*, 401(10377), pp.673-687.

[29]. Unango, K., 2024, South Sudan's bold climate change commitment: A Journey from vision to action. *South Sudan Mining Journal*, 3(1), pp.22-23.

[30]. World Health Organization, 2017, Weekly Bulletin on Outbreaks and other Emergencies: Week 16: 15-21 April 2017. *Weekly Bulletin on Outbreaks and other Emergencies*, pp.1-11.

[31]. World Health Organization, Regional Office for Europe. One Health. <https://www.euro.who.int/en/health-topics/health-policy/one-health> (Accessed December 10, 2021). <https://www.mef.gov.it/en/focus/People-planet-prosperity-The-Italian-G20-Finance-track-00001/>

(Accessed February 25, 2022). <https://www.ispionline.it/it/think-t20-italy>

(Accessed February 25, 2022).

[32]. World Health Organization, 2019, Taking a Multisectoral, One Health Approach. A Tripartite Guide to Addressing Zoonotic Diseases in Countries.

[33]. Zinsstag, J., Schelling, E., Waltner-Toews, D., Whittaker, M., and Tanner, M., 2015, One Health: The Theory and Practice of Integrated Health Approaches. *CABI*, Wallingford, United Kingdom.

[34]. Krejcie, R. V., & Morgan, D. W., 1970, Determining sample size for research activities. *Educational and Psychological Measurement*, 30, 607-610.



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