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Determinants of Vaccine Hesitancy among Parents in Rural Communities of the Greater Upper Nile Region, South Sudan

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Abstract

This study investigates the underlying factors contributing to vaccine reluctance among parents in rural communities within South Sudan's Greater Upper Nile Region, aligning with Sustainable Development Goal 3, which emphasizes reducing child mortality through expanded immunization coverage. Despite global advancements, vaccine hesitancy persists in under-resourced settings. A cross-sectional study involving 375 parents or caregivers across Bor South, Malakal, and Rubkona counties employed a mixed-methods approach, combining structured surveys, desk reviews, Focus Group Discussions (FGDs) with 24 participants, and in-depth interviews (IDIs) with 12 healthcare providers. The research examined key determinants of hesitancy, including socio-economic status, cultural beliefs, knowledge gaps, and the influence of healthcare providers. Findings showed that 69.9% of children were fully vaccinated, while 30.1% were partially or entirely unvaccinated, with primary barriers being financial constraints (74.7%), transportation difficulties (51.7%), and long distances to health facilities (47.7%). Concerns about vaccine safety (86.4%) and lack of awareness (42.1%) also played a significant role. Encouragingly, 96.2% of respondents expressed openness to new vaccines, and 82.7% indicated that support or incentives would improve uptake. In conclusion, while vaccine acceptance is generally high, systemic and informational challenges hinder full coverage, underscoring the need for culturally sensitive, community-based interventions to enhance immunization rates among children in the region.

Keywords*: Immunization, Immunization Determinant, Parental Attitude, Rural Communities, Vaccine Hesitancy, Vaccine Uptake.*

Introduction

Immunization is a highly cost-effective public health intervention that has significantly reduced childhood morbidity, mortality, and disability. It is considered a cornerstone of achieving Sustainable Development Goal 3, which aims to reduce under-five mortality [1]. According to the World Health Organization (WHO), immunization prevents millions of deaths annually. Despite these successes, low-income countries, especially in Sub-Saharan Africa, continue to experience outbreaks of vaccine-preventable diseases (VPDs). Timely vaccination and completion of immunization schedules are crucial for controlling these diseases.

Immunization efforts gained significant momentum in 1974 when the World Health Organization (WHO) launched the Expanded Programme on Immunization (EPI), aimed at helping member states expand vaccination coverage for diseases such as measles, polio, tuberculosis, and tetanus. This initiative has led to notable progress in increasing vaccine coverage across Africa [2]. However, disparities in vaccination rates persist, with some countries still struggling to meet global targets. In 2019, while 116 million infants received essential vaccines, approximately 19.7

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million infants remained unvaccinated, many of whom were from countries like South Sudan [3].

In South Sudan, a nationwide immunization program was launched in 2005 following the signing of the Comprehensive Peace Agreement (CPA). This initiative was further strengthened by the government's development of the basic package of health and nutrition services in 2006 and Health Policy, 2007-2011. Building on these foundational policies, the Ministry of Health, in collaboration with various partners, developed the 2007-2011 Comprehensive Multi-Year Plan for Immunization (cMYP), which served as a roadmap for immunization efforts leading up to South Sudan's independence in 2011.

Prior to the implementation of the Comprehensive Multi-Year Plan for Immunization (cMYP) in 2007, the country experienced major gaps in immunization coverage. Only, around 7.3% of children were fully vaccinated, and coverage for particular vaccinations was disturbingly low. For example, BCG was at 28.3%, DTP-1 at 25.9%, DTP-3 at 22.0%, and measles at only 16.8%. A particularly serious issue was the 41% dropout rate between the first and third DTP dose. Up to 80.8% of vaccines were administered in health facilities, with 19.2% administered at community service locations. Potentially highlighting an issue with access to vaccines in other settings, such as mobile vaccination sites, rural areas, or non-medical locations like schools and workplaces.The primary obstacle to vaccination was a lack of adequate information, with 41.1% of respondents cited as the main reason for missing vaccines [4].

In 2011, a survey was carried out to evaluate the effects of the cMYP, showing significant enhancements in immunization coverage despite persistent obstacles like lack of access, instability, and inadequate health facilities. These results emphasized how the cMYP is successful in closing the immunization gaps and enhancing vaccination rates nationwide. The DTP-3 coverage increased significantly from 20% in 2007 to 80% in 2011, showing a notable enhancement in access to and distribution of vaccines. In addition, there was a decrease in the dropout rate from 41% to 26% between the first and third DTP doses, showing improved retention during the vaccination procedure. Nevertheless, it is crucial to highlight that enhancements in coverage did not occur uniformly nationwide. Immunization rates still varied greatly, showing significant discrepancies observed between different states and counties [4].

These disparities highlight the need for targeted interventions and a more localized approach to immunization, ensuring that even the most remote and underserved populations receive equitable access to vaccines. While progress has been made, addressing these inconsistencies remains a critical challenge in achieving nationwide immunization goals.

In 2019, the World Health Organization ranked vaccine hesitancy as one of the top 10 global health threats. Research on COVID-19 vaccination suggests that rural areas frequently display various factors that contribute to this reluctance [5].

Vaccine hesitancy has been a persistent problem in South Sudan, hampering the acceptance of various vaccines, including the COVID-19 vaccine, due to the fact that the majority of the population in South Sudan lives in rural areas. As of July 2021, South Sudan had only administered 56,989 COVID-19 vaccine doses, compared to the global total of over 3.5 billion doses [6]. With approximately 11.2 million inhabitants, this limited adoption highlights larger issues within the nation. Studies on vaccine reluctance in South Sudan reveal sceptical altitudes towards authorities, along with stigma driven by fear, anger, misinformation, and a perception of low risk-problems that are also observed worldwide [6].

The nation continues to encounter difficulties in accessing distant and vulnerable regions. This research aims to investigate the

factors causing inadequate access to and usage of immunization services, especially in counties experiencing fragility, emergencies, and flooding in the Great Upper Nile region of South Sudan.

Problem Statement

Vaccine hesitancy is a significant global health issue, with varying levels across regions. A 2023 meta-analysis found that 21.1% of parents worldwide express hesitancy toward vaccinating their children. This issue has been amplified by the COVID-19 pandemic, which affected vaccine confidence. A 2022 survey across 23 countries found that while 75.2% of respondents were willing to accept the COVID-19 vaccine, hesitancy varied greatly, from just 1% in the UK to 21.1% in South Africa [7]. In 2023, the WHO reported that 14.5 million children missed vaccinations globally, underscoring the need for increased efforts to address hesitancy [6].

The WHO has identified vaccine hesitancy as one of the top global health threats, contributing to the resurgence of diseases like measles and pertussis. A study in *The Lancet* showed that hesitancy decreases vaccine coverage, increasing the risk of outbreaks. The COVID-19 pandemic worsened this issue, emphasizing the need for targeted interventions to build trust and improve vaccination rates [7].

This research aims to explore the key factors influencing vaccine hesitancy in rural communities, particularly in South Sudan's Greater Upper Nile Region, to develop strategies that improve vaccine acceptance and public health outcomes.

Rationale of the Study

It is crucial to assess vaccine hesitancy among parents in rural communities of the Greater Upper Nile Region to better understand the specific barriers to vaccination in this area. Comprehending these obstacles will lead to the creation of specific, culturally aware actions that can enhance vaccine acceptance, lessen disease impact, and help achieve the overall objective of enhancing public health in South Sudan. Tackling vaccine hesitancy in these areas is essential not just for the well-being of the children and families locally, but also for the overall progress of international health and development objectives.

General and Specific Objectives of the Study

The purpose of this study is to determine factors contributing to vaccine hesitancy among parents in rural communities of the Greater Upper Nile Region of South Sudan.

General Objective

To Identify the factors contributing to vaccine hesitancy in Greater Upper Region of South Sudan.

Specific Objectives

1. To assess the current immunization rates and identify factors that influence vaccine uptake in rural communities of the Greater Upper Nile Region, South Sudan.
2. To examine the socio-economic factors that could contribute to vaccine hesitancy in the rural communities of Greater Upper Nile Region.
3. To Explore the Role of Healthcare Providers in Addressing Vaccine Hesitancy.

Review of Literature

Vaccination is widely recognized as one of the most effective public health strategies, playing a crucial role in significantly reducing the incidence of preventable childhood illnesses. However, vaccination rates remain insufficient in many rural areas, contributing to higher morbidity, mortality, and economic burdens. This review examines the various costs associated with low vaccination coverage, as well as the socio-economic and healthcare provider factors that influence vaccine acceptance in rural communities.

Inadequate vaccination rates cause outbreaks of preventable illnesses like measles, polio, and whooping cough, leading to significant treatment expenses for families and healthcare providers. These outbreaks exert extra pressure on healthcare systems that are already lacking adequate funding [8]. In rural economies, where agriculture or manual labor is frequently the mainstay, diseases that can be prevented by vaccines lead to absences from school and work, exacerbating poverty. Parents caring for their ill children lose income, which further reduces local economic productivity [9]. Illnesses such as meningitis and rubella can result in permanent disabilities, hindering children's economic contributions, thereby imposing extra strain on families and communities [10].

Several studies have recognized a range of interrelated elements that influence vaccination rates in rural regions. Geographic isolation and restricted access to healthcare services pose significant obstacles; since long distances, inadequate transportation, and insufficient infrastructure impede vaccination initiatives [11]. Financial limitations, like the incapacity to manage indirect expenses such as transport or lost wages, additionally hinder families from pursuing vaccinations. Even if vaccines are provided at no charge, these concealed expenses frequently render immunization unaffordable [12]. Insufficient health education and common misunderstandings about vaccines lead to decreased vaccination rates and misinformation, along with conventional beliefs in rural communities, frequently hinders the acceptance of vaccination [13].

Cultural opposition and a historical skepticism toward government-driven health programs also pose considerable obstacles. Social factors, including the views of relatives or community figures, can either promote or obstruct vaccination rates [14]. Moreover, the shortage of healthcare personnel, insufficient vaccines, and the high workloads of healthcare providers in rural regions lead to missed chances for vaccination [15]. Tackling these issues demands specific immunization strategies designed for the requirements of rural populations. Mobile vaccination units, outreach initiatives, and adaptable immunization schedules can help in overcoming access barriers. Public health initiatives aimed at addressing vaccine hesitancy are essential for increasing vaccine acceptance.

Various intervention strategies have been suggested to tackle these obstacles. Mobile vaccination units offer easy vaccine access in isolated regions, addressing logistical challenges. These clinics are most successful when paired with community outreach initiatives aimed at increasing awareness about the significance of vaccination [16]. Health education provided by community health workers and local leaders is crucial for enhancing vaccine awareness and combating misinformation. Involving trusted community leaders builds confidence and promotes vaccination rates. Financial incentives like transportation subsidies or wage loss compensation can ease financial barriers, simplifying the process for families to vaccinate their children. In certain regions, providing minor incentives for vaccination involvement has shown to boost vaccination rates [17].

Socio-economic status (SES) serves as a significant indicator of vaccine hesitancy, as studies consistently demonstrate that people from lower SES backgrounds tend to be more likely to hesitate or decline vaccination. This relationship is influenced by various elements, such as availability of healthcare, understanding of health information, and the dissemination of false information. Individuals with lower incomes frequently encounter obstacles like restricted healthcare access, difficulties with transportation, and economic uncertainty, which may cause vaccination to take a back seat to urgent financial issues. Additionally, reduced education levels are associated with increased vaccine hesitancy, as those with less education might not have access

to reliable health information and are more prone to misinformation [18].

The status of employment also affects vaccine hesitancy. People in steady jobs, especially those with health coverage and paid time off, are more inclined to get vaccinated because they have better access to healthcare. On the other hand, individuals employed in low-wage or gig economy positions, who frequently do not have access to healthcare benefits or paid leave, encounter more difficulties in receiving vaccines, resulting in increased hesitancy [19]. Occupation also influences vaccination rates, as workers in healthcare and education generally demonstrate higher rates due to workplace mandates and better health literacy, whereas individuals in sectors lacking such policies might be more reluctant [20].

Cultural and societal elements likewise play a role in vaccine reluctance. Communities possessing reduced social capital—characterized as the networks, norms, and trust that promote collaboration—are more prone to encountering vaccine misinformation. Furthermore, past injustices and a lack of trust in the healthcare system, especially within marginalized communities, can intensify hesitancy. For instance, past wrongs like the Tuskegee Study and coerced sterilizations lead to profound mistrust of vaccination initiatives in certain communities [21].

The availability of healthcare, particularly in rural or underprivileged regions, is another significant element affecting vaccine reluctance. Geographic, financial, and systemic obstacles might restrict vaccine availability, lowering vaccination rates for those who require it the most [22]. Insufficient health insurance or poor coverage diminishes trust in the healthcare system and may increase vaccine hesitancy. Government initiatives like focused vaccination programs, mobile health clinics, and public health campaigns are crucial in reducing vaccine hesitancy among low-income groups. In the absence of these initiatives, people from underprivileged socio-economic backgrounds might continue to doubt the safety, effectiveness, or necessity of vaccines. Nevertheless, vaccine mandates, especially those lacking proper enforcement or adaptability, can generate further obstacles and intensify hesitancy [23]. Ultimately, the media—particularly social media—influences public perception of vaccines, as people from lower SES backgrounds are more susceptible to false information. Insufficient media literacy and minimal interaction with reliable public health information can contribute to the dissemination of anti-vaccine material, strengthening unfavorable.

Healthcare professionals (HCPs) are typically viewed as the most trustworthy sources of vaccine information. Research indicates that patients have greater confidence in the guidance provided by doctors, nurses, and pharmacists compared to information from media or social networks [24]. This confidence places HCPs as essential players in encouraging vaccination. Nonetheless, studies also show that numerous providers might not pose the required knowledge, training, or communication abilities to properly tackle vaccine hesitancy [25].

Clear communication is vital in addressing reluctance. Research highlights the significance of straightforward, compassionate, and non-aggressive communication [25]. Providers who participate in patient-focused conversations, attentively consider concerns, and thoughtfully correct misinformation tend to enhance vaccine acceptance [25]. The understanding that healthcare providers possess regarding vaccines—specifically their safety and effectiveness—directly affects their ability to confidently challenge myths and false information [26]. Consequently, continuous education in immunization is crucial for providers to remain updated and address patients' inquiries effectively.

The beliefs and attitudes of healthcare providers on a personal level can also influence

their vaccine advocacy. On one hand, providers with negative views on vaccines or worries about their safety might be less inclined to promote vaccination vigorously [27]. On the other hand, providers who are enthusiastic about vaccines take a more active role in promoting vaccination.

Healthcare professionals implement multiple approaches to tackle vaccine hesitancy, mainly by offering transparent, evidence-based information concerning the safety and effectiveness of vaccines as well as the dangers associated with not vaccinating. Establishing trust with patients, customizing suggestions to their specific issues, and taking cultural backgrounds into account are vital approaches [28]. Motivational interviewing (MI) assists patients in examining and addressing their mixed feelings about vaccination and has been found effective in enhancing vaccine acceptance [28].

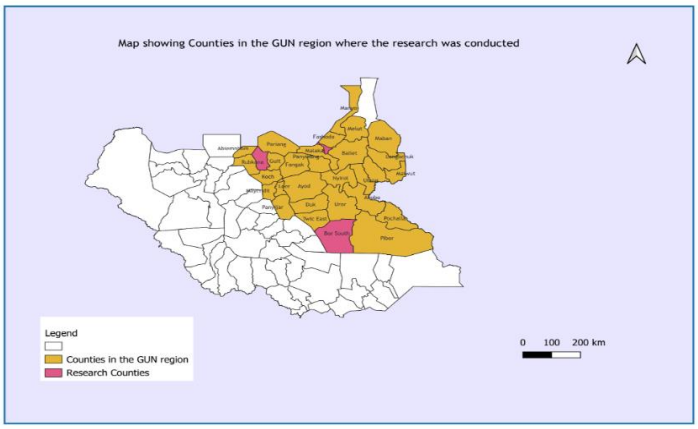
Even though they play a crucial role, healthcare providers encounter various obstacles in tackling vaccine hesitancy. Time limitations in clinical environments—like brief patient appointments and large workloads restrict their capacity to engage in thorough vaccine conversations [37]. Certain providers may not have undergone formal training in vaccine advocacy and could feel ill-equipped to participate in discussions about vaccines [25]. Cultural and socio-economic elements, such as language obstacles, varying beliefs, and monetary limitations, may additionally hinder vaccine advocacy.

Various interventions can assist healthcare providers in surpassing these obstacles and enhance their capacity to tackle vaccine hesitancy. Training initiatives centered on communication, cultural awareness, and approaches to address vaccine hesitancy can improve providers' efficacy. Equipping healthcare professionals with trustworthy, evidence-based resources and decision-making tools can assist them in delivering well-informed advice .Public health efforts that coincide with provider actions can establish a cohesive message and diminish misinformation.

Methodology

Study Design

This study employed a descriptive cross-sectional design, which enabled the collection of both quantitative and qualitative data at a single point in time to assess immunization coverage rates and factors influencing vaccine uptake. A cross-sectional design is particularly suitable for estimating prevalence and exploring associations between health behaviors and socio-demographic variables within a population [29]. This approach was appropriate for evaluating the extent of vaccine hesitancy, examining socio-economic determinants, and understanding the role of healthcare workers in influencing vaccination behaviors in rural communities of the Greater Upper Nile Region of South Sudan.



Study Site

The Greater Upper Nile Region comprises three states (Jonglei, Unity, and Upper Nile) and two administrative areas (GRAA and GPAA), totaling 33 counties. The target population consisted of caretakers or guardians of children aged 0–11 months living in rural areas. These individuals were the primary decision-makers regarding child immunization. The region includes 81 Payams and 300 Bomas, each reflecting distinct cultural dynamics that may affect vaccine perceptions. With an estimated population of 5,192,528, approximately 207,701 children were under one-year of age [30]. Among them, 172,342 had received the Penta 1 dose, while 35,359 were identified as zero-dose children [31].

The study focused on three counties—Malakal, Bor, and Rubkona—with a combined population of 798,131, including 135,682 children under the age of one-year old [31].

Sampling Procedures

To ensure representativeness across diverse ethnic groups and rural locations, the study utilized stratified random sampling, a method that ensures proportional inclusion from subgroups within the population [32].

The sampling process followed four key steps:

1. The Greater Upper Nile Region was stratified into its constituent states and counties.
2. One county was randomly selected from each of the three states.
3. Within each selected county, clusters (villages or communities) were identified using administrative records.
4. Two villages were randomly selected per county, and within each village, households with children aged 0–11 months were selected using simple random sampling.

Sample size estimation was based on an expected vaccine hesitancy rate of 30–40%, with a 95% confidence level and a 5% margin of error. A sample size calculator was used to determine the minimum number of respondents per village to ensure statistical power and precision [32].

Inclusion and Exclusion Criteria

- Inclusion criteria were caretakers or legal guardians of children aged 0–11 months who resides in the selected villages and could provide informed consent (either directly or via a proxy due to illiteracy).
- Exclusion criteria included non-residents, caretakers of children over 11 months, and those unwilling or unable to participate.

The study adopted a mixed-methods approach, integrating both quantitative and qualitative data to comprehensively understand vaccine hesitancy. This approach allowed the triangulation of findings and enhanced the validity of the data [29].

Data collection instruments included structured questionnaires for key informants, focus group discussion (FGD) guides, and in-depth interview (IDI) protocols. Data collectors received comprehensive training on the data study tools, research ethics, data quality, and cultural competence to ensure rigor and sensitivity during data collection.

The study engaged 375 caretakers for Key Informant Interviews (KIIs) (125 per county), 24 caretakers for FGDs, and 12 community leaders and healthcare professionals for IDIs.

Quantitative Component

Quantitative data were collected using a structured and pre-tested questionnaire, which included the following sections:

- Demographic information (age, education, occupation, household size).
- Child vaccination status (not immunized, partially immunized, fully immunized).
- Factors influencing vaccine hesitancy, such as socio-economic status and the role of healthcare providers.

- Healthcare access (proximity to health facilities, availability of vaccines, infrastructure challenges).
- Vaccine Hesitancy Score, assessed using a 5-point Likert scale, measuring agreement with statements like "Vaccines are harmful" or "Vaccines are necessary for my child's health."

Qualitative Component

The qualitative component was designed to explore the underlying causes of vaccine hesitancy. Three FGDs were conducted (one in each village), with 6–8 participants per group. These were facilitated by trained moderators following best practices for group dynamics and cultural sensitivity [33].

Twelve key informants (four per county), including healthcare workers, religious leaders, and community elders, participated in IDIs to provide context-specific insights into barriers and enablers of vaccine acceptance.

Data Analysis

Quantitative data were analyzed using statistical software such as SPSS or Stata. Descriptive statistics (frequencies, percentages) were used to summarize demographic characteristics and vaccine hesitancy levels. Bivariate analyses (e.g., Chi-square tests, t-tests) identified relationships between hesitancy and socio-demographic factors.

All qualitative data were transcribed and subjected to thematic analysis, following Braun and [29]. Six-phase framework: familiarization, coding, theme development, reviewing, defining, and writing up. Analysis was conducted manually to allow nuanced interpretation of local contexts and narratives.

This methodological approach ensured that both numerical trends and lived experiences were captured, yielding a comprehensive understanding of the determinants of vaccine uptake and hesitancy in the Greater Upper Nile Region.

Results

The study was conducted in three counties including Bor South, Malakal and Rubkona from Jonglei, Upper Nile and Unity States respectively. A total of 375 caretakers participated for the KIIs, while 24 participated for the FGDs and 12 community leaders and healthcare professional for the IDIs. This study highlights both progress and persistent challenges in immunization coverage within the Greater Upper Nile region of South Sudan. While 69.9% of children were reported as fully vaccinated and national DPT3 coverage rose from 59% in 2018 to 73% in 2023, only 51.5% of families indicated that all their children were fully immunized. This gap points to continued reliance on outreach services and underperformance of routine immunization systems.

Current Immunization Rates

Immunization coverage was relatively high, with 69.9% of children fully vaccinated, though only half (51.5%) of families reported all their children immunized, while 41.9% had partial coverage and 4% had none. In 2023, South Sudan achieved 73% DPT3 (Diphtheria, Pertussis and Tetanus) coverage among one-year-olds, up from 59% in 2018. The introduction of the malaria vaccine in 2024 and the upcoming Pneumococcal Conjugate Vaccine (PCV) and Rota Virus Vaccine (RVV) rollouts signal progress (See the below figure).

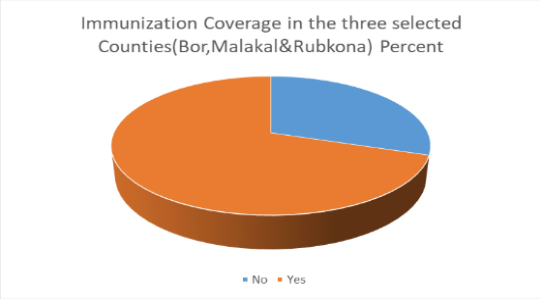


Figure 1. Immunization Coverage

Barriers to Access to Vaccination

Access to vaccination was hindered by financial constraints (74.7%), transportation barriers (51.7%), and long travel distances, with 47.7% of respondents reporting journeys over 10 km to reach vaccination centers (see Figures 2 and 3).

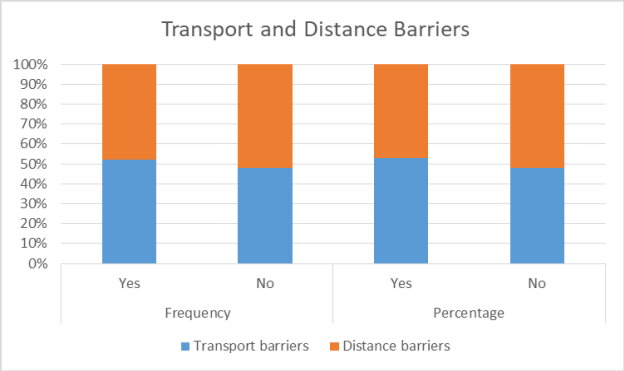


Figure 2. Transportation & Distance Barriers

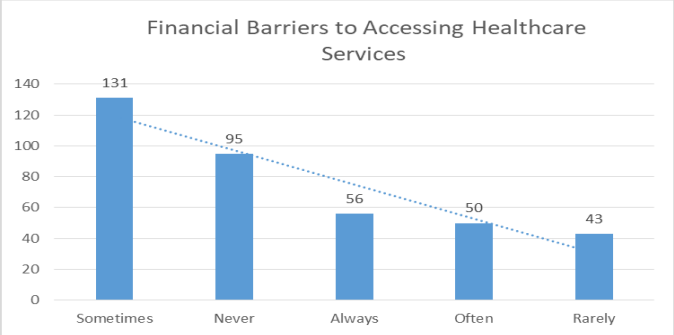


Figure 3. Financial Barriers to Accessing Health Services

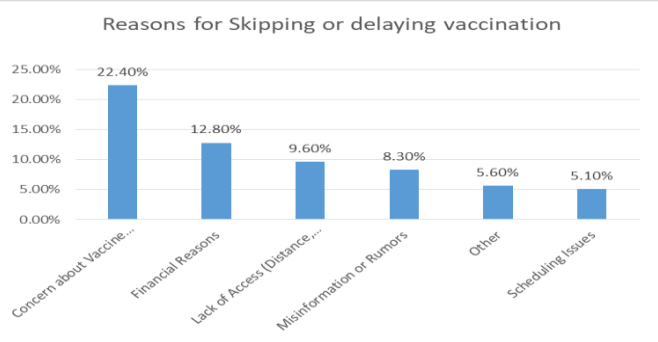


Figure 4. Reasons for Skipping or Delayed Vaccination

In the broader context of healthcare-seeking behavior, the frequency of visits to health facilities is revealing. Most parents (54.1%) reported taking their children for vaccination five or more times, which supports the finding that 69.9% of children received all recommended vaccines. However, barriers remain: 51.7% of respondents reported transportation challenges, and 47.7% reported traveling over 10 kilometers to reach vaccination centers. These logistical challenges, combined with concerns about side effects (reported by 5.1% of those who delayed/skipped vaccination) and financial difficulties (22.4%), highlight the multi-dimensional nature of access issues (see Figure 5 &Table 1).

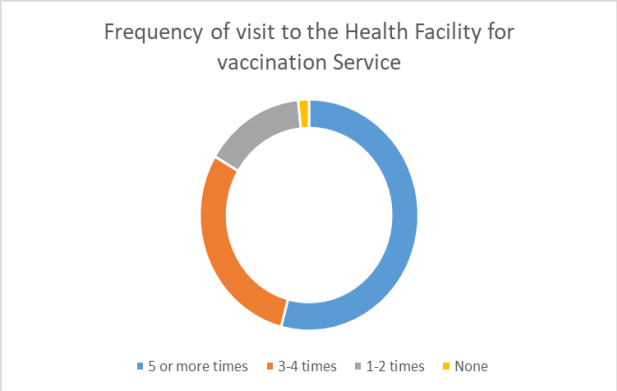


Figure 5. Frequency of Visit to the Health Facility for Vaccination Service

Table 1. Caretakers Healthcare Access and Behavior

Number of visits to the health facility for vaccination	**Frequency**
1-2 times	56
3-4 times	110
5 or more times	203
None	6

The data shows that a substantial proportion of respondents (46.4%) had no formal education, and this group accounted for nearly half (46%) of the children who had not received all recommended vaccinations. However, the chi-square test (p = 0.391) revealed no statistically significant relationship between the respondent's level of education and child vaccination status (see Table 2).

Table 2. Respondent Level of Education vs. Child's Vaccination Status

Chi-square test	**Value**	**Degree of freedom**	**Significancy level (2-sided)**
Pearson Chi-Square	3.004[a]	3	0.391
Likelihood Ratio	3.242	3	0.356
N of Valid Cases	375		
a. 1 cells (12.5%) have expected count less than 5. The minimum expected count is 4.22.			

Vaccine Hesitancy

Vaccines hesitancy was widespread, with 86.4% expressing safety concerns and 45.3% admitting to delayed or skipped vaccinations, primarily due to financial constraints (22.4%), distance and transport issues (12.8%), and misinformation (8.3%) (see Table 3).

Table 3. Likelihood of Accepting New Vaccines vs. Child's Vaccination Status

Chi-square test	Value	Degree of freedom	Significance level (2-sided)
Pearson Chi-Square	22.153a	2	.000
Likelihood Ratio	20.392	2	.000
N of Valid Cases	375		
a. 1 cells (16.7%) have expected count less than 5. The minimum expected count is 4.22.			

A strong, statistically significant was found between parents' stated likelihood of accepting new vaccines and whether their child was fully vaccinated. Parents who reported being "very likely" to accept new vaccines had the highest proportion of children fully vaccinated (73.7%) ($p = 0.000$), while those "unlikely" to accept new vaccines were far less likely to have vaccinated children (14.3%).

Attitudes and Trust towards Vaccination

Attitudes toward vaccination were largely positive, with 97.3% viewing vaccines as necessary, 95.8% recognizing their importance for disease prevention, 80.3% receiving information from healthcare providers, 87.7% expressing high trust in health professionals, and 88% believing the government is adequately supporting immunization efforts (see Tables 4 and 5).

Table 4. Caretakers Attitude towards Immunization

Valid	Frequency	Percent	Valid percent	Cumulative percent
No	51	13.6	13.6	13.6
Yes	324	86.4	86.4	100.0
Total	375	100.0	100.0	

Trust emerged as a critical factor: a statistically significant relationship was shown between trust in healthcare providers and vaccination status ($p = 0.000$). Children of parents who reported "very high" trust in providers were much more likely to be fully vaccinated (76.6%). Conversely, low or no trust correlated with lower vaccination completion.

Table 5. Trust in Healthcare Providers vs. Child's Vaccination Status

Chi-square test	Value	Degree of Freedom	Significance level (2-sided)
Pearson Chi-Square	22.153a	2	.000
Likelihood Ratio	20.392	2	.000
N of Valid Cases	375		
a. 1 cells (16.7%) have expected count less than 5. The minimum expected count is 4.22.			

Delayed or Skipped Vaccinations

According to the data, 54.7% of parents and caregivers have never delayed or skipped any vaccinations for their children, while 45.3% admitted to delaying or skipping vaccines.

Among those who delayed or skipped vaccinations, the top reasons cited include financial constraints (22.4%), concerns about vaccine side effects (5.1%), and lack of access (12.8%), including issues related to distance and transportation. Additionally, misinformation or rumors (8.3%) and scheduling issues (5.6%) were also factors (see Table 6 and Figure 4).

Table 6. Reason for Skipping/Delayed Vaccination

Reason	Frequency
Concern about Vaccine Side Effects	19
Financial Reasons	84
Lack of Access (Distance, Transportation)	48
Misinformation or Rumors	31
Other	36

Discussion

While 69.9% of children are fully vaccinated, only 51.5% of families report full immunization, indicating a dependence on outreach services over routine care. The presence of partial (41.9%) and no coverage (4%) highlights ongoing barriers related to access and information. These disparities underscore the need for targeted strategies to ensure more equitable vaccine delivery, as emphasized by Bangura [34].

Barriers to access to Vaccination

Despite high levels of trust in vaccine safety (86%) and recognition of their benefits (97%), only 55% of respondents complete vaccinations on time, revealing a gap between intention and action. This suggests that structural barriers—like cost, transportation, and misinformation—can hinder vaccine uptake even when attitudes are positive, echoing findings by Bangura, Omer, Bauch and Madhavan [34].

The findings show no significant link between caregivers' education levels and access to vaccination services. This indicates that education is not a key barrier to childhood immunization, as the vast majority (97.3%) of parents, regardless of education, acknowledge the importance of vaccines—aligning with results from Fenta [35].

This reinforces earlier data showing high levels of vaccine hesitancy concern, where 86.4% of respondents expressed safety concerns about vaccines, and highlights the potential risk of hesitancy impacting real-world behaviors. Thus, increasing confidence in both existing and new vaccines could directly improve immunization coverage.

To improve vaccine uptake, the studies by Adamu, and Madhavan recommends expanding community outreach through mobile units and local partnerships, providing financial support like transport subsidies, and enhancing health education with tailored, accessible communication for low-literacy populations strengthening vaccine [36].

Attitudes and Trust towards Vaccination

This finding reinforces earlier results showing that 80.3% of respondents received vaccination information from healthcare providers, highlighting the critical role of trusted communication channels. It also aligns with the observation that 52.5% of respondents reported "very high" trust in providers, emphasizing trust not only as a key predictor of

vaccine uptake but also as a valuable leverage point for targeted interventions.

Despite 88% expressing satisfaction with immunization efforts, 83% still needed more support, highlighting that appreciation of services does not equate to adequate access—underscoring the need for practical interventions like those recommended by Madhavan and Adamu [36]. With 96% willing to adopt new vaccines, the population shows strong intent, but turning this into action requires strengthened support systems and culturally sensitive outreach—consistent with Dubé and MacDonald , who emphasize the role of trust and clear communication in vaccine acceptance [37].

Delayed or Skipped Vaccinations

The relatively high percentage of parents who delayed or skipped vaccinations highlights the need to explore the underlying reasons and potentially address barriers to timely immunization, these reasons underscore a complex mix of logistical, financial, and informational challenges that may need to be addressed through policy interventions or targeted awareness campaigns. In rural communities, financial hardship (64%), limited information (20%), and transportation barriers significantly hinder vaccine access, reflecting systemic healthcare inequities highlighted by Bauch [38]. Strengthening vaccine uptake requires empowering healthcare providers with culturally competent communication skills and motivational interviewing, while also leveraging trusted community figures to combat misinformation and reinforce positive vaccination norms [39].

Conclusion

Despite high levels of trust in vaccine safety and a strong willingness to adopt immunization, rural populations face significant barriers that hinder timely and complete vaccination. These challenges—rooted in socio-economic disparities, limited infrastructure, and inadequate follow-up systems—create a disconnection between intent and action. The findings highlight the need for targeted, practical interventions such as mobile outreach, financial support, and tailored health education to bridge this gap. Additionally, empowering healthcare providers with culturally competent communication skills and engaging trusted community figures are critical strategies to combat misinformation and promote sustained vaccine uptake. Addressing these structural and social determinants is essential to achieving equitable immunization coverage in rural areas.

Recommendations

1. **Expand Mobile and Community-Based Outreach;** Deploy mobile vaccination units and organize regular immunization drives in remote and underserved areas to improve physical access to vaccines.
2. **Provide Financial and Logistical Support:** Introduce targeted subsidies for transportation and lost income during clinic visits, and implement reminder systems (e.g., SMS alerts) to improve dose completion rates.
3. **Enhance Health Education Campaigns**: Develop culturally sensitive, low-literacy educational materials in local languages to address knowledge gaps and clarify misconceptions about full vaccination coverage.
4. **Empower Healthcare Workers**: Train rural healthcare providers in motivational interviewing and culturally competent communication to better engage hesitant individuals and build trust.
5. **Leverage Community Leaders and Trusted Voices**: Partner with local leaders, religious figures, and community influencers to disseminate accurate vaccine information and counteract misinformation effectively.
6. **Strengthen Rural Healthcare Infrastructure**: Invest in health system improvements, including better vaccine

storage, reliable transportation for health workers, and consistent staffing in rural clinics.

7. **Monitor and Evaluate Program Effectiveness**: Establish monitoring mechanisms to track vaccination uptake, missed doses, and public perceptions to continuously adapt and improve intervention strategies.

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Conflict of Interest

I Martin Taban Andrea Tulio declare there is no conflict of interest in all forms.

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