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Access to COVID-19 Vaccines in Wenchi Municipality, Ghana: An Analysis through the Health Belief Model

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Abstract

Equitable access to COVID-19 vaccines remains a major public health priority worldwide. While Ghana initiated nationwide vaccination in early 2021, coverage rates in the Bono Region, and particularly in Wenchi Municipality, lagged behind national targets. Accessibility challenges span across physical, logistical, and social dimensions. This influences individuals' ability and willingness to receive the vaccine. A mixed-method, cross-sectional study was used to recruit 288 adults in Wenchi Municipality via probability proportional to size sampling. Data was collected using a structured questionnaire with both closed and open-ended items. Quantitative data were analyzed with descriptive and inferential statistics, while qualitative data underwent thematic analysis. The Health Belief Model (HBM) provided the basis for the conceptual framework for examining accessibility factors. Physical access barriers such as poor road infrastructure, long distances to vaccination points, and reliance on walking were identified as significant factors. Logistical challenges included occasional vaccine stockouts, confusion about eligibility, and indirect costs such as transport. Social access barriers included stigma (17.6% of respondents), religious and cultural objections (3.8%), and mistrust fueled by misinformation. Contributory factors to accessibility included encouragement from family and friends, endorsements by community leaders, and convenient operating hours at most sites. Access to COVID-19 vaccines in Wenchi Municipality is constrained by a complex interplay of geographic, operational, and socio-cultural factors. Addressing these requires a multi-pronged approach: mobile vaccination teams, reliable supply chains, culturally attuned messaging, and visible endorsements from trusted local figures. The HBM recommendations framework provided offers practical, theory-based guidance for policymakers and practitioners.

Keywords: *Accessibility, COVID-19 Vaccination, Health Belief Model, Vaccine Uptake, Wenchi Municipality.*

Introduction

The coronavirus disease 2019 (COVID-19) pandemic has posed one of the most significant public health challenges in modern history. Originating in Wuhan, China, in late 2019, the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) rapidly spread globally, leading the World Health Organization (WHO) to declare it a Public Health Emergency of International Concern in January 2020, and subsequently a pandemic in March 2020 [1]. By May 2024, more than 775 million confirmed cases and over 7 million deaths had been

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reported worldwide [2]. The pandemic disrupted health systems, economies, and social structures, placing unprecedented strain on national and community-level resources.

Vaccination emerged as the cornerstone of pandemic control. Multiple vaccine types were developed, tested, and approved under emergency use authorizations in record time [3]. The WHO-led COVAX initiative aimed to ensure equitable global vaccine access, particularly for low and middle-income countries (LMICs). While high-income countries reached coverage levels above 70% within the first year of vaccine rollouts, disparities persisted in LMICs, including Ghana, due to supply constraints, distribution challenges, and vaccine hesitancy [4].

Ghana began its COVID-19 vaccination program in February 2021, receiving its first doses through COVAX [5]. Initial priority groups included healthcare workers, security personnel, the elderly, and individuals with comorbidities. However, despite national targets to vaccinate at least 70% of the eligible population by mid-2022, progress was uneven. By December 2023, 71.6% of the target population had received at least one dose, but full vaccination coverage stood at only 56.7% [6]. Coverage was even lower in certain regions, including Bono Region, where Wenchi Municipality recorded only 25.3% full vaccination by July 2024.

Accessibility is a critical determinant of vaccination uptake, encompassing physical, logistical, and social dimensions. Physical access refers to the geographic proximity of vaccination sites and the transportation infrastructure that enables travel to them [7]. Logistical access includes vaccine availability, operational hours, eligibility criteria, and service organization [8]. Social access reflects cultural norms, stigma, trust in health systems, and the influence of community leaders [9].

In many LMICs, including Ghana, physical access is limited by rural geography, poor road networks, and long distances to health facilities [32]. Logistical challenges often arise from irregular supply chains, cold-chain requirements, and limited human resources for vaccine delivery. Social access is further constrained by misinformation, religious opposition, and political mistrust [14, 33].

Wenchi Municipality presents a microcosm of these barriers. Spanning a land area of 7,619 km², it includes both urban centers and remote rural communities. While some residents live within walking distance of hospitals or Community-Based Health Planning and Services (CHPS) compounds, others face significant travel burdens. Public transport options are limited, particularly in rural areas, and road conditions deteriorate during the rainy season, making access to health services challenging [10].

The Health Belief Model and Accessibility

The Health Belief Model (HBM) offers a useful theoretical framework for understanding vaccine uptake behaviors. Initially developed in the 1950s to explain preventive health actions, the HBM posits that individuals' decisions are shaped by Modifying Variables, Perceived Susceptibility, Perceived Severity, Perceived Benefits, Perceived Barriers and Cues to Action. The perceived susceptibility and severity; and the perceived benefits and barriers finally influence the individual's behavior on uptake of COVID-19 vaccine.

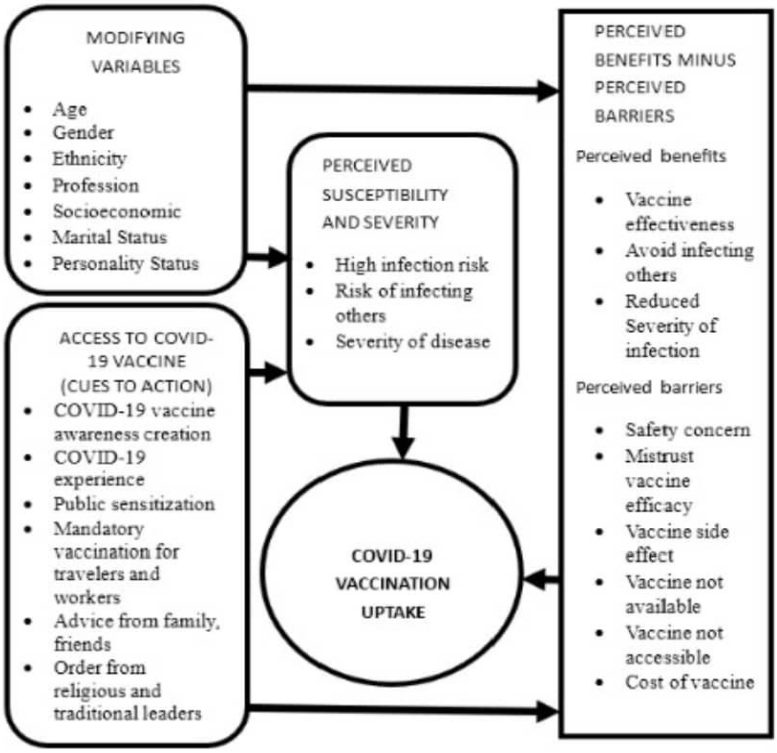

Figure 1. Conceptual Framework

Source: Adopted from the Health Belief Model of [11,12].

In the context of the HBM, as depicts by figure 1 above, vaccine accessibility, physical and logistical constraints can be interpreted as *perceived barriers*, while proximity to services and reliable supply enhance *perceived benefits*. Social cues: such as community leader endorsements or seeing peers get vaccinated: function as *cues to action*. Modifying variables like age, gender, education, and socio-economic status influence how individuals perceive both the risks of disease and the benefits of vaccination.

Recent studies have applied the HBM to COVID-19 vaccination in diverse settings. [13] found that perceived barriers and benefits were the most significant predictors of vaccine hesitancy, while [35] highlighted the importance of social cues in overcoming reluctance. Recent studies that applied the HBM to COVID-19 vaccination in diverse settings [13], found that perceived barriers and benefits were the most significant predictors of vaccine hesitancy, while [35] highlighted the importance of social cues in overcoming reluctance. In Ghana, Abubakari *et al* reported that misinformation and mistrust in vaccine safety reduced uptake, but community-based advocacy improved acceptance [14].

Global and African Contexts of Vaccine Accessibility

Globally, vaccine inequities have mirrored broader health inequalities. High-income countries secured the bulk of early vaccine supplies, while LMICs faced prolonged shortages [8]. Geographic disparities also emerged within countries, with rural and underserved urban communities experiencing lower coverage rates.

In Africa, additional barriers included limited cold-chain capacity, insufficient health workforce, and socio-political instability in some regions [15]. Misinformation spread via social media further undermined public trust, with narratives ranging from vaccine safety concerns to conspiracy theories about population control [16].

Studies from Nigeria [17] and Ethiopia [18] have documented how logistical challenges, such as stockouts and distance to vaccination sites, intersect with social factors like religious beliefs and peer influence. In both settings, community-based strategies, including mobile outreach and engagement with local leaders, were effective in improving uptake.

Early COVID-19 vaccination revealed stark inequities: high-income countries secured most early doses via advance purchases and export controls while low-income countries faced shortages; by May 2022 only 16% in low-income countries had received one dose [19, 15]. Inequity was reinforced by concentrated manufacturing and Intellectual Property (IP) constraints, with Trade Related Intellectual Properties (TRIPS) flexibilities proving insufficient without technology transfer [20, 21]. Voluntary mechanisms like COVAX/ACT-A were unprecedented yet hampered by supply shocks, funding gaps, and limited LMIC voice [22, 15]. These failures prolonged transmission and recovery, catalyzing calls for a binding instrument to guarantee equitable access [34, 23].

In May 2025, the World Health Assembly adopted the WHO Pandemic Agreement. It focused on equity and establishing a Pathogen Access and Benefit-Sharing (PABS) system that targets 20% of real-time production of vaccines or therapeutics or diagnostics, for WHO allocation by public-health need, alongside a global supply-chain and logistics network, a coordinating financial mechanism, and support for technology transfer and regional manufacturing [24-26]. The agreement complements the 2024 IHR amendments that embedded explicit equity commitments [37]. For Africa and other LMICs where early first-dose coverage lagged, these measures aimed to shorten time-to-access and reduce reliance on ad-hoc donations in future pandemics [28, 24].

Ghana's Vaccine Rollout

Ghana's COVID-19 vaccine rollout was structured in phases, beginning with high-priority groups and gradually expanding to the general population. A variety of vaccine types were deployed, including AstraZeneca, Moderna, Pfizer-BioNTech, and Johnson & Johnson [6]. The rollout benefited from Ghana's experience with routine immunization programs, but the adult-focused campaign required new strategies, as adult vaccination had a historically low precedent outside of specific disease control programs.

Despite these efforts, disparities persisted between regions. As of July 2024, the Bono Region ranked among the lowest in vaccination coverage, with Wenchi Municipality performing below the regional average. The municipality's coverage gap underscores the need to examine accessibility barriers at the local level, where national strategies encounter community-specific realities.

Rationale for the Study

The study aimed to describe the accessibility of COVID-19 vaccines to the targeted population within the Wenchi Municipality. Given the urgency of increasing coverage to achieve herd immunity and prevent future outbreaks, understanding the multi-dimensional nature of accessibility is essential. While quantitative data can identify the prevalence of barriers, qualitative insights reveal the experiences behind these statistics. Applying the HBM allows holistic interpretation that connects structural barriers to individual perceptions and behaviors.

By focusing on Wenchi Municipality, this study addressed a critical evidence gap. Its findings can inform targeted interventions not only for COVID-19 but also for future adult vaccination campaigns in Ghana and comparable LMIC contexts.

Materials and Methods

The Study Area and Population

The study population comprised adults aged 18 years and above residing in Wenchi Municipality for at least one week during the past two years who were willing and able to provide informed consent. Adults were chosen because COVID-19 vaccines were targeted primarily at individuals aged 18 and above.

The Wenchi Municipality is located in the Bono Region of Ghana and covers an estimated land area of 7,619 km². According to the Ghana Statistical Service [29], the projected 2024 population of Wenchi Municipality was 135,165, with approximately 56% (75,693) aged 18 years or older and therefore eligible for COVID-19 vaccination.

Health infrastructure consists of three hospitals, two maternity homes, five health centers, three private clinics, and 19 Community-Based Health Planning and Services (CHPS) zones.

Geographical challenges include poor road conditions, particularly during the rainy season, and limited public transportation in rural zones. Socio-cultural diversity is evident, with ethnic groups with many residents engaged in subsistence farming and market trading.

Study Method

This study adopted a convergent mixed-method cross-sectional design to examine accessibility to COVID-19 vaccination in Wenchi Municipality, Bono Region, Ghana. The mixed-method approach was chosen in line with the pragmatist research philosophy [30], which emphasizes methodological pluralism to capture the complexity of real-world health phenomena. This approach allowed for simultaneous collection and analysis of quantitative and qualitative data, ensuring both numerical measurement of accessibility barriers and rich narrative accounts from participants.

A cross-sectional design was appropriate because the aim was to assess accessibility factors at a specific point in time, rather than evaluate changes over time. This design also enabled the inclusion of diverse demographic and socio-economic groups within a limited data collection period.

Sample Size Determination

The sample size was calculated using Cochran's formula [31] for estimating proportions with a 95% confidence interval and a 5% margin of error.

The total population for Wenchi Municipality for 2024, a, is 135,165 [29].

The population of 18 years and above, b, is 56% [29] of the total population. Which is $= 56\% * a = 75{,}692$

Population 18 years and above who have received the COVID-19 vaccine in Wenchi Municipality [6], c, is 19.150

The proportion of the population receiving the vaccine

$$= \frac{c}{b} * 100 = p = 25.3\%$$

approximately 25%

Sample size=$n = \frac{z^2 pq}{d^2}$

Where z= coefficient of reliability at 95% CI=1.9.

p: estimated proportion of the population receiving the vaccine $q = (1 - p)$ and d: deviation= 0.5.

then $n = \frac{(1.96)^2(0.25)(0.75)}{(0.05)^2} = \frac{0.7203}{0.0025} = 288.12$, approximately 288

Therefore, the sample was estimated at 288.

Sampling Procedure

A Probability Proportional to Size (PPS) sampling method was applied to ensure each sub-municipality's representation matched its share of the eligible population. The six sub-municipalities were considered primary clusters.

For logistical feasibility, three clusters were selected using systematic random sampling from a randomly ordered list of sub-municipalities.

Within each selected cluster, systematic household sampling was employed to select a respondent.

Data Collection Instruments and Procedure

A structured questionnaire was developed to capture Demographic Information, Accessibility Factors and COVID-19 Vaccination Status. The questionnaire was pre-tested in three non-study communities in another district with similar characteristics.

Data collection was conducted by five trained National Service Personnel under the supervision of the principal investigator. Training covered Ethical research conduct. , Administration of the questionnaire in both English and Akan, Strategies for minimizing bias (e.g., neutral phrasing, avoiding leading questions) and COVID-19 safety protocols during fieldwork. Enumerators visited households, introduced the study, obtained consent, and conducted face-to-face interviews. Where possible, vaccination cards were inspected to verify self-reported vaccination status.

Open-ended responses were recorded verbatim in the questionnaire forms. Where participants consented, interviews were audio-recorded to ensure accuracy of quotes. The qualitative component allowed deeper exploration of experiences, particularly around perceived barriers, cues to action, and social influences.

Data Management and Analysis

Quantitative Analysis:

1. Data were entered into IBM SPSS Statistics v24.
2. Descriptive statistics (frequencies, percentages) summarized demographic variables and accessibility indicators.
3. Logistic regression examined associations between socio-demographic factors and vaccination uptake.
4. Statistical significance was set at $p < 0.05$.

Qualitative Analysis:

Thematic analysis followed Braun and Clarke's [38] six-step framework:

1. Familiarization with data (reading and re-reading responses).
2. Initial coding (assigning labels to meaningful segments).
3. Searching for themes (grouping codes into patterns).
4. Reviewing themes (ensuring internal consistency and distinctiveness).
5. Defining and naming themes.
6. Producing the report with illustrative quotes.

Quantitative and qualitative findings were integrated at the interpretation stage, guided by the Health Belief Model.

Ethical Considerations

Ethical approval was obtained from:

1. Texila American University's Institutional Review Board (IRB).
2. Navrongo Health Research Centre IRB.
3. Bono Regional Health Directorate, Ghana Health Service.

Additional community entry protocols were observed, including:

1. Formal notification of municipal and sub-municipal health authorities.
2. Courtesy visits to traditional leaders.
3. Public announcements in selected communities.

Informed consent was obtained from all participants. Confidentiality was maintained by:

1. Assigning unique ID codes instead of names.
2. Storing data in password-protected files.
3. Restricting access to the principal investigator and authorized research assistants.

There were no anticipated physical risks to participants. COVID-19 preventive measures (mask-wearing, physical distancing, hand hygiene) were enforced during data collection.

Results

This section presents the demographic characteristics of the study sample, followed by findings on physical, logistical, and social accessibility to COVID-19 vaccination in Wenchi Municipality. Quantitative results are supplemented with qualitative insights drawn from open-ended responses to provide a richer understanding of accessibility challenges and facilitators. All interpretations are framed with reference to the Health Belief Model (HBM) constructs.

Table 1. Socio-Demographic Characteristics of Respondents

	Demographic Information	**Frequency**	**Percentages**
Age groups of respondents	20 years and below	25	8.0
	21-30 years	105	33.7
	31-40 years	91	29.2
	41-50 years	55	17.6
	51-60 years	16	5.1
	60 years and above	19	6.1
Sex	Male	142	45.5
	Female	169	54.2
Primary Occupation	Student/Pupil	52	16.7
	Apprentice	59	18.9
	Working in the formal sector	85	27.2
	Working in the informal sector	115	36.9
Ethnicity	Bono	129	41.3
	Other Akan	45	14.4
	Dagaati	70	22.4
	Ewe	7	2.2
	Other tribes	60	19.2
Educational background	None	26	8.3
	Pre school	9	2.9
	Primary	31	9.9
	JHS	106	34.0
	SHS/Tech/Voc	85	27.2
	Tertiary	54	17.3
Marital Status	Single	123	39.4
	Married	158	50.6
	Divorced	1	0.3
	Widow	11	3.5
	cohabiting	18	5.8
where do you live	Rural (pop<20000)	186	59.6
	Urban (Pop =>20000)	118	37.8

The table 1 above shows a total of 288 adults participated in the study, with a 54.3% female and 45.7% male distribution. The largest age group was 21 - 30 years (33.7%), followed by

31 - 40 years (29.2%), and 41 - 50 years (17.6%). A small proportion (8.0%) were below 20 years, and 6.1% were over 60 years.

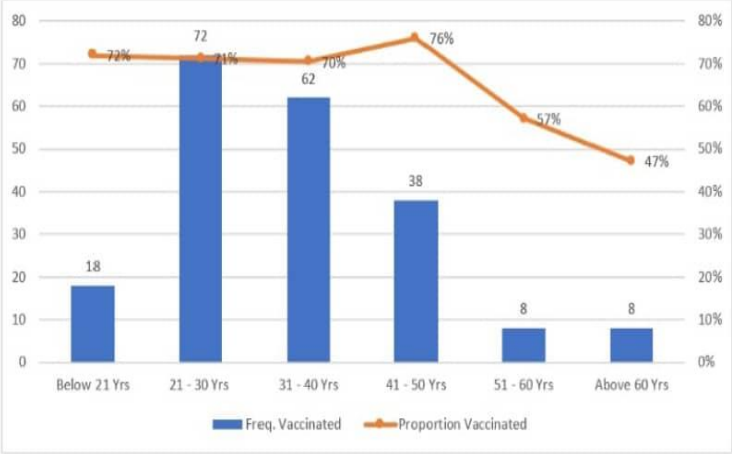

Figure 2. Frequency Distribution and Proportion of Age Groups and COVID-19 Vaccination

Source: Field data

The figure 2 above indicates the age groups of respondents and their uptake of the vaccine. In the 20 years and below age group, 18 of them took the vaccine. Those in the age group of 21-30 years, 72 of them took the vaccine. In the 31-40 years age group, 62 respondents took the vaccine. Thirty-eight respondents who took the COVID-19 vaccine where in the age group from 41-50 years. In the age group of 51-60 years, 8 of them were vaccinated and those who were 61 years and above, 8 of them got vaccinated with the COVID-19 vaccine.

Table 2. Frequency and Proportional Distribution of COVID-19 Vaccination Status by Sex of Respondents

Sex	Freq. Vaccinated	Not Vaccinated	Total	% Vaccinated
Male	93	43	136	68%
Female	113	46	159	71%
Total	206	89	295	

The table 2 above compares the intake of the COVID-19 vaccine with the gender of the participants. The males were 136 and the females were 159. In the males, 93 (68%) out of 136 took the COVID-1vaccine. With regards to the females, 113 (71%) out of the 159 females took the COVID-19 vaccine.

Table 3. Level of Education and COVID-19 Vaccination Uptake

Education Level	Ordinal Code	Vaccinated (Yes)	Not Vaccinated (No)	Total
None	0	14	4	18
Pre-school	1	1	4	5
Primary	2	19	9	28
JHS	3	73	33	106
SHS/Voc	4	55	30	85
Tertiary	5	44	8	52

An ordinal logistic regression model was applied as shown in table 3 above. This model estimates the log odds of being vaccinated as a function of the ordinal level of education.

This analysis examines the association between level of education and COVID-19 vaccination uptake using ordinal logistic regression. The educational level is treated as an ordinal predictor variable, and the outcome variable is binary: vaccinated (Yes = 1) and not vaccinated (No = 0).

The coefficient for Education Level is 0.524 and is statistically significant ($p < 0.001$). This indicates that as the level of education increases, the likelihood of being vaccinated also increases. The odds ratio is approximately 1.69 (exp(0.524)), meaning each one-unit increase in education level is associated with a 69% increase in the odds of being vaccinated. There is a significant positive relationship between education level and vaccination uptake. Individuals with higher levels of education are more likely to be vaccinated against COVID-19.

Education levels varied: 8.3% had no formal education, 2.9% had pre-school only, 9.9% had completed primary school, 34.0% had Junior High School (JHS) education, 27.2% had Senior High School (SHS), Technical, or Vocational training, and 17.3% had tertiary-level education. 36.9% worked in the informal sector (trading, farming, artisanship), 27.2% were in formal sector jobs, 18.9% were apprentices, and 16.7% were students.

However, cue to action as a result of COVID-19 experience due to infection on the respondents or someone known by the respondents, lead to only 10.53% of all occupations who took the vaccine. The majority (59.6%) resided in rural communities (population <20,000), while 37.8% lived in urban centers.

Table 4. Crosstabulation for Reasons of Vaccination and Primary Occupation

Reason for Vaccination	Primary Occupation				
	Student/Pupil	Apprentice	Working at formal sector	Working at informal sector	Total
To protect myself	29	32	63	71	195
I was earlier on infected	1	0	1	6	8
Someone I know was infected	1	1	9	3	14
It was required by my employer	3	3	12	8	26
It was a traveling requirement	5	2	7	22	36
Total	34	33	67	75	209

High proportion (93.30%) of respondents of all occupations who took the vaccine was because they wanted to prevent themselves from getting infected, as shown in the crosstabulation table 4 above. It ranges from 85.21% of students/people to as high as 97% of apprentices.

A cue to action, that is mandatory vaccination for travelers and workers and workers was higher after awareness of preventing COVID-19 infection. More (29.67%) of all occupations got vaccinated because of mandatory vaccination. However, this was higher (17.91%) among those at the

formal sector than those at the informal sector (10.67%). Mandatory vaccination among students/pupils (8.82%) and apprentices (9.19%) was very low among students/pupils and apprentices respectively who got vaccinated.

Table 5. Vaccination Status by Settlement

Settlement	Freq. Vaccinated	Not Vaccinated	Total	% Vaccinated
Rural (pop<20000)	128	45	173	74%
Urban (Pop>20000)	72	43	115	63%
Total	200	88	288	

The table 5 above compares vaccine uptake with respect to the respondent's location. One Hundred and Twenty-Eight (128) out of the respondents who were in the rural areas took the vaccine. Two Hundred (200) out of the 288 respondents who were in the urban areas were also vaccinated.

Physical Accessibility

Over half (55.4%) of respondents walked to vaccination points, while 30.8% used bicycles or motorbikes, 7.4% used commercial vehicles, and only 1.3% traveled by private car.

Table 6. Association between Mode of Transport and Vaccination Uptake

Means of transport	Vaccine up-take		Total	%
	Yes	No		
Walk	121	47	168	72.0
Bicycle/Motorbike	55	38	93	59.1
Commercial Vehicle	21	2	23	91.1
Private Vehicle	4	0	4	100
Total	201	87	288	

A 4x2 contingency table, in table 5 above, was analyzed using the Chi-Square Test of Independence.

Chi-Square = 12.23, df = 3, $p < 0.05$. Shows significant association between mode of transport and vaccine up-take.

The proportions below show which means of transport is most likely associated with vaccination uptake. The private vehicle users have the highest rate of 100%, the number, however, is small (n=4). Therefore, it is not statistically reliable. Commercial vehicle users follow closely with 91.1% and their sample size (n=23) is more meaningful. People who use commercial vehicles are the most likely to take the vaccines. Long travel distances and poor road conditions were consistently cited as major barriers.

Road Conditions

Participants noted that access roads to vaccination sites were often in poor condition, particularly in the rainy season.

Table 7. Association between Distance to Vaccination Centre and Vaccination Uptake

Distance to Vaccination Centre	Vaccine up-take		Total
	Yes	No	
≤1 km	130	48	178
1 – 5 km	45	31	76

>5 km	8	5	13
Distance not known	21	4	25
Total	204	88	292

This was more problematic in hilly or low-lying flood-prone areas. As shown in table 7 above and from the qualitative data, some respondents stated that outreach services had been helpful but were not frequent enough to ensure everyone could access them in a timely way.

"I wanted to take the vaccine earlier, but the road to town is bad and I couldn't leave the farm for a whole day to go and queue."

This comment typifies the lived realities of many rural participants, linking occupation and physical accessibility.

Proximity to Services

Those living in urban Wenchi reported shorter travel times and greater ease in accessing hospitals and clinics. In contrast, remote communities relied on periodic outreach services or had to travel to sub-municipal capitals.

Qualitative Insight

A young woman commented: "I missed the outreach day because I was at the market selling yams. I didn't know when they would come again." A rural male respondent (age 36) shared: "The CHPS compound is about 5 kilometers from here. During the rainy season, the road gets muddy and slippery, so even the motorbike can get stuck." This reflects the *perceived barrier* component of the HBM, where the physical difficulty of reaching a site can discourage vaccine-seeking behavior. This points to both logistical timing issues and physical access limitations.

Logistical Accessibility

Vaccine Availability

While 88.8% of respondents found operating hours convenient, 29.8% reported that vaccines were available only for limited categories during certain phases of the rollout (e.g., elderly, health workers). In addition, stockouts were mentioned by 11.2% as a reason for failed vaccination attempts.

Table 8. Frequency Analysis of Health Workers Availability at Health Facility/Outreach Point for COVID-19 Vaccination

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	292	93.6	96.4	96.4
	No	11	3.5	3.6	100.0
	Total	303	97.1	100.0	
Missing	System	9	2.9		
Total		312	100.0		

A bout 96.4% of respondents, as shown in table 8 above, believed health workers would be available to vaccinate them at health facilities or outreach points, indicating a high level of confidence in the availability of vaccination services. Only 3.6% expressed doubt, which could suggest isolated service delivery challenges or miscommunication. Ensuring consistent staff availability and improving public communication may help address these concerns.

Table 9. Availability of COVID-19 Vaccine in Limited Quantities for Limited Categories of the Population

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	93	29.8	31.1	31.1
	No	206	66.0	68.9	100.0
	Total	299	95.8	100.0	
Missing	System	13	4.2		
Total		312	100.0		

As indicated in table 9 above, 29.8% of the respondents said that COVID-19 vaccine was in limited quantities and 68.9% said that the vaccine was not in limited quantities.

Table 10. A Binary Logistic Regression on Trust on Reliability of Vaccine

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
								Lower	Upper
Step 1[a]	Trust in the reliability of the manufacturer and the source of supply.	-.517	.288	3.234	1	.072	.596	.339	1.048
	Entertained fear about the side effects of COVID-19 vaccine.	.530	.322	2.714	1	.099	1.699	.904	3.191
	Fear that the vaccine is new and has not been used before			.413	2	.814			
	The vaccination was the sure way to control the COVID-19 outbreak	-.986	.335	8.654	1	.003	.373	.193	.720
	Constant	21.203	28420.675	.000	1	.999	1615459328.348		

A binary logistic regression, in table 10, was conducted to determine whether trust on the reliability of the manufacturer, fear of the vaccine side effects, and the surety of the vaccine to control COVID-19 having on people not taking the vaccine. The model was statistically significant, ($\chi 2=26.972$, $p < 0.001$), explaining between 8.3% (Cox & Snell R square) and 11.8% (Nagelkerke R square) of the variance in COVID – 19 vaccination status and correctly classifying 70% of the cases. In the model, vaccination was the sure way to control the disease was statistically significant *(B=-0.986, Wald= 8.654, p=0.003, Exp(B)=0.373, Cl [0.193, 0.720]).* The negative beta means that an increase in the predictor will decrease the number of people who want to vaccinate.

Trust and Safety of Vaccine

Logistic regression analysis was conducted to investigate the impact of trust about safety of the vaccine, the efficacy of the vaccine, favourable days of the vaccination and the cost

of taking the vaccine on the likelihood of COVID-19 vaccination. The model was statistically significant, ($\chi 2=25.50$, $p < 0.001$), explaining between 7.9% (Cox & Snell R square) and 11.2% (Nagelkerke R square) of the variance in COVID – 19 vaccination status and correctly classifying 70% of the cases. In the model, both working days and hour favorable to you and the cost of accessing the vaccine were not statistically significant (*B =-0.47 Wald =0.195, p =0.659, Exp(B) =0.625, 95% Cl [0.78, 5.032*]) and *(B =0.70, Wald =0.43, p =0.836, Exp(B) =0.932, 95% Cl [0.480, 1.812])* respectfully. Trust on the safety of the vaccine was statistically significant *(B =-0.936, Wald =7.170, p =0.007, Exp(B) =0.392, 95% Cl [0.198, 0.778*]*)* indicating that an increase in the trust on the safety of the vaccine will reduce the number of people not taking the vaccine. The efficacy of the vaccine was statistically significant (*B =-0.931, Wald =7.909, p =0.005, Exp(B) =0.382, 95% Cl [0.196, 747*]). The findings indicate that public education and sensitization on safety and the efficacy of the COVID-19 vaccine will improve the intake of the vaccine.

The open-ended responses were analyzed qualitatively to focus on meanings, patterns and themes. The fear of the side effects of the vaccine was a major reason. About two third of the participants said that "the side effects of the vaccine made them not to take the vaccine". One participant went on to say that "not only does she fear about the side effects of vaccine; she is afraid of the syringe". The reason why another participant did not take the vaccine was the public speculations about the vaccine. Four participants said that "they fear of becoming impotent in bed so they didn't take the vaccine". One lady also said that "she doesn't want to be a barren woman so she will rather not take the vaccine".

Some of the participants revealed that taking of the COVID-19 vaccine was against their religious beliefs. Two participants said that "they are seventh day Pentecostal so it's against the belief". One participant also said "he is a Jehovah witness member and it is against their belief".

One participant said that "weekends is the most important appropriate time for him". This will help to get most people.

A male teacher (age 34) said: "The first time I went, they said the vaccine was finished. I had to wait two weeks and by then I was busy with school."

This aligns with literature noting that stockouts increase *perceived barriers* and reduce motivation to return (Santangelo et al., 2024).

Cost Considerations

Most respondents (76.0%) said the vaccine was affordable; in part because it was free at the point of delivery. However, indirect costs (transport fares, missed work hours) were reported as barriers by both rural and urban residents.

Table 11. The Association between Affordable Cost of Accessing the Vaccine and Vaccine Uptake

Affordable Cost	**Vaccine up-take**		**Total**
	Yes	**No**	
Yes	159	72	231
No	41	16	57
Total	200	88	288

A 2x2 contingency table was analyzed using the Chi-Square Test of Independence. There was no significant association between affordable cost of accessing the vaccine and vaccine uptake.

Chi-Square = 0.208, df = 1, $p > 0.05$, Phi Coefficient = 0.027.

A trader from Wenchi East explained: "It's not the injection that costs money, but leaving my shop means losing sales for the day."

Service Hours and Scheduling

The majority of respondents (88.8%) said working days/hours were favorable. However, some qualitative responses suggested that inflexible outreach schedules failed to match the livelihood patterns of farmers and traders.

Social Accessibility

Stigma and Perceptions

About 17.6% of respondents were concerned that others might see and judge them for going to get vaccinated. This was particularly true where vaccination sites were highly visible (e.g., entrances facing market squares).

One young man (age 27) from the urban center remarked:

> *"Some people said if you go for the vaccine, it means you think you will get corona, so they will avoid you."*

This reflects *perceived social barriers* as an important layer in HBM-based accessibility analysis.

Cultural and Religious Influences

Only 3.8% explicitly cited religious or cultural beliefs as barriers, but narratives suggest a broader undercurrent of skepticism. For example, some pastors advised congregations to "trust in divine protection" rather than seek vaccination.

Role of Social Networks

Family and friends were major facilitators of uptake. Many respondents said they were encouraged by relatives or community members who had been vaccinated without adverse effects.

A rural grandmother (age 61) noted:

> "When I saw my pastor take it in front of the church, I knew it was safe."

This illustrates the *cue to action* effect of visible role models.

Vaccination Uptake

Overall, 66.0% of respondents reported having received at least one dose of a COVID-19 vaccine, while 28.5% had not been vaccinated at all. Among those vaccinated:

1. 53.2% received their vaccine within their own community.
2. 37.8% knew the vaccine type they received (most common: Moderna, AstraZeneca, Pfizer).
3. 57.8% were eligible and took the vaccine, while 14.5% were eligible but did not take it.

Integration with HBM Constructs

The results show a clear mapping to HBM:

1. **Perceived Susceptibility and Severity**: Lower in rural communities where COVID-19 was seen as a "city disease."
2. **Perceived Benefits:** High among those motivated to protect family or meet employer requirements.
3. **Perceived Barriers**: Physical distance, transport, road conditions, stockouts, stigma.
4. **Cues to Action**: FM radio announcements, religious leader endorsements, market-day outreach.
5. **Modifying Variables**: Age, education, occupation, urban/rural location.

Discussion

This study examined accessibility to COVID-19 vaccination in Wenchi Municipality, Ghana, focusing on physical, logistical, and social factors as framed by the Health Belief Model (HBM). The mixed-method approach provided both statistical evidence and rich qualitative insights into the barriers and facilitators affecting vaccine uptake.

The findings reveal that perceived barriers: particularly long distances, poor road conditions, transport costs, occasional vaccine stockouts, and social stigma: were central in shaping accessibility outcomes. However, cues

to action from trusted leaders, family encouragement, and accessible service hours were equally important facilitators. These results echo patterns documented in other LMIC settings [14, 17, 18], underscoring the need for a multi-pronged approach to improve vaccination coverage.

Physical Accessibility in the Context of HBM

Physical access was a major determinant of whether individuals received the vaccine. Over half of respondents walked to vaccination points, and many rural residents faced travel distances exceeding 5 km. This aligns with findings from Sebring et al. [32] in Malawi, where rural populations experienced lower vaccine uptake due to poor road infrastructure and long travel times.

From an HBM perspective, these physical constraints function as perceived barriers: the higher the effort and inconvenience, the lower the motivation to act, particularly when perceived susceptibility to the disease is low. For example, respondents in remote areas often described COVID-19 as a problem for "city people," reducing their willingness to overcome physical challenges.

Qualitative narratives revealed the seasonal dimension of accessibility: during the rainy season, roads became muddy and impassable, discouraging attempts to reach vaccination sites. This resonates with the work of Rotenberg et al. [9] in rural South Africa, where seasonal weather patterns exacerbated health service access inequalities.

Logistical Accessibility and Service Organization

Logistical factors; including vaccine availability, stockouts, eligibility restrictions, and service hours; were prominent in this study. While most respondents (88.8%) reported favorable service hours, 29.8% experienced category-based eligibility restrictions in the early rollout, and 11.2% faced stockouts.

This is consistent with Ghana Health Service data indicating periodic vaccine shortages during 2021–2022 due to global supply chain constraints [6]. Similar challenges were reported in Ethiopia by Yenew et al. [18], where rural sites were more likely to experience stockouts than urban facilities.

The HBM interprets these as tangible barriers: if an individual invests effort to reach a site only to find the vaccine unavailable, the likelihood of making another attempt diminishes. This is compounded when individuals must sacrifice income or other activities to travel.

Social Accessibility: Stigma, Norms, and Trust

The study revealed that 17.6% of respondents feared stigma, being judged by others for getting vaccinated. While the proportion is relatively small, the qualitative evidence suggests stigma can have a ripple effect: a few vocal opponents in a community can influence wider perceptions.

Social access issues were also tied to religious and cultural beliefs, albeit in a smaller proportion (3.8%). However, respondents indicated that trusted role models, pastors, imams, chiefs; played a decisive role in countering skepticism. This is in line with [35], who found that leader endorsements function as potent cues to action in contexts with strong communal ties.

Trust emerged as a critical enabler of social access. Respondents were more likely to attend vaccination events organized by familiar health workers or at known community venues. This aligns with studies in Nigeria [17] showing that trust in local health workers increases uptake even in resource-constrained settings.

Perceived Susceptibility and Severity

Perceived susceptibility was generally low among rural residents, many of whom saw COVID-19 as a disease affecting urban dwellers. This misperception reduced

motivation to overcome barriers. In contrast, those who had seen local cases or deaths reported a higher sense of vulnerability and were more proactive in seeking vaccination.

Perceived severity was variable: while most acknowledged that COVID-19 could be dangerous, some minimized its impact, often citing mild symptoms experienced by acquaintances. This mirrors findings in South Africa [16] and Kenya [36], where underestimation of severity correlated with lower vaccine uptake.

Perceived Benefits and Barriers Interaction

Where perceived benefits were strong, such as the belief that vaccination protects family members or enables travel, individuals were more likely to seek out the vaccine despite barriers. For instance, traders who needed to cross regional borders for their business were highly motivated to get vaccinated due to travel requirements.

The interaction between benefits and barriers is central to HBM: high benefits can offset high barriers, but where benefits are unclear or undervalued, even minor barriers can deter action. This has implications for messaging strategies, which should emphasize tangible personal and communal gains from vaccination.

Cues to Action: The Role of Information and Influence

Cues to action were prominent facilitators in Wenchi. FM radio announcements, religious leader endorsements, and visible vaccination of community figures spurred uptake. Market-day outreach was especially effective, as it combined convenience with peer visibility.

However, misinformation also served as a negative cue, spreading doubts about vaccine safety and necessity. Combatting these narratives requires proactive, locally tailored communication campaigns, as shown by Kuatewo et al. [33] in their study of rural Ghanaian vaccine hesitancy.

Modifying Variables and Inequities

Socio-demographic factors, age, education, occupation, and urban/rural status, modified accessibility patterns. Rural residents faced more physical and logistical barriers; lower-educated respondents were more susceptible to misinformation; informal sector workers were more sensitive to indirect costs.

These patterns underscore the need for equity-focused interventions. Without targeted strategies, universal policies risk perpetuating gaps in coverage between urban and rural, educated and less-educated populations.

Policy and Practice Implications

The integration of HBM into the analysis highlights actionable entry points for interventions:

1. **Reducing barriers** through mobile outreach, improved road maintenance, and flexible service hours.
2. **Increasing perceived benefits** via messaging on protection of loved ones, livelihood preservation, and travel facilitation.
3. **Enhancing cues to action** by leveraging community leaders, radio programming, and public vaccination events.
4. **Addressing modifying variables** with tailored strategies for rural and low-literacy populations.

These implications are supported by evidence from other African settings, where context-specific, community-driven approaches have improved vaccination uptake [15, 9].

Recommendations

Perceived Susceptibility

The study found that rural residents often perceived themselves at lower risk for COVID-19 infection, a view reinforced by the lack of visible local cases during early stages of the

pandemic. This low perceived susceptibility discouraged vaccine uptake, as individuals saw little need to overcome physical or logistical challenges. To counter this, risk communication must be localized by the vaccination service providers and their collaborators. Sharing relatable stories; for example, of rural community members who contracted COVID-19, can help personalize the threat. Such campaigns should leverage familiar channels such as FM radio and community durbars.

Perceived Severity

Underestimation of COVID-19's severity was linked to hearing about mostly mild cases. Public health messages, from the service providers, should highlight the potential for severe disease, long-term complications, and the broader economic impact of illness on households. Survivor testimonies, particularly from respected figures in the community, can humanize the disease and increase urgency.

Perceived Benefits

Respondents who valued protecting family members or maintaining their livelihood were more willing to seek vaccination despite barriers. Messaging should emphasize these tangible benefits. Partnerships with trade and transport unions can reinforce the idea that vaccination protects economic activity. Linking vaccine proof to inter-regional travel or market access can also motivate uptake.

Perceived Barriers (Physical)

Distance to vaccination points and poor transport infrastructure were major obstacles. Mobile vaccination units and outreach services can bridge this gap, especially when coordinated with market days or other high-attendance events. Local leaders should be involved in mobilization to ensure strong turnout.

Perceived Barriers (Logistical)

Stockouts and rigid schedules discouraged repeat attempts to get vaccinated. Supply chain forecasting should be improved at the municipal level to match demand, and vaccination should be incorporated into existing routine outreach visits by health workers. Flexibility, such as extending hours during peak farming or trading seasons; will reduce opportunity costs.

Perceived Barriers (Social)

While relatively few respondents cited religious or cultural objections, stigma and mistrust persisted. Public endorsements from trusted leaders, including pastors, imams, chiefs, and teachers, can neutralize misinformation. Visible role modeling, leaders being vaccinated publicly, was repeatedly cited in qualitative responses as a strong motivator.

Cues to Action

The study confirmed that FM radio, leader endorsements, and public vaccination events were powerful cues. These should be sustained and expanded, with interactive formats (call-in shows, Q&A sessions with health workers) to address community concerns in real time. Social media could also complement traditional channels, particularly for younger populations.

Modifying Variables

Urban residents generally had better access than rural residents, and education levels influenced susceptibility to misinformation. Tailored strategies are essential: for low-literacy populations, materials should be highly visual and in local languages. Occupationally, outreach should target people during times they are most available, such as after farm work or before market hours.

Conclusion

This study underscores the accessibility to COVID-19 vaccines in Wenchi Municipality of Ghana, is shaped by a complex interplay of physical, logistical and social factors. Using the Health Belief Model (HBM) as a framework allowed for a structured understanding of how perceived susceptibility, perceived severity,

perceived benefits, perceived barriers, cues to action, and modifying variables influence vaccination behaviors.

Key Findings Reveal That:

1. Physical barriers such as distance, poor road conditions, and limited transport remain significant in rural areas.
2. Logistical challenges include vaccine stockouts, eligibility restrictions in early phases, and inflexible outreach schedules.
3. Social barriers involve stigma, pockets of religious discouragement, and misinformation, although trusted leaders and visible role models serve as powerful facilitators.
4. Cues to action like FM radio campaigns, leader endorsements, and public vaccination events can meaningfully boost uptake.

To achieve equitable vaccine coverage in Wenchi and similar LMIC contexts, interventions must reduce barriers, increase perceived benefits, and strengthen positive cues. This requires not only health system investment in supply chain and service delivery but also culturally attuned community engagement strategies.

Conflict of Interest

The author hereby declares that, there is no conflict of interest in this manuscript.

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