Original Article

Rural Inhabitants' Perception-Induced Immunisation Status: The Case of Yellow Fever Vaccination in the Ashanti Region of Ghana

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Abstract

Background
Vaccines effectively reduce infectious disease mortality worldwide, including in Africa. Immunization is critical to lowering morbidity and improving public health, yet uptake in some rural areas remains low. This study assessed perceptions of yellow fever (YF) vaccination and their influence on immunization status among residents across 10 rural communities in the Ashanti Region of Ghana.

Methods
A community-based cross-sectional study involving 130 respondents used structured questionnaires to assess knowledge, perceptions, and attitudes toward YF vaccination. Logistic regression identified factors associated with immunization status, with significance set at $p < 0.05$.

Results
Most participants (96.9%) had good or fair awareness of vaccination, and nearly all (98.5%) valued staying healthy. However, many lacked understanding of vaccination benefits (89.2%) and vaccine-preventable diseases (66.2%). Significant predictors of non-immunization included poor vaccination awareness (AOR = 1.93, 95% CI: 1.48–3.12, p = 0.009), poor knowledge of benefits (AOR = 1.19, 95% CI: 1.26–3.35, p = 0.042), lack of campaign awareness (AOR = 2.98, 95% CI: 2.62–5.14, p = 0.038), and perceived poor campaign coverage (AOR = 3.52, 95% CI: 1.57–7.49, p = 0.037).

Conclusion
While general awareness of vaccination is high, substantial knowledge gaps and limited campaign visibility hinder uptake. Strengthened public health education and broader outreach could improve vaccination rates and reduce preventable disease burden.
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Keywords: Vaccination, immunization, infectious diseases, yellow fever (YF), Ghana

Introduction

Yellow fever (YF) is a viral hemorrhagic disease transmitted primarily by Aedes and Haemogogus mosquitoes.[1] It causes high fever, cutaneous bleeding, and liver and kidney cell death in severe cases.[1] The disease is a significant public health issue in Africa, with an estimated 200,000 illnesses and 30,000 deaths annually, predominantly in Sub-Saharan Africa.[2] Yellow fever has no known cure, but vaccination remains one of the most effective preventive measures.[3–5] Booster doses of the yellow fever vaccine are necessary for long-term protection, especially for infants vaccinated at 9 months of age.[6]

The virus can be transmitted in three primary cycles: sylvatic, intermediate, and urban. Sylvatic yellow fever occurs when monkeys in tropical rainforests are infected by mosquitoes, and the virus spreads to humans via mosquito bites when people visit or work in these areas.[7] Intermediate yellow fever, also known as savannah yellow fever, occurs at the borders of forests where the virus is spread by mosquitoes from both monkeys and humans.[4,8,9] Urban yellow fever, caused by Aedes aegypti mosquitoes, primarily affects people living in cities.[10] These transmission cycles depicts the complex nature of the disease's spread, especially in rural and underserved areas.[4,8,9] In Ghana, the national yellow fever vaccination coverage is approximately 88%, but rural areas report lower coverage rates.[11,12] For example, a study in the Savannah Region of Ghana found that vaccination coverage among nomadic populations was only 80%.[13] Despite generally positive caregiver attitudes toward vaccination, knowledge gaps and challenges in adhering to immunization schedules persist, especially in rural settings.[14,15] Interestingly, rural children in Ghana are more likely to complete their vaccinations compared to their urban counterparts.[16,17] However, factors such as maternal education, employment status, health insurance coverage, and wealth significantly influence vaccination uptake.[18–21]

Rural Ghana faces several barriers to vaccination, including delayed health-seeking behaviors, vaccine safety concerns (e.g., fears of miscarriage among pregnant women), logistical challenges, and mistrust of the healthcare system.[14,15] These challenges are compounded by inconsistent communication about vaccination schedules and booster doses. Furthermore, there is a need for improved data management and surveillance to ensure timely follow-up and accurate reporting of vaccination coverage.[22,23]

Globally, similar challenges are faced in rural areas. In Uganda, for example, while emergency yellow fever vaccination campaigns reached 96.1% coverage, only 51.6% of recipients had valid vaccination cards, reflecting issues with record-keeping and follow-up.[24] Similarly, in Nigeria, yellow fever vaccination coverage was reported at 55%, with widespread barriers to access such as vaccine unavailability, time constraints among caregivers, and transportation challenges.[25] These findings highlight the need for targeted interventions to improve vaccination coverage, particularly in rural areas.[14,15]

Mass vaccination campaigns have proven to be an effective means of improving immunization coverage. For example, in Angola, a well-executed mass vaccination campaign during a yellow fever outbreak helped reduce mortality and morbidity.[26] Preventive mass vaccination campaigns (PMVCs) in Africa have reduced yellow fever outbreaks by 34% between 2005 and 2018.[27] However, sustaining high vaccination coverage requires addressing structural challenges, particularly in rural and underserved regions.[14,15]

Despite the successes of mass vaccination campaigns, the persistence of yellow fever outbreaks in some regions underscores gaps in surveillance, vaccine distribution, and booster dose administration.[4,9,28] Waning immunity after initial vaccination further complicates efforts to maintain adequate protection against the disease.[29]

New strategies, such as fractional-dose vaccines during outbreaks, have been explored to address vaccine shortages and improve coverage in resource-limited settings.[14,15] Fractional doses are safe and effective in Kenya and Uganda.[30] Tools like the POLICI web application are also being used to monitor vaccination coverage and identify gaps in rural immunization.[31]

In response to these challenges, Ghana launched a massive yellow fever vaccination campaign in 2020, aiming to protect 5.6 million people aged 10 to 60.[32] This initiative followed a similar campaign in 2019 targeting 5.3 million people across 65 districts. Despite these efforts, illiteracy, superstitious beliefs, and cultural values in rural areas continue to influence individuals' decisions to get vaccinated, highlighting the need for tailored communication and education strategies.[33]

Given the identified research gaps discussed, this paper assessed the perception of yellow fever immunization and its influence on the immunization status of individuals in a rural context. The study aimed to:

i. Identify socio-demographic factors influencing perceptions of yellow fever immunization among rural inhabitants in Ghana.
ii. Examine the level of knowledge, attitudes, and practices regarding yellow fever vaccination, including understanding of its benefits and perceived risks.
iii. Determine the key risk factors associated with perception-driven vaccination behaviors among rural inhabitants in Ghana.

Methods

Study design

This study employed a cross-sectional quantitative survey design, conducted in December 2020. The study was conducted from early December 2020 to late January 2021, beginning approximately one month after Ghana's nationwide yellow fever vaccination campaign in November 2020.[32] This allowed the researchers to assess vaccination status and related experiences shortly after the campaign.

Study Setting and YF Coverage

This study was conducted in rural communities of the Ashanti Region, which is the most populous region in Ghana after Greater Accra, with an estimated 4.78 million inhabitants.[34] Ghana is located in West Africa that shares borders with Burkina Faso to the north, the Gulf of Guinea to the south, and Togo and Ivory Coast to the east and west respectively and has a population of approximately 30.83 million. The Ashanti Region's economy is based largely on gold, cocoa, and timber production.[34] The weather in Ghana changes dramatically between the wet and dry seasons. Gold, cocoa, and timber are among the most popular commodities exported from this nation. Christianity, Islam, and traditional religions are the three (3) most prominent faiths in the study area. About 51% of the people identify as Christians, and 20% as Muslims, while the rest adhere to other indigenous faiths and philosophies.[14]

Study Population, Sample, and Sampling Technique

This was a community-based cross-sectional study employing a quantitative research design. It was conducted in 10 rural communities within the Ashanti Region, selected using the following criteria: (1) a sufficient number of households to ensure an adequate sampling frame, (2) accessibility for data collection during the COVID-19 pandemic, and (3) representativeness of typical rural communities in Ghana, enabling generalization of findings to similar settings. Data collection was influenced by the COVID-19 restrictions that limited movement and reduced direct contact between the research team and potential participants.To address these constraints while ensuring methodological rigor, a three-stage sampling strategy was adopted. Initially, convenience sampling was applied to recruit participants who were readily accessible and willing to take part in the study during the pandemic period.

Snowball sampling followed, with early participants referring other eligible individuals from their social networks. This approach was particularly valuable for reaching residents who would otherwise have been difficult to access under the prevailing restrictions. Finally, within selected households, simple random sampling was applied to identify the individual respondents. This final stage reduced sampling bias and increased the representativeness of the data collected.

The sample size was calculated using the formula developed by Krejcie and Morgan,[35] based on an estimated 500 households in the selected communities. This calculation produced a minimum required sample size of 217 respondents. Data were collected over an eight-week period, yielding 130 completed questionnaires and a response rate of 60 percent. Interviews lasted between 25 and 30 minutes and were conducted primarily in the native language of participants. Responses were self-reported and captured digitally using ODK Collect to ensure safety and efficiency during the data collection process.

Sample Size Calculation

The sample size was calculated using the Cochran formula for sample size estimation for categorical data in finite populations:

$$n_0 = \frac{Z^2 \times p \times (1-p)}{e^2}$$

Where:

- n_0 = initial sample size
- Z^2 = Z-score corresponding to the desired confidence level (1.96 for 95%)
- p = estimated proportion of YF immunization rate (commonly 0.5 if unknown)
- e = margin of error (precision), set at 0.05

Given the finite population correction for total households N=500, the adjusted sample size n is:

$$n = \frac{n_0}{1 + (\frac{n_0 - 1}{N})}$$

Assuming p=0.5, Z=1.96, e=0.05, and N=500:

$$n_0 = \frac{(1.96)^2 \times 0.5 \times (1-0.5)}{(0.05)^2} = \frac{3.8416 \times 0.25}{0.0025} = \frac{0.9604}{0.0025} = 384.16$$

Adjusting for the finite population:

$$n = \frac{384.16}{1 + (\frac{384.16 - 1}{500})} = \frac{384.16}{1 + (0.7663)} = \frac{384.16}{1.7663} \approx 217$$

Therefore, the minimum required sample size was approximately 217 respondents; however, only 130 questionnaires were completed due to COVID-19 restrictions.

Inclusion and Exclusion Criteria

Participants were eligible for inclusion if they were permanent residents of the selected rural communities in the Ashanti Region, aged 18 years or older, present during the data collection period, and willing to provide informed consent. Individuals with or without a history of yellow fever vaccination were included, as this information was considered important for assessing the influence of vaccination history on knowledge, attitudes, and practices.

Exclusion criteria comprised those unwilling or unable to provide informed consent, and individuals who were seriously ill or unavailable during the data collection period.

Instrument and measures

A structured questionnaire was used as the primary data collection instrument. It was developed to include two (2) main sections. The first section captured respondents' socio-demographic characteristics, which served as control variables. The second section assessed respondents' knowledge, perception, and attitudes regarding yellow fever (YF) immunization. Specifically, the survey included questions that assessed: 1) participant socio-demographic factors, 2) participant knowledge and perception, and 3) attitudes toward yellow fever immunization. The questionnaire was self-developed by the research team, drawing inspiration from similar instruments used in prior studies measuring yellow fever awareness and behaviors in various populations.[5]

To ensure content relevance and clarity, it was reviewed by public health and survey research professionals for face and content validity. Reliability was established through pilot testing and internal consistency analysis, with Cronbach's alpha values for major constructs exceeding the acceptable threshold ($\alpha \geq 0.70$), as also demonstrated in similar research settings.[35] Participants were assured of the anonymity and privacy of their responses to minimize bias related to self-reporting.

Approach to Participants

Participants were approached using a combination of direct visits to accessible households and referrals from other respondents. In all cases, the research team explained the purpose of the study and obtained informed consent prior to data collection. COVID-19 safety measures were strictly observed, including the wearing of masks, physical distancing, and minimal contact. These procedures followed the recommendations outlined by Park et al.[36] to ensure both participant and researcher safety while maintaining the quality and completeness of data collection.

Statistical analysis

A double-input procedure was used to enter the obtained information into a data entry file created using EpiData software, version 3.1. The data were transferred to Stata version 14 for processing. Following the collection of data, it was necessary to sort, correct, and code it. The analysis was carried out using the STATA version 14 software. The following analyses were carried out: descriptive statistics, univariate analysis, followed by a multivariable logistic regression analysis, which included all statistically significant covariates ($p<0.05$). A univariate analysis was carried out first, followed by a multivariable logistic regression analysis, which included all statistically significant covariates ($p<0.05$). For each independent variable, odds ratios (ORs), 95 percent confidence intervals (95 percent CIs), and p-values were calculated.

Ethics statement

Ethical approval for this study was obtained from the Committee on Human Research, Publications and Ethics (CHRPE) of the Kwame Nkrumah University of Science and Technology (KNUST), under the approval number CHRPE/AP/206/20. In addition to institutional clearance, permission to conduct the study was granted by the traditional authorities and community leaders in the respective study areas. All participants were provided with detailed information regarding the objectives, procedures, potential risks, and benefits of the study. Informed consent was obtained from each participant prior to data collection, either in written or verbal form depending on context and literacy levels. Participation was entirely voluntary, and participants were informed of their right to withdraw from the study at any point without penalty. To ensure data protection, all collected information was treated with strict confidentiality. Personal identifiers were anonymized or excluded, and data was securely stored in password-protected systems accessible only to the research team. The study adhered to internationally recognized ethical standards for research involving human subjects, with particular attention to the privacy, autonomy, and dignity of all participants.

Results

Socio-demographic characteristics of the participants

The study involved 130 participants, of whom 54.6% were male. Reporting gender distribution helps contextualize the sample and understand potential differences in vaccination knowledge and practices, guiding more targeted public health interventions. Regarding the nature of the participants, the study found that 68.5% of the respondents were individual informants, while 22.3% were opinion leaders. This distribution suggests that a significant portion of the participants were individuals with personal experiences or perspectives, contributing to a diverse range of opinions.

Table 1. Socio-demographic characteristics of the study participants

Characteristics	Frequency (N=130)	Percentage (%)
Gender		
Male	71	54.6
Female	59	45.4
Age		
18-25 years	42	32.3
26-30 years	30	23.1
31-35 years	18	13.9
36 and above years	40	30.8
Marital Status		
Single	62	47.7
Married	52	40.0
Divorced / Separated / Widowed	16	12.3
Educational level		
No formal education	37	28.5
Formal education	93	71.5
Occupational level		
Employed	39	30.0
Unemployed	26	20.0
Self employed	65	50.0
Religion		
Christianity	106	81.5
Muslim	20	15.4
Others (Traditional, etc.)	4	3.1
Social status /Role in Community		
Opinion leaders	29	22.3
Staff members in the Assembly	12	9.2
Locals (individual and key informants)	89	68.5

Source: Field Survey, 2020

In terms of marital status, the study reported that 47.7% of the participants were singles. This indicates that a substantial proportion of the respondents were not married. Regarding education, the study found that 71.5% of the participants had formal education. This suggests a relatively high level of educational attainment among the respondents, which may influence their perceptions and decision-making processes regarding yellow fever vaccination. The study also examined the age distribution of the participants. It revealed that more than 60% of the respondents belonged to the young age group (18-25 years) and the older age group (36 years and above). This distribution implies that the study included a broad range of age groups, allowing for insights into how different age cohorts perceive yellow fever vaccination. Occupationally, the study found that 50.0% of the respondents were self-employed. This indicates that a significant proportion of the participants were engaged in entrepreneurial or independent work activities. Religiously, the study found that 106 of the participants identified as Christians. This suggests that Christianity is a dominant religious affiliation among the study participants. (Table 1).

Knowledge/Perception and Attitudes Associated with YF Immunization Status

The findings presented in Table 2 highlight the respondents' knowledge, perception, and attitudes towards yellow fever (YF) immunization, as well as the results from multivariate analysis. The study was conducted among a sample of 130 respondents. Of these, 20 individuals (15.4%) were not immunized, while 110 individuals (84.6%) reported having received Yellow Fever (YF) vaccination. Several variables were assessed, and both unadjusted and adjusted odds ratios (ORs) with 95% confidence intervals (CIs) were calculated to determine the strength of associations, with statistical significance determined at $p < 0.05$.

Awareness of vaccination, particularly regarding yellow fever, emerged as a significant predictor of immunization status. Among those classified as having good or fair awareness (n=126), 87.3% (n=110) were immunized, while 12.7% (n=16) were not.

Conversely, those with poor or very bad awareness (n=4) were all not immunized. The adjusted odds ratio (AOR) for poor awareness was 1.93 (95% CI: 1.48–3.12) with a statistically significant p-value of 0.009, indicating that poor awareness significantly increases the likelihood of not being immunized. This underscores the crucial role that health education and information dissemination play in improving vaccine uptake.

A high proportion of respondents (98.5%, n=128) agreed on the importance of staying healthy regardless of the means. Among these, 110 were immunized and 18 were not. Only two respondents disagreed or were unsure, and both were not immunized. Despite this attitudinal difference, the relationship was not statistically significant (AOR = 1.01, 95% CI: 0.82–35.01; p = 0.76), suggesting that while this belief may be widespread, it does not independently influence vaccination decisions.

Respondents with good or fair knowledge of vaccination benefits (n=14) showed a high immunization rate (85.7%, n=12). In contrast, those with poor or very bad knowledge (n=116) had a lower immunization rate (84.5%, n=98). The adjusted odds ratio was 1.19 (95% CI: 1.26–3.35), with a significant p-value of 0.042, indicating that individuals with poor understanding of vaccination benefits were significantly less likely to be immunized. This highlights the need for targeted educational strategies to enhance comprehension of vaccine utility.

A notable association was observed between awareness of vaccination campaigns and immunization status. Among the 29 respondents aware of the campaign, 96.6% (n=28) were immunized, while only one was not. In contrast, of the 101 respondents unaware of the campaign, only 81.2% (n=82) were immunized. The adjusted odds ratio was 2.98 (95% CI: 2.62–5.14), with a significant p-value of 0.038, indicating that lack of campaign awareness nearly triples the odds of being unvaccinated. This emphasizes the importance of effective public health messaging and outreach.

The study examined whether experiencing common symptoms such as diarrhea, cough, fever, or vomiting on the vaccination day impacted immunization status. None of these symptoms showed statistically significant associations. For example, the AOR for diarrhea was 1.09 (95% CI: 0.79–6.98; p = 0.74), and for vomiting, 1.11 (95% CI: 0.54–0.82; p = 0.77). This suggests that while illness may be perceived as a barrier to vaccination, it does not significantly affect actual immunization rates in this population.

Respondents with good or fair knowledge of vaccination importance (n=24) had a higher immunization rate (91.7%, n=22), compared to those with poor knowledge (n=106), among whom 88 were immunized. However, the relationship was not statistically significant (AOR = 0.97, 95% CI: 0.77–3.41; p = 0.90). This finding suggests that perceived importance of vaccination may be widespread across both groups and may not distinctly predict immunization behavior.

Knowledge about vaccine-preventable diseases did not show a statistically significant impact on immunization status, despite a seemingly high odds ratio. Those with good/fair knowledge (n=44) had a higher immunization rate (93.2%, n=41), while those with poor/very bad knowledge (n=86) had a lower rate (80.2%, n=69). The adjusted odds ratio was 3.02 (95% CI: 0.88–17.03), with a p-value of 0.99, indicating wide confidence intervals and statistical insignificance.

Finally, perception of vaccination coverage significantly influenced immunization. Only 12.3% (n=16) of respondents rated coverage as good or fair, with 93.8% (n=15) immunized. Those perceiving coverage as poor or very bad (n=114) had a lower immunization rate (83.3%, n=95). The adjusted odds ratio was 3.52 (95% CI: 1.57–7.49), with a significant p-value of 0.037, indicating that negative perceptions of campaign reach are significantly associated with lower vaccination uptake.

In addressing the third research question, these findings reveal several statistically significant impediments to yellow fever immunization: lack of awareness (AOR = 1.93), inadequate campaign exposure (AOR = 2.98), ignorance of vaccine benefits (AOR = 1.19), and perceived poor campaign coverage (AOR = 3.52). These barriers point to critical deficits in both health communication and service delivery. Although the respondents generally valued health and demonstrated basic vaccine awareness, these were not always accompanied by comprehensive knowledge or access to services. Therefore, multi-layered interventions are necessary including intensified public health campaigns, community engagement, and the expansion of accessible immunization programs. Such strategies are essential to bridge the knowledge-action gap and enhance yellow fever vaccine coverage across vulnerable populations.

Table 2. Respondents' Knowledge/Perception and Attitudes Associated with YF Immunization Status

Characteristics	Total N (%)	YF Immunization Status		Unadjusted		Adjusted	
		NO, N = 20[1]	YES, N = 110[1]	OR (95% CI)	p-value[2]	OR (95% CI)	p-value[2]
Awareness of vaccination (e.g., yellow fever)							
Good/fair	126 (96.9)	16	110	1		1	
Poor/very bad	4 (3.1)	4	0	2.10 [1.52, 3.67]	0.011*	1.93 [1.48, 3.12]	0.009*
Need to stay healthy regardless of means							
Agree	128 (98.5)	18	110	1		1	
Disagree/Don't know	2 (1.5)	2	0	1.20 [0.68, 7.50]	0.62	1.01 [0.82, 35.01]	0.76
Knowledge about benefits of vaccination							
Good/fair	14 (10.8)	2	12	1		1	
Poor/very bad	116 (89.2)	18	98	1.45 [1.11, 3.72]	0.035*	1.19 [1.26, 3.35]	0.042*
General campaign awareness							
Yes	29 (22.3)	1	28	1		1	
No	101 (77.7)	19	82	3.25 [2.78, 5.62]	0.018*	2.98 [2.62, 5.14]	0.038*
Morbidity on vaccination day							
Diarrhoea	22 (16.9)	3	19	1		1	
Cough	20 (15.4)	4	16	1.25 [0.75, 5.80]	0.69	1.09 [0.79, 6.98]	0.74
Fever	18 (13.8)	3	15	1.50 [0.09, 8.90]	0.88	1.42 [0.05, 9.03]	0.92
Vomiting	22 (16.9)	4	18	1.18 [0.61, 1.01]	0.72	1.11 [0.54, 0.82]	0.77
None	48 (36.9)	6	42	2.01 [0.95, 13.82]	0.81	1.87 [0.93, 14.06]	0.84
Knowledge of importance of vaccination							
Good/fair	24 (18.5)	2	22	1		1	
Poor/very bad	106 (81.5)	18	88	1.10 [0.83, 3.90]	0.84	0.97 [0.77, 3.412]	0.90
Knowledge of vaccine-preventable diseases							
Good/fair	44 (33.8)	3	41	1		1	
Poor/very bad	86 (66.2)	17	69	3.25 [1.01, 15.80]	0.098	3.02 [0.88, 17.03]	0.99
Coverage of vaccination exercise							
Good/fair	16 (12.3)	1	15	1		1	
Poor/very bad	114 (87.7)	19	95	3.65 [1.76, 7.98]	0.022*	3.52 [1.57, 7.49]	0.037*

Source: Field Survey, 2020. **Notes**: *p-value < 0.05 indicates statistical significance. **AOR** = Adjusted Odds Ratio; **CI** = Confidence Interval.

Discussion

The findings presented in this paper provide significant insights into the knowledge, perceptions, and attitudes of respondents regarding yellow fever immunization. The demographic patterns observed in this study suggest that social norms, community structures, and individual circumstances significantly shape perceptions and practices regarding yellow fever (YF) vaccination in rural Ghana. The slight male predominance among participants may reflect broader gendered dynamics in health engagement, where men often occupy more public-facing roles in community decision-making.[37] This aligns with findings from other West African contexts, where male involvement can influence household health decisions and vaccine uptake.[38,39] However, contrasting evidence from East African settings shows higher vaccination coverage among women, largely due to their regular contact with maternal and child health services.[40,41] These differences highlight the need to determine whether YF vaccination in rural Ghana follows a male-driven participation pattern or could be improved through targeted outreach to women.

Such gendered patterns intersect with other demographic influences education, employment, and religion that have been shown across multiple studies to affect vaccination attitudes and behaviors.[19,42–44] Higher education levels generally enhance vaccine awareness and acceptance,[19,42] yet persistent gaps in YF coverage despite high awareness, as seen in this and other studies, suggest that knowledge alone may not be sufficient to ensure uptake. Employment patterns, particularly the prevalence of self-employment, point to the role of economic opportunity costs, as time away from work can act as a practical barrier to accessing vaccination services.[45] The strong Christian affiliation within the sample mirrors broader evidence that faith-based organizations can be powerful partners in addressing vaccine hesitancy, correcting misinformation, and mobilizing communities.[46,47]

The inclusion of opinion leaders among participants underscores the importance of trusted community figures in influencing vaccination decisions.[48] This aligns with global findings that, while the YF vaccine is highly effective and confers long-term immunity,[5] uptake in rural and at-risk populations remains hindered by factors such as limited access, vaccine supply constraints, and knowledge gaps.[22,23] In such contexts, opinion leaders and faith-based actors can bridge institutional outreach and local trust, thereby helping to address both informational and attitudinal barriers.[11,12] Furthermore, recent concerns about waning immunity and rare breakthrough infections have underscored the need for continued surveillance and targeted communication strategies to maintain public confidence and sustain protection over time.[22,23] Collectively, these insights point to the conclusion that optimizing YF vaccination requires a dual approach: addressing logistical and informational barriers, and engaging deeply with the social and cultural contexts that shape participation.

Building on the demographic influences discussed earlier, the findings on respondents' knowledge, perceptions, and attitudes toward yellow fever (YF) vaccination reveal both encouraging foundations and persistent barriers to uptake in rural Ghana. Overall, there appears to be a strong baseline awareness of vaccination, consistent with previous research showing that general vaccine knowledge is associated with more positive health attitudes and greater likelihood of uptake.[14] However, the gap between this general awareness and the specific understanding of YF vaccination benefits suggests that knowledge alone is insufficient to ensure participation, an observation supported by multiple studies indicating that awareness often fails to translate into action due to factors such as misinformation, incomplete knowledge, or limited access.[25,49] This disconnect mirrors findings that people may value

vaccination in principle yet lack clarity on the role of specific vaccines or the risks of non-vaccination.[50–52] Wu et al. further note that delayed or poorly targeted dissemination of immunization information, especially among high-priority groups like postpartum mothers can contribute to missed opportunities for timely uptake.[53] Addressing this gap will require communication strategies that go beyond generic vaccine promotion to clearly articulate the direct and communal benefits of YF immunization.

The strong belief among respondents in the importance of maintaining health aligns with literature showing that individuals with positive health orientations are more likely to engage in preventive measures.[48,54] Yet, as other studies have demonstrated, positive attitudes toward health do not necessarily lead to engagement in specific interventions like vaccination. Patel et al. highlight that logistical constraints such as transportation difficulties and inflexible schedules, often deter participation, even when preventive measures are valued.[55,56] Such access-related challenges have been widely documented as barriers to vaccination in rural and resource-limited contexts[55,56] In parallel, healthcare providers report that persistent concerns about vaccine safety and a lack of accurate information continue to undermine participation.[57,58] Taken together, these findings suggest that bridging the gap between favorable health attitudes and actual vaccination behavior requires a dual approach: first, removing structural barriers that hinder access; and second, delivering timely, targeted, and trust-building information that empowers individuals to act on their positive health beliefs.

This study highlights four major barriers to yellow fever vaccination: unawareness of vaccination, insufficient campaigning, limited understanding of vaccine significance, and inadequate vaccination coverage. These barriers mirror patterns observed in other low-resource settings, where logistical, informational, and sociocultural as well as socioeconomic factors such as income, geographic access, and transportation collectively hinder uptake. [26] The finding that unawareness remains a key impediment aligns with previous research showing that lack of knowledge or the spread of misinformation significantly reduces vaccine uptake.[26] Similar studies in sub-Saharan Africa and other endemic regions have demonstrated that awareness gaps not only delay vaccination but also make populations more susceptible to misinformation about vaccine safety and efficacy.[59–63] However, some studies in more urbanized settings report lower levels of unawareness, suggesting that proximity to health facilities and better media penetration can partially mitigate this barrier,[40,62,64,65] highlighting the need for context-specific interventions.

The role of inadequate campaigning in reducing participation is consistent with literature emphasizing the effectiveness of targeted communication and active community engagement.[7] Studies in Ethiopia and Ghana, for instance, have shown that localized campaigns involving community leaders can substantially boost turnout,[66,67] a strategy that was notably absent in the 2020 yellow fever mass immunization campaign assessed here. The lack of such targeted mobilization in our context likely contributed to low participation. In contrast, some well-resourced campaigns in other African mass immunization drives have achieved high coverage despite similar initial awareness levels,[66,67] revealing that campaign quality, not just frequency matters. The finding of limited understanding of the significance of vaccination despite general health knowledge parallels evidence from other studies where individuals recognized the concept of immunization but did not perceive it as urgent or personally relevant. [68,69] In our study, this manifested as respondents acknowledging vaccination in principle but lacking appreciation of its necessity for yellow fever prevention, a pattern also seen in studies from Nigeria and Uganda where partial knowledge

led to delays or refusals.[68,69] While similar patterns have been reported elsewhere, a few studies in high-uptake communities demonstrate that targeted health education, emphasizing both personal and communal benefits can shift perceptions and encourage timely vaccination.[66,67]

The observed insufficient vaccination coverage is consistent with WHO reports of uneven distribution of vaccines in resource-limited settings.[7] and with other studies noting that logistical challenges, poor infrastructure, and distance to vaccination points often hinder uptake.[70–72] Comparable studies in Nigeria and the Democratic Republic of Congo have reported that introducing mobile vaccination units and strategically locating vaccination posts significantly improved coverage,[70–72] whereas findings from conflict-affected regions, such as South Sudan, show that even with mobile services, coverage remained poor due to security constraints.[73] These inconsistencies indicate that political stability and safety are critical determinants of vaccination success.

The presence of preventable infectious disease symptoms among participants, including diarrhea, cough, fever, and vomiting, further underscores the urgency of addressing these barriers. This aligns with research showing that expanded vaccination coverage can significantly reduce not only the incidence of vaccine-preventable diseases but also the strain on already overburdened health systems.[66,74] In a nutshell, the study's findings are consistent with global evidence on barriers to immunization in low-resource settings. The variations in awareness levels and campaign effectiveness across regions highlight the need for tailored, context-specific interventions. Strengthening public health education, improving vaccine accessibility, and implementing community-led campaigns remain critical steps to bridge the gap between knowledge and vaccine uptake.

Limitations

This study sampled only 130 participants, with recruitment restricted by adherence to COVID-19 safety guidelines. The limited sample size and research design may have introduced selection bias and reduced generalizability to the broader population.

Conclusion

Yellow fever remains a re-emerging mosquito-borne viral illness in many African countries, including the study area. This study shows that rural residents have only partial knowledge of yellow fever and its vaccination process. Although most participants were generally aware of vaccination and valued maintaining health, significant gaps remain in understanding vaccine-preventable diseases and the necessity of immunization. Addressing these gaps through culturally tailored public health education, community engagement led by trusted local figures, and sustained, visible vaccination campaigns is essential to improving coverage. Future studies should adopt robust mixed-methods approaches to explore community perceptions in greater depth and monitor changes in attitudes toward vaccination over time.

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Competing interests

There are no competing interests

Authors' contributions

QAM: Contributed to the study concept and design, assisted in data collection, Analysis, and interpretation as well as Writing of the manuscript, and editing of the written work.
KE: Contributed to the study analysis and interpretation as well as the development of questionnaires and Writing of the manuscript.

QA: Contributed to the study concept and design. AS: revised the manuscript. AN: collection of data. All authors have read and agreed to the published version of the manuscript.

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