



Original Research Article

KNOWLEDGE, ATTITUDE AND DETERMINANTS OF COVID-19 VACCINE UPTAKE AND HESITANCY AMONG RURAL DWELLERS IN BENUE STATE, NIGERIA: IMPLICATIONS FOR PUBLIC HEALTH PREPAREDNESS AND FUTURE IMMUNIZATION PROGRAMS

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ABSTRACT

The global COVID-19 pandemic underscored the critical importance of effective vaccination campaigns for public health. Despite the acute phase of the COVID-19 crisis having subsided, the insights gained from studying vaccine acceptance and hesitancy remain profoundly relevant for strengthening health systems, improving routine immunization programs, and enhancing preparedness for future epidemics or emerging infectious diseases. This study investigated the knowledge, attitude, and willingness to receive the COVID-19 vaccine among rural dwellers in Benue State, Nigeria. A cross-sectional survey involving 380 participants was conducted. The findings revealed that regarding COVID-19 vaccines, 59.2% of respondents demonstrated good knowledge, while 40.8% had poor knowledge, 40.5% exhibited a positive attitude whereas 59.5% held a negative attitude. Only 26.1% expressed willingness to accept vaccination without hesitation, with a high perception that vaccines might have side effects (74.7%), is not safe (60.8%) and that not everyone should receive vaccination. Bivariate logistic analysis indicated that attitude was a significant predictor of vaccine acceptance $\beta=0.058$ (95% CI: 0.029-0.116, $p < 0.0001$). These results highlight the need for targeted health education strategies to improve vaccine acceptance in rural Nigerian communities.

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INTRODUCTION

The global COVID-19 pandemic has made vaccination a critical public health intervention to curb disease transmission, reduce severe illness, and save lives. Despite the availability of effective vaccines, achieving high vaccination coverage has been challenging, particularly in low- and middle-income countries and rural populations where rates often lag

significantly behind global targets [1]. Vaccine hesitancy is seen as refusing vaccination or reluctance in accepting vaccination irrespective of the availability of vaccination services. This situation has been recognized as a significant threat to global health [2]. While the acute phase of the COVID-19 pandemic has subsided, the insights

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gained from studying vaccine acceptance and hesitancy during this period remain critically relevant for ongoing public health efforts and future pandemic preparedness [3,4]. Vaccine hesitancy continues to be a top global health threat [5,6,7], impacting routine immunization programs and posing challenges for emerging infectious diseases [6,8]. Understanding the factors that influenced COVID-19 vaccine uptake, such as concerns about side effects, misinformation, and mistrust in institutions, provides valuable lessons for strengthening public health communication, building community trust, and designing effective vaccination strategies for various diseases in diverse contexts, particularly in rural African settings [9,10,3,4]. Furthermore, experiences from the COVID-19 vaccination drive in African countries offer crucial insights into sensitive barriers and opportunities to strengthen primary healthcare systems for future health crises [11,12,13,14].

Several factors contribute to vaccine hesitancy, of importance is that of safety of and side effects. These two factors are the most frequently cited reasons for reluctance in various populations. Misinformation, rumors, and conspiracy theories have been identified as major drivers of vaccine refusal in Nigerian communities and elsewhere, adversely affecting public perception and challenging vaccine uptake [15,16,9,10]. Misinformation, including beliefs that vaccines contains microchips, alter DNA, or for the purposes of depopulating the world, particularly in Africa, significantly contributed to hesitancy in rural and underserved Nigerian communities [15]. Mistrust in government, pharmaceutical companies, and healthcare systems also plays a crucial role in shaping negative attitudes towards vaccination [17,10,4]. Furthermore, logistical barriers such as inconvenient access, long waiting times, and inadequate information about vaccine eligibility and sites can also hinder uptake in rural and underserved areas [18,19,].

In Nigeria, understanding the specific drivers of vaccine acceptance and hesitancy among different demographic groups is crucial for designing effective public health campaigns. Studies in Nigeria have similarly shown that factors such as risk perception, attitudes towards vaccination, and mistrust in government significantly influence vaccine acceptance among urban dwellers [20,17]. This study aims to assess the knowledge, attitudes, and willingness to receive the COVID-19 vaccine among rural dwellers in Benue State, Nigeria, to inform local

and national vaccination strategies and address identified gaps.

METHODS

Study Design and Setting

This was a cross-sectional study conducted in Benue state which is lies approximately between latitude 6°30'N and 8°10'N and longitude 7°20'E and 10°00'E in North central Nigeria. The study was carried out among rural dwellers in five Local Government Areas (LGA) located within these coordinates in the southern and central parts of the state. The LGA include: Orokam and Owukpa of Ogbadibo, Okpoga LGA and Ugbokolo of Okpokwu LGA, Obagaji of Agatu LGA, Igumale of Ado LGA, Aliade of Gwer East local LGA. Benue State has a population of about 4,253,641 as at 2006 and harbors the second largest river in Nigeria, River Benue, from where the state derives its name. Benue is bordered by six states: Nasarawa, Taraba, Kogi, Enugu, Ebonyi and Cross-Rivers States towards North, East, West, South-West and South- south respectively. Benue dwellers are mostly farmers and hence are known as food basket of the nation for their excellent agricultural performance.

Study Population, Sample Size and Sampling Technique

The study population is about 4,000,000. Using the Sample Size Calculator by Raosoft, Inc. [21] and setting the estimated error margin at 5%, confidence interval at 95% and response rate at 50% a sample size of 385 was gotten. To take care of non-response, a total of 400 participants were enrolled. Cluster sampling techniques were employed for sampling the population. From each cluster, participants were included using random sampling techniques.

Data Collection Tool

Structured questionnaires that contained sets of statements assessing socio-demographic characteristics, knowledge regarding COVID-19 vaccination, attitudes towards the vaccines, perceptions about their safety and efficacy, and willingness to receive the vaccine were employed. Specific questions aimed to gauge awareness of vaccine types (e.g., Pfizer, AstraZeneca, Moderna, Sputnik V, Johnson & Johnson), routes of administration (e.g., oral, intravenous, intramuscular),

approved age groups for vaccination (e.g., 18 years and above), and perceived side effects.

Content and Face Validity Testing

The questionnaire's content validity was reassessed by professionals to ensure each item accurately measured the intended variable. The face validation was done by conducting a presurvey among ten respondents using the drafted questionnaire. The presurvey was undertaken to examine readability, comprehensibility and face validity. Observed challenges were used to adjust the questionnaire's final version.

Data Collection

Data was collected by three research assistants recruited across each selected community. The research assistants received 1-2 hours of education on the study objective and questionnaire content, along with brief training on administering questionnaires. Questionnaires were administered to respondents fulfilling the inclusion criteria of 15 years and above and have given their consent to participate. Self-administration was employed when respondents could not read, comprehend well, or were indisposed to fill the questionnaire themselves.

Data Analysis

IBM SPSS Statistics version 27 was used for data analysis. Respondents' characteristics were analyzed using simple frequencies, percentages, means, and standard deviations. Relationship between readiness to receive COVID-19 vaccination and socio-demographic characteristics, knowledge, attitude, and perception towards COVID 19 vaccination were determined using Pearson correlation while Logistic regression was used to ascertain the determinants of readiness to receive COVID-19 vaccination. Differences in independent variables were considered statistically significant at $p < 0.05$ with a 95% confidence interval. Bivariate logistic regression (crude odds ratio [COR] at 95% CI) was performed, and variables with $p < 0.05$ were subjected to multivariable logistic regression.

Measurement of Variables

Knowledge: Knowledge about COVID-19 vaccination was assessed using a set of questions. Codes such as "1" and "0" were given to correct and wrong answers respectively. Respondents with values

above or below the median value were categorized as having "Good" or "Poor" knowledge respectively.

Attitude: Attitude towards COVID-19 vaccines was measured. Questions had yes or No responses and were coded as above. Respondents with values above or below the median value were categorized as having "Positive" or "Negative" attitude respectively

Perception: Perception towards COVID-19 vaccination was assessed using restructured "Yes" and "No" questions, with scoring like knowledge and attitude. Respondents were categorized as having "Positive" or "Negative" perception towards COVID-19 vaccination based on their values above or below the median

Willingness to Accept Vaccine: This was the dependent variable, defined as readiness to receive COVID-19 vaccination without hesitation

Ethical Considerations

Ethical approval for the study with reference number CPPM/HREC/24/UG/0055, was obtained from Health Research and Ethics Committee Department of Clinical Pharmacy & Pharmacy Management Faculty of Pharmaceutical Sciences University of Nigeria, Nsukka. Informed consent was obtained from all participants before data collection. Confidentiality and anonymity of the participants were maintained throughout the study.

RESULTS

Socio-demographic Characteristics

A total of 400 questionnaires were shared among the participants, 380 of them correctly completed and returned them, resulting in 95% response rate. Most participants were aged 31 years and above (65.3%), followed by those aged 21-25 years (13.9%). Females constituted 53.2% of the sample, most respondents were married (77.4%), followed by widowed (11.1%). Regarding education, the largest group had college/secondary education (75.0%), with smaller proportions having no formal education (5.8%). Other demographic characteristics are shown in Table 1.

Table 1: Socio-Demographic Information of Respondents

Age in years	Frequency (%)	n=380
15-20	248 (65.3)	
21-25	53 (13.9)	
26-30	36 (9.5)	
31 and above	43 (11.3)	
Sex		
Male	178 (46.8)	
Female	202 (53.2)	
Marital Status		
Single	294 (77.4)	
married	30 (7.9)	
widowed	42 (11.1)	
Divorced	14 (3.7)	
Education		
No formal education	22 (5.8)	
Primary school	32 (8.4)	
College/secondary	285 (75.0)	
Tertiary/university	31 (8.2)	
Postgraduate	10 (2.6)	
Family type		
Nuclear	281 (73.9)	
Extended	99 (26.1)	
Monthly Family Income		
Less than 10,000 naira	154 (40.5)	
11,000-50,000 naira	97 (25.5)	
51,000-99,000 naira	67 (17.6)	
>100,000 naira	62 (16.3)	
Received Vaccine in Lifetime		
Yes	222 (58.4)	
No	158 (41.6)	

Knowledge about COVID-19 Vaccination

Overall, 59.2% (225 respondents) had good knowledge of COVID-19 vaccines, while 40.8% (155 respondents) had poor knowledge. Specific knowledge points included: Vaccine types 52.1% were aware of Pfizer, Route of administration: 38.9% identified oral as route of administration, Dose interval: 37.4% knew the interval was 3-4 weeks, and Approved age: 49.2% correctly identified 18 years and above as the approved age for COVID-19 vaccination. Other responses on knowledge of COVID 19 vaccination are displayed in Table 2.

Attitude Towards COVID-19 Vaccines

Attitude towards COVID-19 vaccines was characterized by 40.5% of respondents holding a positive attitude, while 59.5% (226 respondents) had a negative attitude. Key attitudes included: Safety: 39.2% agreed that newly discovered COVID-19 vaccines are safe, Essentiality: 39.2% agreed that COVID-19 vaccines are essential for everyone, Healthcare workers vaccination: only 26.1% agreed that all healthcare workers should be vaccinated to protect the public, while 50.3% disagreed, Encouraging others: 44.5% agreed to encourage family/friends/relatives to get vaccinated. Table 3 shows other variables assessing their attitude towards COVID 19 vaccination.

Perceptions of COVID-19 Vaccines

Perceptions about COVID-19 vaccines were also assessed; 74.7% of respondents believed that newly discovered COVID-19 vaccines may have side effects while 63.9% believed that getting vaccinated was a good way to protect their family and other people against infection. About half (44.4%) suggested healthcare workers should be vaccinated first while 57.4% would buy the vaccine at their own expense if not provided free by the government, if they were at risk. Other assessment points for perception are displayed in Table 4.

Willingness to Receive COVID-19 Vaccine

Overall, only 26.1% (99 out of 380) of participants indicated they would willingly accept to be vaccinated for COVID-19. Conversely, 74.0% stated they would not take the COVID-19 vaccine without any hesitation if it were available.

Factors Associated with Acceptance to Receive COVID-19 Vaccine

Binary logistics regression analysis (Table 5) showed that respondents' attitude was a statistically significant predictor of acceptance to receive the COVID-19 vaccine $\beta=0.058$ (95% CI: 0.029-0.116, $p < 0.0001$). Other socio-demographic characteristics such as age, gender, education level, monthly family income and prior vaccine history were not found to be significantly associated with vaccine acceptance in this analysis.

Table 2: Respondent's knowledge about COVID-19 vaccination.

Questions	Frequency (n)	Percentage (%)
What is COVID-19 vaccine		
Drug used for treatment of COVID-19	84	22.1
Drug used for treatment of disease related to COVID-19	102	26.8
Drug used for the prevention of COVID-19	194	51.1
How many types of vaccines are approved for use in Nigeria?		
2	148	38.9
3	124	32.6
6	108	28.4
What is the route of administration of COVID 19 vaccines?		
Oral	148	38.9
Intravenous	124	32.6
Intramuscular	108	28.4
What is the dose interval between the first and the second dose of COVID 19 vaccine?		
1-2 weeks	124	32.6
3-4 weeks	142	37.4
4-6 weeks	114	30
What age is approved for COVID 19 vaccination		
1-11 months	56	14.7
1-5 years	65	17.1
6-17 years	72	18.9
18 years and above	187	49.2
What is the different COVID-19 vaccines available for use in Nigeria? (multiple response possible)		
Pfizer	198	52.1
Johnson & Johnson	42	11.1
Mordena	72	18.9
AstraZeneca	183	48.2
Oxford	72	18.9
Sputnik V	46	12.1
What are the common side effects of COVID-19 vaccines? (Multiple response possible)		
Fever	206	54.2
Fatigue	37	9.7
Headache	76	20
Muscle pain	42	11.1
Chills	145	38.2
Diarrhea	3	0.8
Pain at injection site	58	15.3

Table 3: Respondents attitude towards COVID-19 vaccines

Questions	Frequency (n)	Percentage (%)
The newly discovered COVID-19 vaccines are safe.		
Disagree	149	39.2
Undecided	82	21.6
Agree	149	39.2
COVID-19 vaccines are essential for everyone.		
Disagree	158	41.6
Undecided	73	19.2
Agree	149	39.2
All healthcare workers should be vaccinated to protect the public		
Disagree	191	50.3
Undecided	90	23.7
Agree	99	26.1
I will also encourage my family/friends/relatives to get vaccinated.		
Disagree	137	36.1
Undecided	74	19.5
Agree	169	44.5
COVID-19 vaccine is not needed to reduce the incidence of COVID-19		
Disagree	149	39.2
Undecided	95	25.0
Agree	136	35.8
Everybody should receive COVID-19 vaccine		
Disagree	148	38.9
Undecided	80	21.1
Agree	152	40.0
I will take the COVID-19 vaccine without any hesitation, if it is available		
Yes	99	26.0
No	281	74.0

Table 4: Perceptions of respondents about COVID-19 vaccines

Questions	Frequency (n)	Percentage (%)
Does the COVID-19 vaccine have side effects?		
Yes	248	74.7
No	96	25.3
Do you think that you and your family members will be protected from COVID 19 by being vaccinated?		
Yes	243	63.9
No	137	36.1
In your opinion who should be vaccinated?		
COVID-19 negative individuals	129	33.9
COVID-19 positive individuals	131	34.5
Patients recovering from COVID-19	43	11.3
Everyone	77	20.3
In your opinion which sector should be vaccinated first?		
General public	121	31.8
Healthcare workers	169	44.4
Civil servants	46	12.1
Teacher/ student	26	6.8
People with chronic diseases	96	25.3
Businessman and women	12	3.2
Would you have paid for the COVID 19 vaccine if they were not free?		
Yes	217	57.4
No	161	42.4

Table 5: Bivariate analysis of factors associated with acceptance to receive COVID-19 vaccine among rural dwellers in Benue

Variables	Acceptance to receive COVID-19 vaccine		COR 95% (CI)	P value
	Yes	No		
Age in years				
15-20	9	34	2.882 (.889 - .889)	.078
21-25	16	37	2.440 (.706 - 8.429)	.159
26-30	9	27	2.287 (.573 - 9.128)	.241
31 and above	65	183	Ref	
Sex				
Male	55	123	1.222 (.686 - 2.175)	.496
Female	44	158	Ref	
Marital Status				
Single	77	217	.892 (.191 - 4.173)	.885
Married	7	23	.560 (.100 - 3.131)	.509
Widowed	11	31	1.152 (.219 - 6.054)	.868
Divorced	4	10	Ref	
Education				
No formal education	3	19	.548	.590
Primary school	12	20	4.121	.131
College/secondary	71	214	.805	.803
Tertiary/university	10	21	3.817	.156
Postgraduate	3	7	Ref	
Family type				
Nuclear	71	210	1.069	.833
Extended	28	71	Ref	
Monthly Family Income				
Less than 10,000 naira	40	144	.853	.269
11,000-50,000 naira	21	76	.709	.711
51,000-99,000 naira	22	45	1.653	.472
>100,000 naira	16	46	Ref	
Received Vaccine in Lifetime				
Yes	60	162	1.031 (.582 - 1.828)	.917
No	39	119	Ref	
Knowledge about COVID-19 vaccine				
Poor	36	119	.820 (.459 - 1.465)	.504
Good	63	162	Ref	
Attitude towards COVID-19 vaccine				
Negative*	20	206	.058 (.029 - .116)	.0001*
Positive	79	75	Ref	
Perceptions of COVID-19 vaccine				
Negative	32	129	.565 (.312 - 1.022)	.059
Positive	67	152	Ref	

*Indicates variables included in the multivariable logistic regression analysis; Ref indicates reference category

DISCUSSION

The findings from this study in rural Benue State, Nigeria, provide important insights into the factors influencing COVID-19 vaccine acceptance.

Knowledge about COVID-19 Vaccination

The study revealed varied knowledge levels regarding COVID-19 vaccine types and administration routes. While 59.2% of respondents demonstrated good overall knowledge, a notable 40.8% had poor knowledge. Specific knowledge gaps were evident, such as less than half of the respondents correctly identifying the approved age for vaccination or having accurate awareness of various vaccine brands. These findings emphasize the presence of significant educational deficits that require targeted interventions to improve vaccine literacy among rural populations.

The knowledge level reported in this work differs from another study conducted among adult men in Southwest Nigeria which reported a much higher percentage of good knowledge regarding COVID-19 vaccines at 91.9% [22]. This disparity could be attributed to differences in study populations (e.g., general rural dwellers vs. adult men, potentially with different access to information or education levels), geographic location, or the specific criteria used to define "good knowledge." However, another study in rural communities in Ghana, a neighboring West African country, found that 55.0% of participants had inadequate knowledge, which is more aligned with our study's findings of 40.8% poor knowledge (or 59.2% good knowledge) [23]. This suggests that knowledge levels can vary significantly even within similar regional contexts.

Attitude Towards COVID-19 Vaccines

Attitude towards COVID-19 vaccines was characterized by a clear division, with 59.5% of respondents holding a negative attitude compared to 40.5% with a positive attitude. This negativity was further reflected in the finding that over half (50.3%) disagreed that all healthcare workers should be vaccinated to protect the public. Such polarized attitudes suggest a complex interplay of trust, personal beliefs, and perceived necessity influencing vaccination decisions, even among those who might otherwise generally endorse vaccination.

This result agrees with the finding of a multi-regional study in rural Ghanaian communities which reported 59.4% poor attitudes towards COVID-19 vaccines,

which translates to approximately 40.6% positive attitudes, very similar to our study's 40.5% positive attitude [23]. This similarity highlights a shared challenge in fostering positive vaccination attitudes across rural Sub-Saharan African contexts. However, a study in the Federal Capital Territory, Nigeria, indicated generally negative attitudes towards COVID-19 vaccination, suggesting a broader issue across different regions within the country [24]

Perceptions of COVID-19 Vaccines

Perceptions regarding the safety and efficacy of COVID-19 vaccines were particularly influential. A high proportion of respondents (74.7%) believed that newly discovered COVID-19 vaccines might have side effects. This concern is a frequently cited barrier to vaccine uptake globally and within Africa [25,3], highlighting the critical need for transparent and accurate communication about vaccine safety and potential adverse events. Despite these safety concerns, 63.9% of respondents believed that getting vaccinated was a good way to protect their family and others indicating a recognition of the collective benefit of vaccination that could be leveraged in public health campaigns. This high perception of side effects is echoed in a study from Sokoto State, Nigeria, which cited an 89% belief that COVID-19 vaccines may have side effects, suggesting this is a widespread concern in Nigeria [27].

Willingness to Receive COVID-19 Vaccine

Overall, only 26.1% of participants indicated they would willingly accept to be vaccinated for COVID-19 without hesitation. Conversely, a significant majority (74.0%) stated they would not take the COVID-19 vaccine without any hesitation if it were available. This low willingness to receive the vaccine is consistent with observations of low vaccine uptake in many other low- and middle-income countries and rural settings in sub-Saharan Africa [26], highlighting a substantial gap between general knowledge or even positive perceptions and actual intent to vaccinate.

Several studies in Nigeria and Sub-Saharan Africa show varied vaccine acceptance/willingness rates. A national survey in Nigeria reported 50.7% willingness to take the vaccine [27], while a systematic review of barriers to COVID-19 vaccine uptake in Nigeria found acceptance rates ranging broadly from 24.3% to 86.2% [28]. Another study in Sub-Saharan Africa, including data from Nigeria, reported a higher acceptance rate of 78.4% for Nigeria [14]. A study in

North-Central Nigeria found that 70.5% were willing to be vaccinated or already vaccinated, and 29.5% were unwilling [29]. The significantly lower willingness in our study (26.1%) compared to many others (50.7% to 78.4%) might be attributed to the specificity of the rural context of Benue State. It could also reflect differing methodologies or the evolving perception of the pandemic over time, as data collection periods varied across these studies. For instance, respondents may be more willing to receive vaccination during the event than in post COVID 19 era.

Predictors/Determinants of COVID-19 Uptake and Hesitancy

The study found that attitude was a statistically significant predictor of acceptance to receive the COVID-19 vaccine ($P < 0.0001$). This strong association aligns with broader research suggesting that attitudes, often shaped by perceptions of risk and benefit, are significant determinants of vaccination behavior [30]. The specific attitude and beliefs identified in this study as barrier to vaccine uptake include that the newly discovered COVID-19 vaccines are not safe and have side effects.

Most of the respondents believe that the vaccine is not essentially for everyone and that the vaccine is not required to reduce the incidence of COVID disease. Two third of them hold the view that if everyone maintains preventive measures, that COVID 19 would be eradicated without vaccination. It is also a thing of concern that more than half of the respondent would not encourage their relatives to receive the vaccination owing to their belief that it is not safe

Other socio-demographic characteristics were not found to be significantly associated with vaccine acceptance in this analysis, indicating that psychological and perceptual factors played a more dominant role in this specific context compared to demographic variables.

Beyond individual attitude and perception, factors like mistrust in government and health authorities, as identified in other Nigerian studies, may implicitly contribute to negative attitudes and hesitancy [17,10,4]. The spread of misinformation and conspiracy theories, which have been noted to undermine immunization programs in Nigeria, also needs to be effectively counteracted through culturally adapted strategies [15,16,9]. Misconceptions, such as beliefs that COVID-19 was a government fabrication

to siphon funds or that vaccines would implant microchips, were prevalent in rural Nigerian settings and profoundly influenced vaccine acceptance [15].

Clinical and Public Health Implications

The low vaccine acceptance rates observed in this study have significant implications for public health, particularly in the context of persistent infectious disease threats. First, low COVID-19 vaccination coverage in rural areas like Benue State contributes to continued vulnerability, not only to COVID-19 variants but also to other vaccine-preventable diseases [1]. This sustained vulnerability strains already limited healthcare resources, leading to prolonged illnesses and increased mortality, and reduces the availability of human resources needed to manage both COVID-19 and non-COVID-19 health burdens [1].

Second, the findings underscore critical challenges for future immunization programs in Nigeria and similar African contexts. The logistical barriers identified, such as distance to vaccination centers, lack of transportation, and inadequate cold chain infrastructure, are pervasive in rural settings [31, 19]. Addressing these requires innovative approaches like mobile vaccination units, leveraging community volunteers, and strengthening the primary healthcare system to ensure equitable access [31,4].

These results underscore the necessity for tailored public health interventions that go beyond mere information dissemination. Strategies should include using trusted local messengers, tailoring messages to address specific community concerns, and employing community-led approaches to identify and overcome barriers to access and uptake. Addressing the behavioral determinants of vaccine acceptance, including the underlying reasons for negative attitudes and safety concerns, is critical to increasing vaccine uptake in rural communities in Benue State and similar regions.

CONCLUSION

This study reveals that knowledge and, more importantly, attitudes significantly influence COVID-19 vaccine acceptance among rural dwellers in Benue State, Nigeria. Targeted interventions addressing concerns about vaccine side effects and fostering positive attitudes are crucial to improving vaccination rates in these communities. The findings also provide valuable insights into the broader challenges of vaccine delivery and acceptance in rural African

settings, offering lessons for strengthening public health preparedness against future infectious disease threats.

Study Limitations

Limitations to this study include employing a cross-sectional study design, which does permit monitoring changes in study variables over a period of time. The study location and setting was in a single rural area, multiple centers may present more robust presentation of the ideal situation in rural areas.

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AUTHORS CONTRIBUTION

Conceptualization of the work was done by EEA and NBA, Literature review and drafting of the work was done by PO, SD, ISM, and CU, Data collection was done by PO and SD while data analysis was done by EEA. The final version was read by all and approved by EEA and NBA

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest to this work

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