

COVID-19 Vaccination Uptake and Associated Factors in Selected Communities in Two Southwestern States in Nigeria

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Abstract

Introduction: COVID-19 vaccine uptake and acceptance have been a major global concern due to the prevalent misinformation and disinformation that has characterized the vaccine rollout worldwide. This study aimed to assess COVID-19 vaccine uptake and acceptance, and associated factors among selected community members in two states in southwestern Nigeria. **Method:** We conducted a cross-sectional study using a multistage sampling technique. Fifty catchment settlements of 10 health facilities in each of Oyo and Ogun States targeted for a COVID-19 infection prevention and control intervention were randomly selected. Four households were targeted per settlement. All households that refused access were replaced, to ensure a minimum of four households randomly selected per settlement. The primary household decision-maker was interviewed in each household. Information elicited included respondents' sociodemographic characteristics, health history, knowledge, risk and benefit perception about the COVID-19 vaccine, vaccine uptake, and willingness to be vaccinated. The study was conducted from July–August 2021. Data were analyzed using SPSS IBM version 23. **Result:** Four hundred household decision-makers were surveyed in Oyo and Ogun states, after replacement. The mean age of the respondents was 43.0 ± 11.0 years. The majority, 346 (86.5%) had heard about COVID-19 vaccination, but only 47 (13.6%) had received a COVID-19 vaccination. Of the 299 respondents who reported not receiving a COVID-19 vaccination, 166 (55.5%) were willing to be vaccinated. In univariate analysis, respondents who were female had tertiary education, perceived that COVID-19 vaccines are free and accessible, perceived that COVID-19 vaccines have minimal side effects, and perceived

higher benefits of COVID-19 vaccination had higher odds of being vaccinated. In contrast, younger respondents, respondents with higher knowledge scores on COVID-19 preventive measures, and with chronic illness had lower likelihoods of being vaccinated. In multivariate analysis, only the respondent's age, perception score on COVID-19 vaccine benefits, knowledge score on IPC measures, and positive response on accessibility and safety were significant after adjusting for other factors. **Conclusion:** COVID-19 vaccine uptake rate as well as willingness to receive vaccination were low in the study setting. There is an urgent need for policymakers to embark on well-designed campaigns to address barriers to COVID-19 vaccination to increase vaccine uptake.

Keywords

COVID-19, Vaccination, Vaccine, Vaccine Uptake

1. Background

COVID-19 was declared a public health emergency of international concern (PHEIC) on January 30, 2020, by the World Health Organization (WHO), and a pandemic on March 11, 2020 [1] [2]. As of 3rd February 2023, there were over 750 million confirmed COVID-19 cases, over 6.8 million confirmed deaths, and over 13 million COVID-19 vaccine doses administered globally [3]. In Nigeria, as of 3rd February 2023, there are over 266,463 confirmed cases and 3155 confirmed deaths, with 57% and 10% of the eligible population partially and fully vaccinated, respectively [4] [5].

Earlier measures in curtailing the spread of the COVID-19 pandemic globally focused on non-pharmaceutical measures including wearing face masks, physical distancing, and hand hygiene [6]. COVID-19 vaccination has been described as a game changer in curtailing the pandemic, especially when used concurrently with non-pharmaceutical measures [7]. Vaccines became available in record time, with the COVID-19 Pfizer-BioNTech COVID-19 vaccine sent to the FDA for possible Emergency Use Authorization (EUA) on November 20, 2020, and authorized on December 11, 2020, only nine months after the pandemic declaration. Other COVID vaccines soon followed, including the Moderna vaccine, Johnson and Johnson vaccine, and AstraZeneca vaccine.

The administration of COVID-19 vaccines was prioritized among high-risk populations, including healthcare workers, the elderly, people living with pre-existing chronic health problems, and political leaders, after which other members of the population were vaccinated [8]. In Nigeria, the first batch of 4 million doses of AstraZeneca/Oxford COVID-19 vaccines arrived in the country on 2nd March 2021; by 2nd March 2022, one year after 1st shipment, the country had received more than 65.8 million doses of various COVID-19 vaccines, with about 27 million doses in the pipeline [9] [10]. As of 3rd February, only 65,679,094

persons (57% of the eligible population) in Nigeria were reported to be fully vaccinated despite the availability of vaccines [5]. Previous studies from various countries have revealed that individuals who perceived taking the vaccine as important to protect themselves had higher odds of vaccine acceptance and uptake [11] [12] [13]. Vaccine acceptance and uptake were also positively associated with COVID-19 knowledge, worry or fear regarding COVID-19, higher income, younger age, and testing negative for COVID-19 [11]. However, chronic disease and female gender reduced the odds of vaccine acceptance [11]. The main reasons underpinning vaccine refusal in low- and middle-income countries including Nigeria, were misinformation, religious fanaticism, fear of side effects, cost, convenience of location, lack of confidence in vaccine effectiveness, and environment [12] [13].

The objective of this study was to determine COVID-19 vaccine acceptance, uptake, and associated factors among inhabitants of selected catchment communities in Oyo and Ogun states in southwestern Nigeria.

2. Methods

2.1. Study Setting

This study was conducted in Oyo and Ogun states in southwestern Nigeria. Ogun State has a projected population of approximately 6.38 million in 2022 based on the 2006 National Census [14]. Ogun State shares a border with Lagos State, the epidemic center for COVID-19 in Nigeria [15], and ranked among the first five states with a high incidence of COVID-19 in the early pandemic period in Nigeria [15]. The state reported a total of 5810 COVID-19 cases as of October 26th, 2022 [5] [15]. According to administrative data, 1,282,912 individuals in Ogun have had full COVID-19 vaccination in the state as of 26th October 2022 (either one dose or two doses of vaccine) [5]. Oyo State has a projected population of approximately 7.98 million in 2022 and is also ranked among the first five states with the highest incidence of COVID-19 in Nigeria [14] [15]. The total number of COVID-19 cases reported in the state was 10,334, with 1,797,581 vaccinated against the disease as of October 26th, 2022 [5] [15].

2.2. Study Design

Questions on COVID-19 vaccination uptake and associated factors were included in a cross-sectional household survey conducted from July to August 2021 among inhabitants of selected communities in Oyo and Ogun states.

2.3. Sampling Technique and Study Participants Recruitment

A multistage sampling technique was employed to select participants for the study. In each state, ten facilities providing comprehensive HIV care were purposively selected to ensure spread across the geopolitical districts in the state, as well as a mix of different levels of care and facility ownership for a related intervention to improve uptake of health services during the COVID-19 pandemic.

Five communities being served by each facility were randomly selected from the sampling frame of each facility's catchment communities. Map verifiers were deployed to conduct a boundary census of the selected settlements and these were used to produce a map layout of the settlements. The compact segment sampling technique [16] was utilized to identify one-quarter of each catchment community where the survey was carried out. Household listers enumerated all the households in the selected compact segments, out of which four households were randomly selected per compact segment for the survey. All households that refused access were replaced, to ensure a minimum of four households selected per settlement. Eligible respondents for the survey were household decision-makers, defined as household members who make decisions on household member health and health-seeking behavior. Decision-makers who cater to household needs but are not involved in household decision-making were excluded. A total of 400 household decision-makers were interviewed in both states.

2.4. Assessment Tools and Data Collection Procedure

The study was conducted using a semi-structured questionnaire that elicited information on respondents' sociodemographic characteristics, health history, knowledge of COVID-19 infection, risk, and perceptions about COVID-19 infection and vaccination, willingness to receive COVID-19 vaccination, vaccine uptake, and associated factors. The questions were adapted from previous online studies on COVID-19 acceptance and uptake [11] [12] [13]. Respondents' perceptions of the risk of contracting and dying from COVID-19 infection and dying were assessed using two structured questions on a 6-response scale of no risk (assign a score of 1) to very high risk (assign a score of 6). A perception of COVID-19 vaccination benefits score was computed using four structured questions with three response categories; agree (assigned score of 1), don't know/unsure (assigned score of 0), and disagree (assigned score of -1). Knowledge of COVID-19 preventive measures was assessed by asking respondents to mention five preventive measures for COVID-19 infection, with each correct preventive measure mentioned assigned a score of 1; the sum was used as a cumulative knowledge score. The study outcome was respondent's uptake of COVID-19 vaccination measured using the question "Have you ever taken COVID-19 vaccination" with a "yes" or "no" option. Secondary outcomes included (1) willingness to take the COVID-19 vaccine, among those who had not yet been vaccinated, and (2) willingness to encourage family members to take the COVID-19 vaccination.

The questionnaire was programmed into Android devices for field administration using the KoboCollect application (<https://www.kobotoolbox.org/>) [17]. The tools were administered by research assistants (RA) trained over a period of 5 days.

2.5. Data Analysis

Data were cleaned and analyzed using SPSS IBM version 23 and presented with

tables and charts. Analyses were adjusted to account for clustering within facility catchment settlements. Collinearity was assessed using correlation analyses. The association between exploratory variables and COVID-19 vaccination uptake was assessed using univariate and multivariate logistic regression. Factors that were significant at a p-value of 0.05 at a univariate level were included in multivariate analyses.

2.6. Ethical Consideration

Ethical approval for the study was sought from the Nigerian National Health Research Ethical Committee with approval number NHREC/01/01/2007-09/11/2020; this was deemed a program evaluation activity by the US Centers for Disease Control and Prevention Human Research Protection Office. Written consent was obtained from every study participant before data collection. In addition, the study complied with the Declaration of Helsinki on conducting research among human subjects

3. Results

Four hundred household decision-makers in 100 catchment communities were surveyed in Oyo and Ogun states between July to August 2021. The mean age of the respondents was 43.0 ± 11.0 years. The mean number of people living in the surveyed households was 5.4 ± 3.2 (**Table 1**). Most respondents were male ($n = 322$; 80.5%), married/cohabiting ($n = 364$; 91.0%), and the most common occupation was trader/farmer ($n = 154$; 39.1%). Of household respondents, 15 (3.8%) had underlying chronic illnesses.

About half (56.0%) of the participants agreed that the COVID-19 vaccine is free and accessible. Less than two-fifths (39.5%) agreed that COVID-19 has minimal adverse effects and is tolerable. The mean perception scores were average for the risk of contracting or dying from COVID-19 (3.06 out of a maximum obtainable score of 6), and Covid-19 vaccination benefits (1.16 out of a maximum obtainable score of 4) (**Table 2**).

Only 33 (8.3%) reported having ever had a COVID-19 test in the past, and all reported that the test was negative. Although 346 (86.5%) had heard about COVID-19 vaccination, only 47 (13.6%) had received a COVID-19 vaccine. Of the 299 respondents who reported not receiving COVID-19 vaccination, 299 (55.5%) said they were willing to receive the vaccine in the future. Of the 346 respondents who had heard about COVID-19 vaccination, 208 (60.1%) reported that they would encourage their family members to take it (**Table 3**).

Out of the 106 (35.5%) who were not willing to receive the vaccine, 67.7% reported fear of potential side effects, 15.0% noted that it is against their religious belief, and 10.5% claimed that it is a plan to depopulate the black race. Other less common reasons given for not being willing to take the vaccine included perceived effects on male potency, libido, and sterility; the vaccine being a mark of the devil and the vaccine being a tracking and monitoring device (**Figure 1**).

Table 1. Respondents' background characteristics.

Variable (s)	Mean	SD	Frequency (n = 400)	Percent
Respondent Age (N = 400)	43.0	11.0		
The average income per month? In Naira (N = 394)	45,528.7	54,753.6		
Number of people living in the household (N = 400)	5.4	3.2		
Respondent Gender				
Male			322	80.5%
Female			78	19.5%
Highest Educational Level				
No formal education			32	8.0%
Completed primary education			90	22.5%
Completed secondary education			193	48.3%
Completed tertiary education			85	21.3%
Marital Status				
Single			2	0.5%
Married/cohabiting			364	91.0%
Widow/widower			20	5.0%
Separated/Divorced			14	3.5%
Occupation (n = 398)				
Civil/Public Servant			66	16.8%
Artisan/Skilled laborers			129	32.7%
Unskilled laborers			40	10.2%
Trading/Farming			154	39.1%
Unemployed/Student			5	1.3%
Suffering from chronic disease			15	3.8%
Self-reported Health Status				
Medium			25	6.3%
Good			127	31.8%
Very good			248	62.0%

Univariate regression analysis demonstrated the following factors were associated with a significantly higher likelihood of having been vaccinated: female respondents vs male [Crude Odd Ratio (COR): 1.94 (1.56 - 2.42)], those that had secondary [COR: 2.18 (1.22 - 3.88)] or tertiary education [COR: 2.81 (1.56 - 5.07)] vs. no formal education, those who agreed that COVID-19 vaccine is free and accessible vs those who disagreed [COR: 2.37 (1.58 - 3.57)] and that COVID-19 vaccine has minimal side effects vs those who felt that there were

Table 2. Respondent's knowledge and perception about COVID-19 vaccination uptake.

Variable (s)	Mean	Std. Deviation	Freq	%
Perceive that the COVID-19 vaccine is free and accessible (n = 400)				
Disagree			38	9.5%
Don't Know			138	34.5%
Agree			224	56.0%
Perceive that COVID-19 has minimal adverse effects and is tolerable (n = 400)				
Disagree			75	18.8%
Don't Know			167	41.8%
Agree			158	39.5%
Respondents' perception score on the risk of contracting or dying from COVID-19 (n = 346)	3.06	1.65		
Respondents' perception score on COVID-19 vaccination benefits (n = 346)	1.61	1.90		
Respondent knowledge score on COVID-19 infection prevention measures (n = 346)	3.24	1.84		

Table 3. Respondents' awareness, uptake, and willingness to receive COVID-19 vaccination.

Variable (s)	Frequency	Percent
Have you heard of COVID-19 vaccination? (N = 400)		
yes	346	86.5%
Have you taken the COVID-19 vaccination? (N = 346)		
yes	47	13.6%
Would you like to take the COVID-19 vaccination? (N = 299)		
No, I would not	106	35.5%
Yes, I would	166	55.5%
Not sure/Uncertain	27	9.0%
Would you encourage your family to take COVID-19 Vaccination? (n = 346)		
No, I would not	104	30.1%
Yes, I would	208	60.1%
Not sure/Uncertain	34	9.8%

side effects [COR: 3.67 (2.68 - 5.02)]. Furthermore, the higher the respondent's COVID-19 vaccine benefits perception score [COR: 1.74 (1.61 - 1.87)], the higher the likelihood of being vaccinated. In contrast, the older age of respondents [COR: 0.99 (0.98 - 0.10)] or higher knowledge score on infection prevention and control (IPC) measures [COR: 0.87 (0.82 - 0.91)] were associated with a

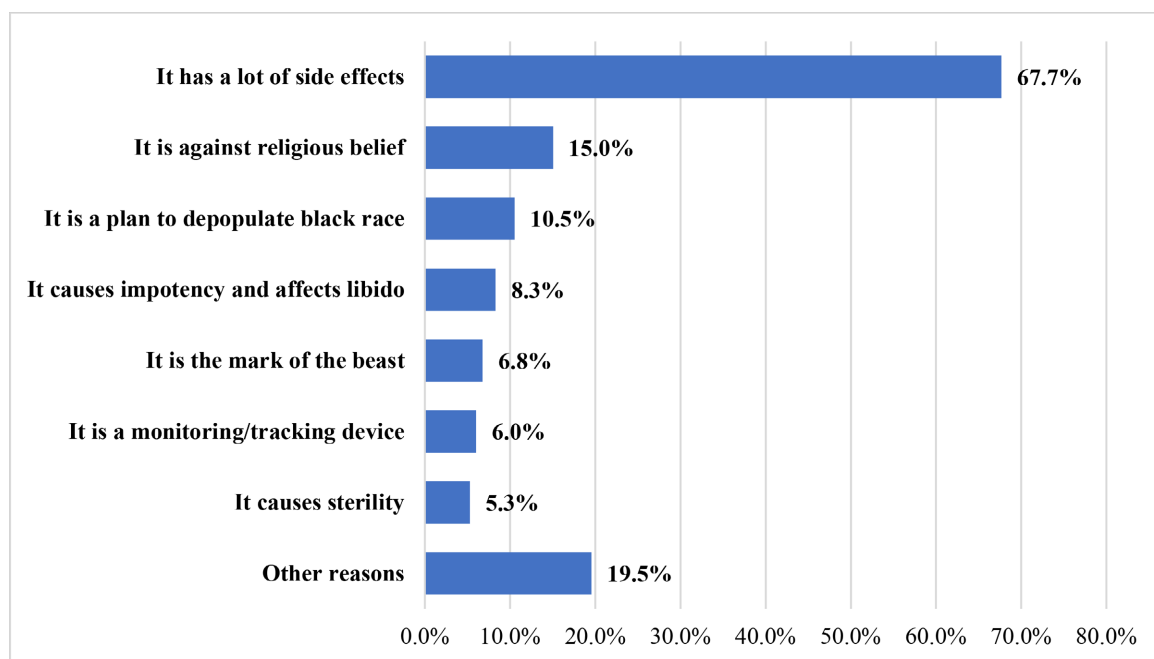


Figure 1. Reasons for non-willingness to take COVID-19 vaccination.

lower likelihood of being vaccinated. Respondents who were suffering from chronic diseases [COR: 0.29 (0.14 - 0.59)] had a lower likelihood of being vaccinated when compared to their colleagues who were civil servants or had no chronic diseases, respectively (**Table 4**).

Respondent's age [adjusted odds ratio (AOR): 0.99 (0.98 - 1.00)], gender [3.41 (2.60 - 4.47), Ref; male], perception score on COVID-19 vaccine benefits [AOR: 1.55 (1.41 - 1.70)], knowledge score on IPC measures [AOR: 0.79 (0.74 - 0.84)], a positive agreement that COVID-19 vaccine is free and accessible [AOR: 2.03 (1.30 - 3.19), Ref; No] and safe [AOR: 4.04 (2.77 - 5.88), Ref; No] were the factors that were significantly associated with COVID-19 vaccine uptake at multivariate level after adjusting for other factors.

4. Discussion

We assessed respondents' prior COVID-19 testing, vaccine access, and related factors in the study settings. Only 8.3% of our respondents in both study locations had ever been tested for COVID-19 before the survey. This finding is in keeping with the WHO Regional Office for Africa reports which show that only one in seven (14.2%) of COVID-19 cases are detected in Africa [18]. Furthermore, a Nigeria Centre for Disease Control report showed that only about 1.7% of the populace has so far been tested for COVID-19 since the onset of the pandemic in 2020 [19]. The testing rate in Nigeria is low considering the large population (estimated to be more than 200 million). South Africa has tested approximately 23% of its population while the testing rate is currently about 3% in Egypt and Kenya respectively [20]. WHO has asserted that COVID-19 testing is a critical component of the overall prevention and control of the disease [21].

Table 4. Examines association between exploratory variables and COVID-19 vaccination uptake at univariate and multivariate levels.

Variable (s)	Crude OR (95% CI)	Adjusted OR (95% CI)
Age	0.99 (0.98 - 1.00)*	0.99 (0.97 - 1.00)*
Gender, female vs male	1.94 (1.56 - 2.42)*	3.41 (2.60 - 4.47)*
Highest level of education		
No Formal Education	1	
Completed Primary Education	1.34 (0.72 - 2.48)	1.06 (0.55 - 2.04)
Completed Secondary Education	2.18 (1.22 - 3.88)*	1.42 (0.76 - 2.67)
Completed Tertiary Education	2.81 (1.56 - 5.07)*	1.58 (0.81 - 3.09)
Occupation		
Civil/Public Servant	1	1
Artisan	0.37 (0.28 - 0.49)*	0.45 (0.31 - 0.67)*
Unskilled Labourers	0.52 (0.34 - 0.79)*	1.11 (0.65 - 1.88)
Trading/Farming	0.72 (0.57 - 0.92) *	0.94 (0.66 - 1.33)
Unemployed/Student	0	
Suffering from chronic diseases	0.29 (0.14 - 0.59)*	0.53 (0.25 - 1.14)
Health status rating		
Medium	1	
Good	0.92 (0.59 - 1.45)	
Very good	1.30 (0.85 - 2.01)	
Perceive that COVID-19 vaccine is free and accessible (Yes vs No)	2.37 (1.58 - 3.57)*	2.03 (1.30 - 3.19)*
Perceive that COVID-19 vaccination has minimal side/adverse effects and is tolerable (Yes vs No)	3.67 (2.68 - 5.02)*	4.04 (2.77 - 5.88)*
Perception score on the risk of contracting or dying from COVID-19	1.04 (0.98 - 1.11)	
Perception score about COVID-19 vaccine benefits	1.74 (1.61 - 1.87)*	1.55 (1.41 - 1.70)*
Respondents' knowledge score on COVID-19 infection prevention measures	0.87 (0.82 - 0.91)*	0.79 (0.74 - 0.84)*

*Statistically significant at a p-value of less than 0.05.

The Nigerian national COVID-19 response teams have primarily focused their testing efforts on international travelers and their contacts. Although these efforts are commendable, there is an urgent need for a well-articulated, community-based, and user-friendly COVID-19 testing program utilizing existing Rapid Diagnostic Testing (RDT) kits. In some regions of the country, these activities have begun, but they need to be scaled up. This becomes crucial in the era of the Omicron variant, which has a very high rate of community transmission. In addition, the number of reference laboratories equipped with PCR machines to confirm cases must be increased. In Nigeria, only 157 (84 public and 73 private) out of 5349 laboratories are currently accredited for this purpose.

The current study revealed that despite the high COVID-19 vaccine awareness rates in the study settings, only 13.6% of the study participants have been vaccinated. Empirical evidence shows a low vaccination rate in Nigeria compared with other countries. For instance, the most recent report by “Our World in Data” revealed that only 4.5% of Nigerians had received one dose while a lower proportion (2.1%) had been fully immunized as of 27th December 2021 [22]. In comparison, full immunization rates were 26.6% in South Africa, 1.7% in Mali, 5.3% in Senegal, and 7.3% in Kenya [22].

Reasons for the low COVID-19 vaccination rate documented by this study, and perhaps in Nigeria overall, can be multi-factorial. Firstly, it could have been due to the relative scarcity of vaccines in the country. Frontline healthcare workers, the elderly, those with pre-existing chronic health problems, and political leaders were given priority for the first batch of about 4 million doses of COVID-19 vaccines which arrived in Nigeria in March 2021 through the COVAX facility [23]. The second batch of over 4 million Moderna vaccines, meant to benefit the general populace, arrived (1st August 2021) and may have not been sufficiently distributed [24]. Additionally, the low uptake could be due to the existing and widely circulated conspiracy theories regarding COVID-19 causation in Nigeria. Many Nigerians are still doubtful of the existence of the disease, as they believe that the virus is caused by 5G technology and cannot survive in the hot Nigerian weather [25]. Many believe that COVID-19 is being promoted by political leaders to give them the platform to further loot the national treasury [26]. Also, some prominent Nigerian religious and political leaders have openly condemned COVID-19 vaccination acceptance. The religious leaders believe the vaccine is a mark of the anti-Christ and so warn their followers against acceptance [27].

These factors could have also been responsible for the low willingness to accept COVID-19 vaccines among our non-vaccinated respondents. Only 55.5% of the unvaccinated were willing to receive the vaccine and only 60.1% of the vaccinated were willing to recommend the vaccine for their family members. Our results are similar to results from Adejumo *et al.*, who interviewed Nigerian healthcare workers in 4 specialized hospitals in Ondo, Edo, and Delta states, and found that about 55.5% of their respondents had positive perceptions of the COVID-19 vaccine and were willing to accept vaccination. This is particularly concerning given that healthcare workers are expected to have better information on the benefits of vaccination, and we rely on them to encourage others to be vaccinated [28]. A low COVID-19 acceptance rate has been documented in other settings as well. The proportion of those willing to accept COVID-19 vaccination was as low as 28% in the Democratic Republic of Congo,

56.2% in Ethiopia while China and Bangladesh had much higher reported willingness to accept the COVID-19 vaccine, at 91% and 85%, respectively [29] [30] [31]. Additionally, the perceived low case-fatality rate of the disease in Nigeria may contribute to low vaccine acceptability. Currently, the estimated case-fatality rate for the disease is 1.2% in Nigeria compared to the global rate of 2.1%

[32] [33].

Other reasons reported by study participants for lack of willingness to receive the COVID-19 vaccine include fear of side effects, vaccination not in tandem with religious views, and the perception that vaccination was designed to depopulate the black race. This highlights the need for more structured and sustainable health education interventions, to dispel many of the misconceptions regarding COVID-19 causes and prevention. All relevant stakeholders, particularly religious and political leaders, should be involved in planning, implementing, and evaluating health education interventions to ensure that they are effective. All channels of communication should be engaged, and easy-to-understand COVID-19 vaccine-related information should be widely disseminated in local languages.

Participants who perceived the vaccine to be free and accessible were twice as likely to be vaccinated as those who did not, thus, decentralization of COVID-19 vaccination to improve accessibility should help to overcome the hidden costs of receiving the vaccines and hopefully promote uptake. The perception that the vaccine had few side effects and was well tolerated was associated with a 4-fold higher likelihood of being vaccinated, thus there is the need to provide additional education to counteract the misperceptions around vaccine side effects and other myths regarding COVID-19 vaccines. While COVID-19 vaccines are known to cause mild to moderate side effects, like many other vaccines, they are overwhelmingly safe. Despite this, some people still believe that researchers rushed the development process and that COVID-19 vaccines may not be effective and safe for humans [34]. In addition, the Nigerian media continues to promote misinformation, for example, stating that the COVID-19 vaccine causes infertility in women and can make people bleed to death [33]. Globally, it has been widely circulated that mRNA-based COVID-19 vaccines have the potential to change human DNA [34]. It is critical to provide people with reliable information to counter these misperceptions to improve vaccine uptake.

Additional messaging on the accessibility, safety, and health benefits of COVID-19 vaccination has the potential to improve vaccine uptake. To ensure wide dissemination, government officials should seek to engage prominent Nigerian bloggers, social media influencers, actors, and musical artists to promote COVID-19 vaccination exercises and ensure that social media platforms such as Facebook, Instagram, and WhatsApp provide accurate information. Incorporation of religious leaders and faith-based organizations in COVID-19 vaccination programming will also help promote information dissemination, prevent and reduce fear and stigma, provide reassurance to people in their communities, and promote health-saving practices such as COVID-19 vaccination uptake.

Furthermore, messaging should emphasize using a combination of pharmaceutical and non-pharmaceutical strategies (the “Swiss cheese” model), and that either vaccination or non-pharmaceutical measures, such as IPC, do not guarantee one hundred percent protection against COVID-19 infection.

5. Study Limitations

This study may be subject to social desirability bias, in which respondents gave answers that they believed were socially acceptable rather than giving responses that reflected their actual individual life experiences. To attempt to reduce this bias as much as possible, the goal of the research was clearly explained to them, and the confidentiality of their information was assured. This study did not document the type of vaccine received by the participants and the disaggregation of the vaccination uptake by the dose received either 1st, the 2nd, or the booster dose.

6. Conclusion

Uptake of COVID-19 testing and vaccination, as well as willingness to receive vaccination, were low. In addition to legitimate concerns over vaccine accessibility, several misconceptions must be addressed. There is an urgent need for policy-makers and the Nigerian COVID-19 response teams to embark on well-designed awareness campaigns capable of dispelling the myths regarding COVID-19 causes/vaccines and improving positive perceptions of Nigerians regarding the health benefits of COVID-19 vaccination.

Declaration

Authors' Contributions

The study was conceptualized by Oluseye Ajayi. Technical development and data collection were done by Ajayi Oluseye Ayodele, Ogunsola Olabanjo Okunlola, Idowu Ajibola, Ajayi Oluwaseun Kikelomo, Wudiri Kucheli, Asoka-Ikechukwu Rita. Data was analyzed by Ajayi Oluseye. All authors participated in the manuscript writing. Expert reviews were done by Prosper Okonkwo.

Data Availability

The survey data is available upon reasonable request.

Ethical Approval

The project was approved by the Nigeria Health Research Ethical Committee with approval number NHREC/01/01/2007-09/11/2020.

Informed Consent

We obtained written informed consent from all patients who participated in the study.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

- [1] Amzat, J., Aminu, K., Kolo, V.I., Akinyele, A.A., Ogundairo, J.A. and Danjibo, M.C. (2020) International Journal of Infectious Diseases Coronavirus Outbreak in Nigeria: Burden and Socio-Medical Response during the First 100 Days. *International Journal of Infectious Diseases*, **98**, 218-224. <https://doi.org/10.1016/j.ijid.2020.06.067>
- [2] Karia, R., Gupta, I., Khandait, H., Yadav, A. and Yadav, A. (2020) COVID-19 and Its Modes of Transmission. *SN Comprehensive Clinical Medicine*, **2**, 1798-1801. <https://doi.org/10.1007/s42399-020-00498-4>
- [3] WHO: World Health Organization (2023) WHO Coronavirus Dashboard. <https://covid19.who.int/>
- [4] WHO: World Health Organization (2023) WHO Coronavirus Dashboards. <https://covid19.who.int/region/afro/country/ng>
- [5] National Primary Health Care Board (2023) COVID-19 Vaccination Update. <https://twitter.com/NphcdaNG/status/1585238333240008704/photo/2>
- [6] World Health Organization (2020) Interim Guidance on Infection, Prevention, and Control during Health Care When Novel Coronavirus (nCoV) Infection Is Suspected. <https://www.who.int/publications/i/item/10665-331495>
- [7] World Health Organization: Regional Office for Africa Release on COVID-19 Vaccine. <https://www.afro.who.int/health-topics/coronavirus-COVID-19/vaccines>
- [8] National Institute for Legislative and Democratic Studies (February 2021) Nigeria COVID-19 Vaccination Plans: Ensuring Equitable Allocation and Distribution. <https://ir.nilds.gov.ng/bitstream/handle/123456789/439/Nigeria%20COVID-19%20Vaccination%20Plans.pdf?sequence=1>
- [9] WHO: World Health Organization (2021) COVID-19 Vaccines Shipped by COVAX Arrive in Nigeria. <https://www.afro.who.int/news/COVID-19-vaccines-shipped-covax-arrive-nigeria>
- [10] UNICEF (2022) COVID-19 Vaccines Shipped by COVAX Arrived in Nigeria. <https://www.unicef.org/nigeria/press-releases/COVID-19-vaccines-shipped-covax-arrive-nigeria>
- [11] Bono, S.A., Faria, E., Villela, D.M., *et al.* (2021) Factors Affecting COVID-19 Vaccine Acceptance: An International Survey among Low- and Middle-Income Countries. *Vaccines*, **9**, Article 515. <https://doi.org/10.3390/vaccines9050515>
- [12] Wirsiy, F.S., Nkfusai, C.N. and Ako-Arrey, D.E. (2021) Acceptability of COVID-19 Vaccine in Africa. *International Journal of Maternal and Child Health and AIDS*, **10**, 134-138. <https://doi.org/10.21106/ijma.482>
- [13] Adedeji-Ademola, H., Olugbaka, O.A. and Adeosun, S.A. (2022) Factors Influencing COVID-19 Vaccine Uptake among Adults in Nigeria. *PLOS ONE*, **17**, e0264371 <https://doi.org/10.1371/journal.pone.0264371>
- [14] (2023) https://citypopulation.de/en/nigeria/admin/NGA028_ogun/
- [15] NCDC (2022) COVID-19 Nigeria. <https://ncdc.gov.ng/diseases/sitreps/?cat=14&name=An%20update%20of%20COVID-19%20outbreak%20in%20Nigeria>
- [16] Milligan, P., Njie, A. and Bennett, S. (2004) Comparison of Two Cluster Sampling

- Methods for Health Surveys in Developing Countries. *International Journal of Epidemiology*, **33**, 469-476. <https://doi.org/10.1093/ije/dyh096>
- [17] (2022) KOBO Humanitarian Response. <https://www.kobotoolbox.org>
- [18] World Health Organization Regional Office for Africa (2021) Six in Seven COVID-19 Infections Go Undetected in Africa. <https://www.afro.who.int/news/six-seven-COVID-19-infections-go-undetected-africa>
- [19] Nigerian Centre for Disease Control (NCDC) (2021) NCDC Coronavirus COVID-19 Microsite. <https://covid19.ncdc.gov.ng/?fbclid=IwAR0aFrcP1-XwqwquQUJgIQHStOYBNexX851PumHjWjXaM3s5gi8dNUDYGo#!>
- [20] International Centre for Investigative Reported (ICIR) (2021) 17 Months after the First Case, Only 1% of Nigerians Have Been Tested for COVID-19. https://www.icirnigeria.org/17-months-after-the-first-case-only-1-of-nigerians-have-been-tested-for-COVID-19/?_cf_chl_managed_tk=AKZMB3ffjrJJ0jmqmFOLb7jRza34z84maROvRbAJ_IA-1640778227-0-gaNycGzNFb0
- [21] WHO: World Health Organization (2021) Recommendations for National SARS-Cov-2 Testing Strategies and Diagnostic Capacities.
- [22] Our World in Data (2021) COVID-19 Vaccination Rate South Africa. <https://ourworldindata.org/covid-vaccinations>
- [23] WHO: World Health Organization (2021) COVID-19 Vaccines Shipped by COVAX Arrive in Nigeria. <https://www.afro.who.int/news/COVID-19-vaccines-shipped-covax-arrive-nigeria>
- [24] Vanguard (2021) COVID-19: Nigeria to Begin Administering 2nd Batch of Vaccines. <https://www.vanguardngr.com/2021/08/covid-19-nigeria-to-begin-administering-2nd-batch-of-vaccines-aug-10/>
- [25] Gambo, S. and Shem, W. (2021) Social Media and the Spread of COVID-19 Conspiracy Theories in Nigeria. *Journal of Ideas in Health*, **4**, 432-437. <https://doi.org/10.47108/jidhealth.Vol4.Iss3.150>
- [26] Africare (2021) Conspiracy Theories and COVID-19 Vaccine Introduction in Nigeria—Nigeria Health Watch. <https://nigeriahealthwatch.com/conspiracy-theories-and-COVID-19-vaccine-introduction-in-nigeria/>
- [27] Global Voices (2021) Nigerian Pastor Spreads COVID-19 Conspiracies and Disinformation. <https://globalvoices.org/2020/05/15/nigerian-pastor-spreads-COVID-19-conspiracies-and-disinformation/>
- [28] Adejumo, O.A., Ogundele, O.A., Madubuko, C.R., Oluwafemi, R.O., Okoye, O.C., Okonkwo, K.C., et al. (2021) Perceptions of the COVID-19 Vaccine and Willingness to Receive Vaccination among Health Workers in Nigeria. *Osong Public Health and Research Perspectives*, **12**, 236-243. <https://doi.org/10.24171/j.phrp.2021.0023>
- [29] Wake, A.D. (2021) The Willingness to Receive COVID-19 Vaccine and Its Associated Factors: “Vaccination Refusal Could Prolong the War of This Pandemic”—A Systematic Review. *Risk Management and Healthcare Policy*, **14**, 2609-2623. <https://doi.org/10.2147/RMHP.S311074>
- [30] Kamal, A.H.M., Sarkar, T., Khan, M.M., Roy, S.K., Khan, S.H., Hasan, S.M.M., et al. (2021) Factors Affecting Willingness to Receive COVID-19 Vaccine among Adults: A Cross-Sectional Study in Bangladesh. *Journal of Health Management*, **25**, 414-423. <https://doi.org/10.1177/09735984211050691>

- [31] Berihun, G., Walle, Z., Teshome, D., Berhanu, L. and Derso, M. (2022) COVID-19 Vaccine Acceptance and Associated Factors among College Students in Dessie City, Northeastern Ethiopia. *Journal of Multidisciplinary Healthcare*, **15**, 1735-1746. <https://doi.org/10.2147/JMDH.S381151>
- [32] Nigeria Centre for Disease Control (2021) Update on COVID-19 Outbreak in Nigeria <https://ncdc.gov.ng/diseases/sitreps/?cat=14&name=AnupdateofCOVID-19outbreakinNigeria>
- [33] Hopkins, J. (2021) Mortality Analyses. Johns Hopkins Coronavirus Resource Center. <https://coronavirus.jhu.edu/data/mortality>
- [34] Hopkins, J. (2021) COVID-19 Vaccines: Myth versus Fact. Johns Hopkins Medicine. <https://www.hopkinsmedicine.org/health/conditions-and-diseases/coronavirus/COVID-19-vaccines-myth-versus-fact>

Annex 1.**Sustaining Care Seeking for fever and ANC services at Nigerian Health Facilities
in four States in Nigeria****VACCINATION ACCEPTABILITY QUESTIONNAIRE****Consent Statement**

Hello, my name is [enumerator]. I am from APIN Public Health Initiatives. We are conducting a study aimed at assessing household and community acceptability of the COVID-19 vaccine and factors affecting it in selected communities in Nigeria. The outcome of this survey will help to design and implement programs to improve community health outcomes during this COVID-19 pandemic. You have been chosen to participate in this activity because you are a community dweller whose perception will determine community uptake of health services. The process will entail an interview using a semi-structured questionnaire. The interview will also be recorded to permit us to listen and analyze the responses at the end of the interview. There are no direct benefits for participating, but your participation will help to inform the design of programs aimed at improving the health of households in communities like this one. The information provided by you will be held in strict confidence. Neither your name nor other information that could be used to identify you will be recorded. Your information may be stored electronically, and we will use industry standard and nationally required practices to ensure its security. Any information you provide will only be made available to other researchers without any information that could identify you and only for the purpose of research. The survey should take about 30 minutes to complete. Participation is completely voluntary. If we should come to any question you do not want to answer, just let me know and I will go on to the next question. You are also free to stop the interview at any time, should you feel uncomfortable.

Questions	Responses	Skip Pattern
Would you like to participate in this study?		
Field Personnel Information		
Q001 Enumerator's Name and Identification code		
Respondent's Background Characteristics		
Q002 How old were you at your last birthday	002 AGE IN COMPLETED YEARS __ __	
Q003 What is the Respondent Gender?	Male	
	Female	
	Others	
Q004 Does the gender correspond to the respondent biological sex?	Yes	
	No	
Q005 What is the highest level of education that you attained?	No Formal Education	
	Completed Primary Education	
	Completed Secondary Education	
	Completed Tertiary Education	
Q006 What is your religion?	Christianity	
	Islam	
	Traditional	
	Others (specify _____)	

Continued

Q007 What is your current marital status?	Never Married Married Cohabiting (Unmarried living together) Separated/Divorced Widow/widower Others (Specify_____)	
Section 1 COVID-19 vaccination acceptability		
Q 101 Have you heard of COVID-19 infection?	Yes No	If No, go to the end
Q 102 Kindly mention some of the common symptoms of COVID-19 infection	Fever Cough Shortness of Breath or Difficulty Breathing Fatigue Muscle or Body Aches Headache Sore Throat Nausea or Vomiting Diarrhea Loss of taste or smell Others (Specify_____)	
Q 103 Tell us some of the preventive measures for COVID-19 infection	Wear a mask Avoid crowds/gatherings Physically distance from others ($\geq 2m$) Wash hands frequently with soap and water Use alcohol-based hand rub Other (specify)	
Q104 Have you heard of COVID-19 vaccination?	Yes No	If No skip to Q306
Q105 Source of information about COVID-19 vaccination	Healthcare workers working in the health facilities in this community Other HCWs outside this community Health educators within the community Electronic media e.g radio, TV Print media Community leaders or influencers	

Continued

	Friend/Neighbour	
	Others (Specify_____)	
Q 106 How would you evaluate yourself in terms of risk of contracting COVID-19?	No risk	
	Low risk	
	High risk	
Q 107 How would you rate yourself on the risk of dying from COVID-19?	No risk	
	Low risk	
	High risk	
Q 108 Have you taken COVID-19 vaccination jab?	Yes	If yes,
	No	skip to Q
		310
Q 109 If No, why have you not taken COVID-19 vaccination?	I don't know any available vaccination center	
	The vaccination centers are far and not easily accessible.....a	
	There are no vaccines in our community vaccination centers.....b	
	It causes harm or has side/adverse effect on the body	
	It causes sterility	
	It reduces libido and cause male impotency	
	It is a strategy to depopulate the blacks	
	It is a monitoring device	
	Others (Specify_____)	
Q 110 How close is the vaccination centre to the community?	Within 5km radius	Skip if
	5-10km radius	309 is "a"
	More than 10km radius	
Q 111 How many fixed post or vaccination camps do you have in your community?	----- [Type in]	Skip if
	Type 99 if don't know	309 is "a"
Q 112 have you had mobile COVID-19 vaccination visit to your community in the last few months?	Yes	
	No	
How often do they visit the community?	Very often	
	Often	
	Occasionally	
	Rarely	
	Very rarely	
Q 113 Would you like to take COVID-19 vaccination?	Yes	
	No	

Continued

Q 114 Would you encourage your family to take COVID-19 vaccination

Yes
No

I am going to read a series of statements or questions to you and I would like you to tell me if you agree or disagree with the statement

Disagree Don't know/unsure Agree

Q 115 COVID-19 vaccine is very effective in preventing and controlling COVID-19 diseases

Q 116 Vaccinated people have no/reduced risk of contracting COVID-19 vaccine compared to the unvaccinated

Q 117 Vaccinating a larger percentage of a community reduces the community risk of having COVID-19 infection outbreak

Q 118 Previously COVID-19 diagnosed individual do not require the vaccine

Q 119 COVID-19 vaccine has minimal side/adverse effects and is very tolerable

Q 120 COVID-19 vaccine is free
