Case Report

Acceptance of a COVID-19 Vaccine in Nigeria: A Population-Based Cross-Sectional Study

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Abstract

Background: The study aimed to assess the intention to accept a future COVID-19 vaccine in Nigeria and associated factors. **Patients & Methods:** A cross-sectional study was conducted using an online questionnaire between July 2020 and August 2020 that captured demographic data, risk perception; trust in government and public health authorities and willingness to accept a future COVID-19 vaccine. Data were analyzed using Statistical Package for Social Science and Chi-square and logistic regression at a 95% confidence interval calculated. Appropriate institutional ethical board approval and informed consent obtained from all participants were obtained. **Results:** 1,228 responses were received over the study period. The mean age of respondents was 32.8 years (SD 10.4), 12.7% (156/1,228) were health workers, and 66.9% (820/1,228) had tertiary level of education. Intention to accept a future COVID-19 vaccine was expressed by 50.2% (617/1,228). Older age, male gender, trust in government, trust in public health authorities, confidence in vaccine developers, willingness to pay for and travel for a vaccine, and vaccination during an outbreak were significantly associated with COVID-19 vaccine acceptance. Healthcare workers and respondents with pre-existing medical conditions were not significantly different from non-healthcare workers and persons without medical conditions respectively with regards to the willingness to be vaccinated. **Conclusion:** One in 2 persons would accept a COVID-19 vaccine when one becomes available in the country. The government should take pro-active steps to address the factors that may potentially impact on the benefits expected from the introduction of a COVID-19 vaccine in the country.

Keywords: COVID-19; Hesitancy; Intention; Vaccine; Willingness

Introduction

The COVID-19 pandemic caused by the SARS-Coronavirus-2 (SARS-CoV-2) started in Wuhan China in 2019 and has swept across all continents of the world, affecting over 213 countries and territories. [1] The pandemic poses a serious threat to global public health, socio-economic stability, food security, trade and industry with the impact felt in high and low-income countries alike. [2] Since the first case was detected in Egypt on the 14th day of February 2020, the number of cases in Africa has been on a steady rise, though has remained lower than the rest of the world. [3] With over 1.3 billion people and a weak health system plagued by lack of healthcare infrastructure and shortages of health manpower, limited access to social protection and low health literacy, the public health measures implemented at the start of the pandemic will not be sufficient to stop further progress of the virus in Africa or end the pandemic. A COVID-19 vaccine may be the most practical and feasible solution for Africa. Several vaccine candidates are currently under different stages of development and some may be available for phase 3 trials before the end of 2020. [4]

While the focus is more on the development of a COVD-19 vaccine, less attention has been paid to the extent to which a vaccine could be accepted in Africa. The introduction of a new health intervention is not necessarily followed by acceptance and adoption by communities. There are several, demographic, individual, socio-political, financial, and cultural dimensions that interplay to influence the adoption and implementation of new health interventions.

Few studies conducted on acceptance of a COVID-19 vaccine have produced varied results with rates as low as 37% and as high as 86%. [5]

Nigeria is a multi-ethnic, multi-cultural and multi-religious country. Experiences with the GAVI-supported routine immunization program shows vaccination coverage rates differ across the country with higher coverage rates in the southern states compared to the north, and within states, higher coverage rates in urban compared to rural areas. Disparities in rates are also observed when comparison is made across caretaker literacy levels, family wealth index and caretaker age. [6] The

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polio vaccination refusal saga in 3 states in northern Nigeria between 2003 and 2004 is a grim reminder of how public mistrust of government intentions and the international community, political and religious discordances and poor community engagement can disrupt a vaccination program intended for the good of the people with grave consequences. [7] It stresses the need for a clear understanding of the context-specific factors that may influence a COVID-19 vaccination program in Nigeria and the timely implementation of strategies to achieve high coverage rates when a vaccine eventually becomes available in the country. The study objectives were to investigate the intention to accept a future COVID-19 vaccine in Nigeria and to determine the factors associated with intent to accept or refuse the vaccine.

Patients and Methods

Study area and population

The study was carried out in Nigeria, located on the west coast of Africa with boundaries as Niger, Chad, Cameroon, Benin and the Gulf of Guinea. The country covers a landmass of 923,768 square kilometres and is divided into 6 geopolitical zones: North-west, North-central, North-east, South-south, South-east and South-west. With a projected population of 200,000,000 and the annual population growth rate of 2.38%, the country is the most populous in West Africa.

Study population and design

The study population were Nigerians with eligibility as access to the internet, willingness to consent, age above 18 years of age and current place of residence as Nigeria.

The survey utilized a cross-sectional study design with a minimum sample size of 1,068 calculated based on the assumption of a 50% vaccine acceptance rate, a 3% margin of error and a confidence interval of 95%. The survey was conducted between June and August 2020.

Statistical analysis

The statistical analysis of the data entered into the excel sheet was done by SPSS version 23. Numbers and percentages were calculated for descriptive analysis. Chi square test was calculated to assess the associations between the variables. The probability p value of <0.05 was considered as statistically significant in the study.

Sampling

The restrictions on movement and recommendation to maintain physical distancing that was in force at the time the study was conducted did not permit face-to-face recruitment of study participants. Instead, a simplified snowballing technique was used where the link to the online survey tool as distributed on the WhatsApp social media platform to all contacts of the researchers. [8] Recipients were encouraged to forward the invitation and link to their WhatsApp contacts and contacts on other social networks.

Data collection

Data were collected using a structured English language questionnaire created on google forms and shared through a link on WhatsApp. The questionnaire was designed from a literature search and inclusion of questions from the SAGE vaccine hesitancy survey. [9] The introductory part of the questionnaire contained informed consent with a brief introduction to the study and study objectives. Recipients were informed that progression with completion of the questionnaire was taken as consent.

The questionnaire was structured in five thematic sections. The first section collected socio-demographic information including age, sex, marital status, religion, educational level, employment status and occupation and any pre-existing illness specifically hypertension, diabetes mellitus, cancer, Human immunodeficiency disease, Asthma, kidney disease or heart disease. Occupation was dichotomized as healthcare provider and non-healthcare provider. Yes', 'No' and 'I don't know' responses were dichotomized as Yes=1 and 0=No/I don't know.

The second section had 3 questions on basic vaccine knowledge capturing purpose of vaccination, mode of action and relevance in outbreaks, with responses as 'Yes', 'No' and 'I don't know'. Responses were coded as Yes=1, No or I don't know=0. Level of basic knowledge was dichotomized as good or inadequate based on a score of 3-4 or 0-2 respectively.

Section three assessed the socio-political dimensions of vaccine acceptance with 6 questions on whom the vaccine should be made compulsory for, trust in vaccine manufacturers, government, and public health authorities and risk perception. To assess trust, respondents were instructed to select one of 3 responses: 'Yes', 'No' and 'I don't know'. Perceived risk was assessed on a Likert scale as: 'very high risk', 'high risk', 'low risk', and 'no risk'. All Likert-scale responses were dichotomized into as strongly agree/agree=1 and Uncertain/disagree/Strongly disagree=0. [10] Perception of risk was dichotomized as No risk/low risk=0 and High risk/very high risk=1.

Sections four addressed willingness to receive a hypothetical COVID-19 vaccine by the question: "Would you be willing to accept a COVID-19 vaccine when one becomes available in the country?" Respondents were asked to indicate if they would be willing to pay for a COVID-19 vaccine and willing to travel for more than one hour to get a COVID-19 vaccine for which they had to choose from: 'Yes', 'No' and 'I am not sure' responses.

Section five contained 2 questions that assessed history of vaccine hesitancy.

Face and content validation of the study questionnaire was carried out to ascertain the validity of the data collection tool. The reliability of the tool was assessed using the test-retest method with the tool administered to 2 groups of 5 community residents twice at a space of 2 weeks. The Pearson moment-correlation coefficient analysis gave a reliability coefficient of 0.77.

The exposure variables in the study included sociodemographic characteristics, trust in the public health authorities, trust in government, and trust in vaccine developers, risk perception, willingness to travel to receive a vaccine, willingness to for a vaccine, previous vaccine hesitancy. The outcome variable was the intention to accept a future COVID-19 vaccine.

Data analysis

Data analysis was carried out using SPSS version 21 (IBM Corporation, Armonk, NY, USA) Descriptive statistics including frequency tables, means and standard deviation were used to present categorical variables. Dichotomized responses were presented as proportions. Bivariate analysis was used to examine the association between exposure and outcome variables, and regression analysis to derive the odds ratios (OR) and their 95% confidence intervals (95% CI) for variables significant at bivariate analysis. A two-tailed p-value <0.05 was statistically significant.

Ethical approval was received from Irrua Specialist Teaching Hospital Ethics Committee. Information on the study was provided as the first section of the survey and potential respondents were required to click on a button to show they gave consent. Confidentiality was maintained as names were not required, and data was accessible only to the researchers.

Results

One thousand two hundred and twenty-eight responses were received over the survey period. Mean age of respondents was 32.8 years (10.4). The highest proportion was in the 25-34 years age group, 472 (38.4%), 592 (48.3%) were married and the majority, 861 (70.1%) had tertiary level of education. Health workers made up 156 (12.7%) respondents. The summary statistics of the socio-demographic profile of the study participants are shown in Table 1.

One hundred and two (81.6%) knew that vaccines protect individuals against infectious diseases, 962 (78.3%) knew vaccines strengthen the immune system, 980 (79.8%) knew vaccination stops the spread of disease. In all, 988 (80.5%) were assessed to have a good general knowledge of vaccination. One thousand and six (81.9%) were aware of the development of a COVID-19 vaccine. The main source of COVID-19 vaccine-related information was social media 609 (60.6%) followed by Nigeria centre for disease control website, 498 (49.5%) [Figure 1].

Of 1,228 respondents, 669 (54.5%) believed that a COVID-19 vaccine when available in the country should be made compulsorily for school children, 775 (63.1%) for health care workers, 593 (48.3%) for the elderly population, 532 (43.3%) for pregnant women and 583 (47.5%) for persons with pre-morbid conditions.

Six hundred and seventeen (50.2%) respondents were willing to accept a COVID-19 vaccine when one becomes available in the country. Reasons for participating are presented in Figure 2.

For the 611 respondents who expressed unwillingness, the reasons provided are shown in Figure 3.

In multivariate analysis, respondents who were >25 years were 1.66 times likely to accept a COVID-19 vaccine (P<0.001, 95% CI 1.29-2.57) with acceptability increasing with advancing age. Moslems were 1.57 times likely to accept a vaccine compared with Christians (P=0.01, 95% CI 1.10-2.12). Females were 0.77 times likely to accept the vaccine compared to males (P=0.04, 95% CI 0.59-0.96), self-employed respondents were 0.68 times likely to accept a vaccine compared with those in government service (P=0.02, 95% CI 0.52-1.03) [Table 2].

Table 1: Socio-demographic characteristics of respondents (n=1,228).

Variable	Frequency (%)
Age	
<24	276 (22.5)
25-34	472 (38.4)
35-44	330 (26.9)
>.45	150 (12.2)
Sex	
Male	635 (51.7)
Female	593 (48.3)
Religion	
Christianity	1013 (82.5)
Islam	207 (16.9)
Others	8 (0.7)
Marital Status	
Single	587 (47.9)
Married	592 (48.3)
Divorced/widowed/separated	46 (3.8)
Educational level	
Primary	46 (3.7)
Secondary	321 (26.6)
Tertiary	861 (70.1)
Profession	
Non-health care provider	1072 (87.3)
Healthcare provider	156 (12.7)
Employment status	
Employed with government	288 (23.5)
Employed in private sector	174 (14.2)
Self-employed	455 (37.1)
Unemployed	308 (25.1)
Geopolitical zone	
South-south	698 (56.8)
South-East	95 (7.7)
South-West	92 (7.5)
North-Central	219 (17.8)
North-West	102 (8.3)
North-East	22 (1.8)
Existing chronic medical condition	
No	1141 (93.1)
Yes	84 (6.9)

Perception of risk was very high for 218 (17.8%), high for 288 (23.5%), low for 340 (27.7%) and no risk for 382 (31.1%) respondents. Healthcare workers had a significantly higher perception of risk, as 88 (56.4%) compared to 418 (39.0%) felt they were of high/very high risk of infection ($\chi 2$=17.05, P<0.001).

Five hundred and thirty-five (43.6%) and 451 (36.7%) would be willing to travel for at least an hour and be willing to pay for a COVID-19 vaccine, respectively. Five hundred and eight (41.4%) respondents expressed trust in the federal government to take the right decision regarding COVID-19 vaccination in Nigeria, 720 (58.7%) held a contrary opinion. Seven hundred and twenty -nine (59.4%) respondents felt they could trust their

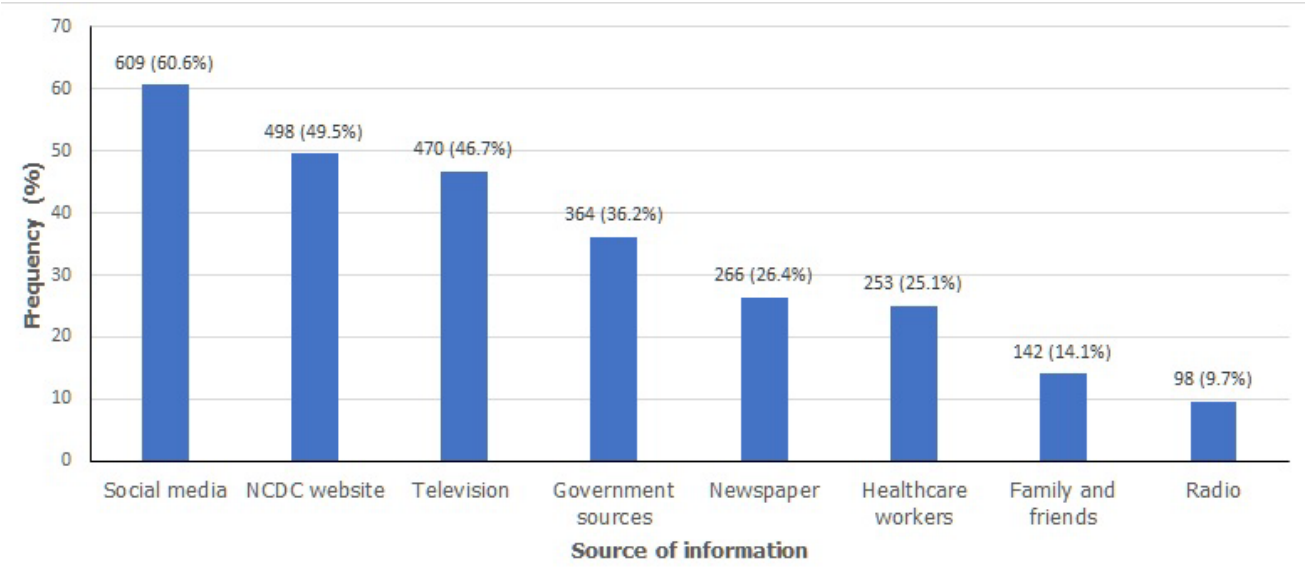

Figure 1. Source of information on COVID-19 (multiple response).

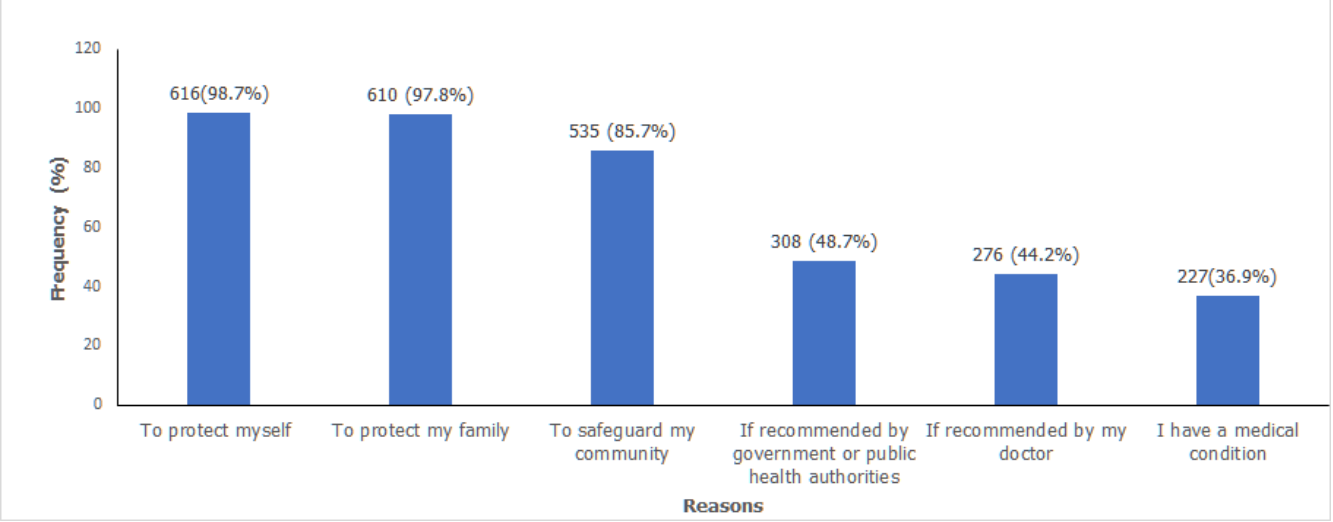

Figure 2. Reasons for vaccine acceptance (multiple response).

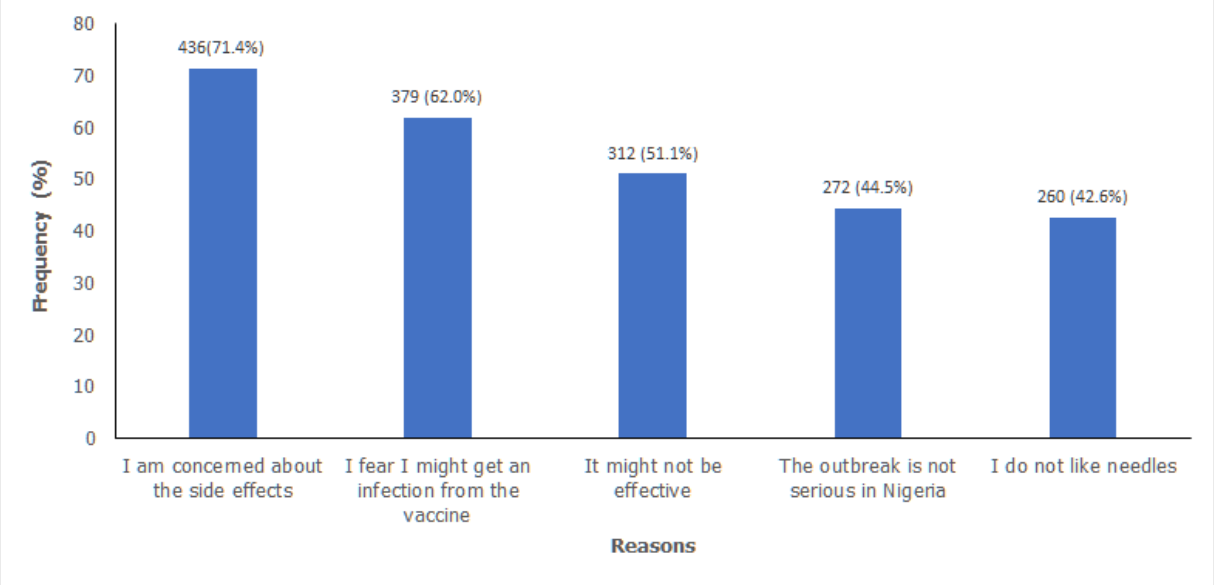

Figure 3. Reasons for vaccine refusal.

public health authorities regarding a COVID-19 vaccine, 761 (62.0%) respondents could trust COVID-19 vaccine producers. Four hundred and ninety (39.0%) considered the availability of a COVID-19 vaccine as a necessity for the restoration of a pre-outbreak way of life.

Respondents who were willing to travel for at least an hour to get a COVID-19 vaccine were 6.70 times more likely to accept a vaccine when it becomes available in the country compared to those who would not be willing to travel. In the same manner, those who expressed they would be willing to pay for a COVID-19 vaccine were 3.69 more likely to accept a vaccine than those who would not be willing to pay. Respondents who expressed trust in government and trust in the health system were 3.35 times and 2.21 times likely to accept a vaccine compared to those who held mistrust for government and public health authorities respectively (P<0.001,95% CI 2.40-4.67 and P<0.001 95% CI 1.56-3.12 respectively). Risk perception and confidence in the genuineness of vaccine producers had no significant effect on willingness to accept a vaccine.

Table 2: Bivariate and multivariate analysis of sociodemographic characteristics and willingness to take a future COVID-19 vaccine (n =1,228).

Variable	Willingness to take a COVID-19 vaccine when available		χ2	P-value	AOR	P-value	95% CI
	No	Yes					
Socio-demographic characteristics							
Age							
<24	166 (60.1)	110 (39.9)	15.95	0.00*	1		
25-34	226 (47.9)	246 (52.1)			1.66	0.00**	1.19-2.30
35-44	149 (45.2)	181 (54.8)			1.88	0.00**	1.30-2.71
>.45	70 (46.7)	80 (53.3)			1.74	0.02**	1.11-2.73
Sex							
Male	293 (46.1)	342 (53.9)	6.87	0.01*	1		
Female	318 (53.6)	275 (46.4)			0.77	0.04**	0.61-0.98
Religion							
Christianity	530 (52.3)	483 (47.7)	19.85	0.00*	1		
Islam	75 (36.2)	132 (63.8)			1.57	0.01**	1.14-2.18
Others	6 (75.0)	2 (25.0)			0.32	0.17	0.06 – 1.62
Marital Status							
Single	297 (50.4)	292 (49.6)	1.28	0.53			
Married	288 (48.6)	305 (51.4)					
Divorced/widowed/ separated	26 (56.5)	20 (43.5)					
Educational level							
Primary	16 (34.8)	30(65.2)	8.9	0.01*	1		
Secondary	178 (55.5)	143 (44.5)			0.75	0.41	0.38-1.48
Tertiary	417 (48.5)	444 (51.6)			0.95	0.87	0.49-1.84
Profession							
Non-health care worker	531 (49.5)	541 (50.5)	0.17	0.68			
Healthcare worker	80 (51.3)	76 (48.7)					
Employment status							
Employed with government	122 (42.4)	166 (57.6)	31.35	0.00*	1		
Employed in private sector	96 (55.2)	78 (44.8)			0.68	0.05	0.46-1.00
Self-employed	267 (58.3)	191 (41.7)			0.68	0.02**	0.49-0.94
Unemployed	126 (40.9)	182 (59.1)			1.44	0.06	0.98-2.10
Pre-existing illness							
No	569 (49.7)	575 (50.3)	0.002	0.96			
Yes	42 (50.0)	42 (50.0)					

*: Significant at bivariate analysis, **: Significant at multivariate analysis.

Table 3: Bivariate and multivariate analysis of factors associated with willingness to take a future COVID-19 vaccine (n =1,228).

Variable	Willingness to take a COVID-19 vaccine when available		χ2	P-value	AOR	P-value	95% CI
	No	Yes					
Self-perception of risk							
Low risk/No risk	401 (55.5)	321 (44.5)	23.45	0.00*	1		
High risk/ Very high risk	210 (41.5)	296 (58.5)			0.8	0.19	0.58-1.11
Willingness to travel for more than one hour to get a vaccine							
No	532 (77.1)	158 (22.9)	4.74	0.00*	1		
Yes	77 (14.4)	458 (85.6)			6.7	0.00**	4.58-9.87

Willingness to pay							
No	544 (70.3)	230 (29.7)	3.5	0.00*	1		
Yes	65 (14.4)	386 (85.6)			3.69	0.00**	2.48 – 5.49
Trust in government							
No	487 (79.7)	233 (37.8)	2.23	0.00*	1		
Yes	124 (20.3)	384 (62.2)			3.35	0.00**	2.40- 4.67
Trust in public health authorities							
No	368 (73.7)	131 (26.3)	1.94	0.00*	1		
Yes	243 (33.3)	486 (66.7)			2.21	0.00**	1.56-3.12
Trust in vaccine developers							
No	334 (71.5)	133 (28.5)	1.42	0.00*	1		
Yes	277 (36.4)	484 (63.6)			1.07	0.71	0.75-1.52
Ever received a vaccine during an outbreak							
No	374 (8.3)	268 (41.7)	39.37	0.00*			
Yes	235 (40.3)	348 (59.2)					
Ever had a side effect following vaccination							
No	523 (50.4)	515 (49.6)	1.06	0.3			
Yes	88 (46.3)	102 (53.7)					
Ever deliberately refused or delayed to get a vaccine for yourself or family member							
No	503 (49.4)	516 (50.6)	0.3	0.58			
Yes	106 (51.5)	100 (48.5)					

*: Significant at bivariate analysis, **: Significant at multivariate analysis.

Five hundred and eighty-three (47.5%) had ever received a vaccine during an outbreak. One hundred and ninety (15.5%) respondents had ever experienced a side effect from vaccination or know someone who has. 106 (16.8%) had ever deliberately refused or delayed vaccination for themselves or family members. In bivariate analysis, having ever received a vaccine during an outbreak was significantly associated with willingness to accept a future COVID-19 vaccine (P<0.001) [Table 3].

Discussion

The spread of the pandemic and the resultant effects on public health and the global economy in the absence of a definitive cure has heightened the demand for a vaccine and progress towards vaccine development. Vaccine hesitancy poses a real threat, as adequate coverage levels are required to stop transmission of the virus. This study examined the willingness to accept a future COVID-19 vaccine.

Most respondents were aware that COVID-19 vaccines were under development, probably because social media, the most frequent source of vaccine information for respondents, is rift with vaccine production debates including conspiracy theories. The low patronage of government websites is a reflection of the reduced trust in government with regards to COVID-19 vaccine. About a quarter of respondents also sourced information from health providers, a worrisome finding, as research has shown that the public's willingness to accept a vaccine was linked to recommendations from a health provider. [11,12] Health professionals should be engaged in community messaging to improve trust in a COVID-19 vaccine and increase uptake when one becomes available in the country.

Some groups have been identified as having increased risk of infection with COVID-19 including the elderly and persons with health conditions. The study showed slightly less than half of the respondents were in favour of vaccines for the elderly and persons with health conditions, and slightly above half for school children. Health communication during planning for a vaccine roll-out in Nigeria should address these opinions, as they will impact on the willingness of families to bring elderly parents and children for vaccination.

About 1 in 2 respondents were willing to take a COVID-19 vaccine, comparable to findings from China, 64.0% [12], Italy 86.1% [11], Australia 85.5% [13] and United States 67.0%. [14] This contrasts with Poland where willingness to accept a vaccine was 31.3% [15] Saudi Arabia 44.7% [16] and France 47.6%. [17] The differences may be a factor of the time during the pandemic when the studies were conducted, as studies conducted early in the outbreak when the virus was still poorly understood may differ from those conducted when the public had a clearer understanding of the disease.

Being an older adult was a predictor of COVID-19 vaccine acceptance, and has been documented in other studies [5,17] and contrasts with a study in Saudi Arabia where younger people were willing to accept a vaccine [16]. While older adults have increased risk of mortality after infection, younger persons may hold the opinion that they are healthy and do not need vaccination yet are more likely to be asymptomatic carriers and spreaders.

Males were also more likely to accept a vaccine as in other studies [5,13], in contrary to a Polish study where an affirmative response was more from females. [15] Although epidemiological information about the disease shows males are more infected than females, heath education should target females.

Interestingly, risk perception was not associated with vaccine acceptance in contrast to other studies. [8,13,17] This finding reflected in the general non-compliance of the public with government regulations on the use of face mask and physical distancing in public places.

The lack of a statistically significant difference in vaccine acceptance between healthcare workers and non-healthcare

workers requires further investigation, as the higher perception of risk among healthcare workers may lead one to conclude that they would be more willing to take a vaccine. This finding has also been documented. [11] It contrasts with findings from China. [8,18] Healthcare workers are a high-risk group for infection due to their close interactions with sick persons and should be prioritized for a COVID-19 vaccination. Further studies are required to investigate the reasons for this observation among healthcare workers.

Christians were less likely than Moslems to accept a vaccine probably because of the widespread conspiracy theory that has been promoted by social media and reputable church leaders. Religious leaders therefore should not only be actively engaged in the planning and implementation phase of any COVID-19 vaccine intervention in the country but be encouraged to support positive messaging and role modelling.

Self-employed respondents were found to have significantly lower vaccine acceptance. This may not be unconnected to the lack of health insurance for the self-employed and therefore high-out of pocket expenditure on health, and the concern that the vaccine may not be without a cost. Further studies are required on the barriers self-employed persons may face in accepting a vaccine.

Personal and family protection was popular reasons given by respondents for accepting a vaccine. These reasons have also been elucidated in other studies. [15] The concerns about a future vaccine's effectiveness and safety raised by respondents who expressed unwillingness have been documented in other studies. [13,17,18] Public health authorities can build on this information to develop intentional messaging to the public. Accessibility and affordability were identified as significant predictors of willingness to accept a vaccine and should be considered when planning to introduce the vaccine into the country.

Trust in government and public health authorities were lower than was reported in other studies [13] and were a predictor of acceptance of a vaccine, with higher trust in government significantly increased likelihood of vaccine acceptance. [19] The country has been plagued in recent years with growing distrust in government, manifested in the disbelief in COVID-19 and insinuations that the disease was a government scam. [20] Building public confidence in government and health authorities will be crucial for successful vaccine uptake in the country and should include targeted messaging and community engagement.

The finding that 1 in 2 Nigerians would accept a vaccine is encouraging as herd immunity through vaccination requires a sufficient proportion of the population to be vaccinated.[5] The herd immunity threshold, calculated as 1-1/R0 (where R0 is the basic reproductive number) is the population proportion that should be immune to prevent transmission of infectious disease and for COVID-19 is estimated to be between 55% and 82%. [14] In Nigeria, R0 is 2.42 [21] leaving herd immunity threshold as 59%.

The study has several limitations that may restrict the generalizability of the study findings. Being an online survey, selection bias could have been introduced in the sampling technique as respondents who had no access to the internet may be different from the general population. Acceptance was assessed using a hypothetical vaccine and findings may differ from what would have been obtained if a vaccine was existent in the country. It may therefore be useful to repeat the survey when there is a vaccine in-country.

Conclusion

One in 2 respondents expressed their willingness to accept a COVID-19 vaccine with significant determinants and barriers identified. Strategies to introduce a COVID-19 vaccine into the country should build on the finding from this study to target groups at high risk of hesitancy, improve public trust in government and health authorities, and develop information and communication on vaccine effectiveness, accessibility and cost.

Authors' Contributions

EAT, AA and MO were responsible for manuscript preparation including concept, design, literature search and data collection. EAT analysed the data using the data analysis plan agreed upon by all authors. The draft manuscript was written by EAT, AA, GA and MO. All authors read and approved the final manuscript.

Conflict of Interest

The authors declare that they have no conflict of interest.

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