Evaluation of Factors Associated with the COVID-19 Vaccine Acceptance in Nigeria

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Abstract

Achieving complete control over the COVID-19 pandemic hinges on two critical factors: widespread access to vaccines and public acceptance of their use. Understanding the nuances of vaccine acceptance within specific populations is crucial for designing effective vaccination campaigns. We conducted a comprehensive study to evaluate the determinants of COVID-19 vaccine acceptance among Nigerian adults from March 2021 till December 2021. Data collected were analyzed using descriptive statistics, Chi-square, and multivariable regression. We found a positive relationship between respondents' COVID-19 knowledge and their willingness to accept COVID-19 vaccines. Overall, COVID-19 knowledge was good, with a mean score of 6.2±0.19 (range 0-8). The COVID-19 vaccine acceptance rate was 65.67%. Our comparisons of respondents' age groups and marital status revealed higher odds of being willing to accept COVID-19 vaccines among respondents who were age 50 ≥ years old (aOR 7.35; 95% CI: 1.69-31.93; p = 0.008) and those who were singles (aOR 4.39; 95% CI: 1.86-10.33; p = 0.001), respectively. However, non-healthcare workers with high income and educational status were unwilling to accept COVID-19 vaccines. The intention to receive the COVID-19 vaccine varied across demographic characteristics, level of education, income, and employment status. We recommend continuous public health education on vaccination's vital role in ending the COVID-19 pandemic.

Keywords: Infectious diseases; Coronavirus; Preventive medicine; Vaccine hesitancy; COVID-19 pandemic

Abbreviations: IPC: Infection Prevention and Control; WHO: World Health Organization; FCT: Federal Capital Territory; FDA: Food and Drug Administration; EMA: European Medicines Agency; MHRA: Medicines and Healthcare Regulatory Agency; Africa CDC: Africa Centers for Disease Control and Prevention; OR: Odds Ratio; CI: Confidence Interval; PhD: Doctor of Philosophy degree; SSCE: Senior Secondary School Certificate; NHWs: Non-Healthcare Workers; HCWs: Healthcare Workers; HCWs: Healthcare Workers; NPHCDA: Nigerian National Primary Healthcare Development Agency

Background

The coronavirus disease 2019 (COVID-19) pandemic has brought all nations on earth to their knees. The pandemic was so severe that humanity had taken measures contrary to the philosophy of the human fraternity and coexistence for the first time in history. Instead of fostering the "together, we stand" cliché globally upheld for decades, humanity would soon advocate for "separated we live," which enabled social distancing and travel restriction among nations, regions, and territory. Just as it is often said, "hard times require desperate measures", same with the approach scientists and political leaders adopted in combating the COVID-19 pandemic.

These include the prompt production and approval of different COVID-19 vaccines for emergency human use without the traditional rigorous testing and trials and the implementation of the Public Readiness and Emergency Preparedness Act with immunity from liability for the COVID-19 vaccines [1-4]. Other drastic measures that were taken to stop the spread of SAR-COV-2 included the initial lockdown of worship centers, markets,

theatres, bars, clubs, the prohibition of crowd gathering, the enforcement of the use of facemask, hand washing and social distancing [5] Initially, the Nigerian masses complied with the infection prevention and control (IPC) measures enacted by the Federal Ministry of Health as well as other global health organizations including the World Health Organization (WHO). However, sustaining these measures for an extended period was no longer possible.

By and large, the successful administration of effective, safe and sustainable vaccines across the globe is widely believed to be crucial in mitigating and preventing the COVID-19 pandemic [6]. To this end, there has been an urgent need to rapidly design, develop and manufacture vaccines that be massively used as a practical tool to end the pandemic since no pharmaceutical interventions has been discovered yet. However, the production of vaccines against SARS-COV-2 was the fastest in the history of vaccinology [7]. Within one year of the emergence of COVID-19, COVID-19 vaccines were developed. Some had been approved by the relevant government regulatory agencies such as the Food and Drug Administration (FDA) of the United States, the European Medicines Agency (EMA), The United Kingdom's Medicines and Healthcare Regulatory Agency (MHRA), and also the National Agency for Food and Drug Administration and Control of the Federal Republic of Nigeria [8].

The acceptability of COVID-19 vaccines by the public is crucial for eliminating this deadly pandemic. In separate studies conducted in Nigeria, Reuben et al. [9] and Adigwe [7] reported low COVID-19 acceptance of 29.0% and 22.7% among residents of northcentral Nigeria and the Federal Capital Territory (FCT), Abuja, respective. In the same vein, although 55.5% COVID-19 acceptance were among health care workers in the southwest and south-south geopolitical zones of Nigeria [10], a lower rate, 40.0%, was however reported among medical students in the Northwestern geopolitical zone in Nigeria [11].

The rapid assessment of information regarding COVID-19 vaccines acceptance among individuals across Nigeria amidst the current COVID-19 pandemic is necessary and crucial in aiding and speeding up vaccination appraisal, monitoring, re-planning, and implementation of behavior change programs/campaigns to increase vaccine acceptance and coverage, which are vital to mitigating COVID-19. The study aimed to evaluate the factors associated with COVID-19 vaccine acceptance among healthcare workers in Nigeria.

Materials and Methods

Study design and participants

We used a non-repeated cross-sectional design to evaluate the COVID-19 risk perception and factors associated with accepting the COVID-19 vaccine in Nigeria, West Africa. The study was from March 2021 to December 2021. The methods used in this study and the questionnaire have been previously published [12,13]. Participants were adults who were twenty years and above and were residents in Nigeria. Google form was used to communicate the questionnaire web link to the target participants. Social media platforms such as WhatsApp, Twitter, Facebook, and Instagram were used to reach participants. A brief description was included in the introduction. The submitted answered questionnaire was considered consent to participate in the study. As described in our previous study, the questionnaire was pre-evaluated for consistency and error [14]. The reliability coefficient was calculated using SPSS v.20. The value of Cronbach's alpha was found to be 0.7. The data from the pilot study was not included in the final data analysis. We recruited four thousand target participants via social media. Four hundred and two (402) participants accepted and completed the questionnaires.

Ethical permit and consent note

The research ethics committee of the Borno State Hospital Services, Ministry of Health, Maiduguri, Nigeria, approved our study protocol (MHSEC/03/2020/00022). The submission of the online answer to the questionnaire was considered as consent to take part in the study. A consent note was not needed.

The Measures

The survey instrument used in this study was based on the tool designed by Municipal Public Health Service Rotterdam-Rijnmond (GGD) together with the National Institute for Public Health and the Environment (RIVM) in the Netherlands [12] with minimal modification. Previous studies consulted included [14], course material regarding coronavirus disease outbreaks, including the current COVID-19 pandemic by WHO [15], and guidelines issued by Africa Centers for Disease Control and Prevention (Africa CDC) [16]. The questionnaire consisted of four (4) parts:

Demographic characteristics of respondents.

Participants were asked to report their age, sex, state of residence, occupation, educational level, marital status, household size, income category, and employment status.

Knowledge of respondents on COVID-19.

This category included eight questions on the cause of COVID-19, transmission, prevention and control, myths, and symptoms. The knowledge questions consisted of dichotomous questions (correct, incorrect and unknown); a correct answer was scored 1 point while a wrong or unknown answer was scored 0 points. The total knowledge score ranged from zero to eight; the mean knowledge score of 0-4.99 was considered poor knowledge, and a mean score of 5-8 was deemed to be good knowledge of COVID-19.

Statistical analyses

We enter the data collected into Microsoft Excel and imported into SPSS version.20.0 for statistical analysis. Descriptive statistical methods were used to summarize data on socio-demographic characteristics and responses to questions regarding respondents' knowledge on COVID-19, Perception of the seriousness, susceptibility to COVID-19 and perception of efficacy and self-efficacy to protect against the disease the intention to accept the COVID-19 vaccine in Nigeria. Data were summarized as categorical variables' frequencies (n) and percentages (%). Furthermore, we presented the data in tables and graphs. Chi-square was used to figure out the level of difference among the categorical variables. A binary logistic regression analysis was applied and expressed as odds ratio (OR) and 95% confidence interval (CI) to figure out the predictors of COVID-19 vaccine acceptance. A p-value of less than 0.05 was considered significant in all tests.

Results

Demographic characteristics of study participants

Table 1: Demographic characteristics of study participants.

Variables	Frequency (N)	Percentages (%)
Gender:		
Male	288	71.6
Female	114	28.4
Marital Status:		
Married	235	58.5
Single	158	39.3
Widow/Widower	9	2.2
Age group:		
20-29	144	35.8
30-39	129	32.1
40-49	69	17.2
50-59	39	9.7
>59	21	5.2
Household size		
<5	132	32.8
10-May	219	54.5
16-Nov	27	6.7
>16	24	6
Education:		
Secondary school (SSCE)	45	11.2
NCE/Diploma	62	15.4
First degree	138	34.3
Master	108	26.9
PhD	49	12.2
Occupation:		
Healthcare	53	13.2
Non-Healthcare	349	86.8
Income category:		
<30000	123	30.6
30000-150000	95	23.6
151000-270000	87	21.6

271000-390000	64	15.9
>390000	33	8.2
Employment status:		
Self-employed	75	18.7
Private organization	26	6.5
NGOs	30	7.5
Local government	9	2.2
State government	42	10.4
Federal government	127	31.6
Students	93	23.1
Total	**402**	**100**

The study included 402 participants from 47.2% (17/36) across all the states in Nigeria and the federal capital territory (Abuja). (Table 1) showed the demographic characteristics of the respondents, where the majority, 288 (71.6%) and 235 (58.5%), were males and married, respectively. Furthermore, 373 (67.9) and 249 (54.5%) were aged 20-39 and 5-10 person households. Although most of the respondents, 295 (73.38%) had either a bachelor, master or Doctor of Philosophy (PhD) degree, 107 (25.62%) had either senior secondary school certificate (SSCE) or Diploma/NCE certificates. Also, we had more 349 (86.8%) non-healthcare workers (NHWs) participation than the healthcare workers (HCWs) Respondents who earned less than 72.86USD (₦ 30,000) per month were 123 (30.6%) while those who made more than 947.18USD (₦390,000) were 33 (8.2%). The majority, 127 (31.6%) of the participants, were employees of the federal government of Nigeria.

Knowledge of participants towards COVID-19 and acceptance of COVID-19 vaccine

Table 2: Knowledge about COVID-19 among the study Participants.

Questions	Response, Yes (%)	Response, No (%)
The main cause of COVID-19 is the 5G network	33 (8.2)	369 (91.8)
COVID-19 is an acute infectious disease	372 (92.5)	30 (7.5)
Infection with SARS-CoV-2 always gives symptoms	213 (53.0)	189 (47.0)
COVID-19 can only be contacted once in a lifetime	39 (9.7)	393 (90.3)
There is a vaccine against COVID-19	185 (46.1)	217 (53.9)
COVID-19 can be prevented by wearing a face mask	352 (87.6)	50 (12.4)
COVID-19 can be prevented by practicing good hygiene	360 (89.5)	42 (10.5)
COVID-19 is caused by a bacterium	75 (18.7)	327 (81.3)
Mean knowledge score = 6.26±0.19 (range = 0-8); correct Rate of the eight questions = 78.25% (95% C.I =61.61-94.99; Median (50th percentile) = 88.55)		

All the respondents agreed to have heard about COVID-19. The correct rate of the eight questions on the knowledge about COVID-19 was 78.25%±0.19 (95% CI =61.61-94.99), with the participants median or percentile rate of learning about COVID-19been 88.55%. The overall mean knowledge score of the participant was 6.26±0.19 (range = 0-8) (Table 2). Multivariate

regression analysis of the respondent data revealed that respondents who believed that the 5G network is not the main cause of the COVID-19 were about two times more likely to accept the COVID-19 vaccines than those who believed that the 5G network was the cause of COVID-19 (OR = 2.376; 95%C.I = 1.053-5.360; P = 0.037). Respondents who opined the non-existence of COVID-19 vaccines were less likely to accept being vaccinated with the available COVID-19 vaccines (OR = 0.603; 95% C.I = 0.390-0.930; P = 0.022). However, respondents who believed COVID-19 is often asymptomatic were less likely to accept the COVID-19 vaccine than those who believed COVID-19 often shows symptoms (OR = 0.539; 95% C.I = 0.349-0.834; P = 0.006) (Table 3).

Table 3: Knowledge as a predictor of COVID-19 Vaccine Acceptance among the Respondents.

Questions	Response	Frequency (%)	AOR	95% C.I	P-value
The main cause of COVID-19 is the 5G network	Yes	33 (8.2)	1	-	-
	No	369 (91.8)	2.376	1.053-5.360	0.037
COVID-19 is an acute infectious disease	Yes	372 (92.5)	1	-	-
	No	30 (7.5)	1.734	0.568-5.295	0.334
Infection with SARS-CoV-2 always gives symptoms	Yes	213 (53.0)	1	-	-
	No	189 (47.0)	0.539	0.349-0.834	0.006
COVID-19 can only be contacted once in a lifetime	Yes	39 (9.7)	1	-	-
	No	393 (90.3)	0.507	0.223-1.154	0.106
There is a vaccine against COVID-19 Yes 185 (46.1)			1	-	-
	No	217 (53.9)	0.603	0.390-0.930	0.022
COVID-19 can be prevented by wearing a face mask	Yes	352 (87.6)	1	-	-
	No	50 (12.4)	1.39	.584-3.311	0.457
COVID-19 can be prevented by practicing good hygiene	Yes	360 (89.5)	1	-	-
	No	42 (10.5)	1.653	0.673-4.060	0.273
COVID-19 is caused by a bacterium	Yes	75 (18.7)	1	-	-
	No	327 (81.3)	1.194	0.679-2.100	0.538

AOR**:** Adjusted Odds ratio.

Demographic factors associated with the acceptance of COVID-19 Vaccine in Nigeria

Regarding demographic factors associated with the COVID-19 vaccine acceptance, 198 (68.8%) of the male had vaccine acceptance while females had 66 (57.9%). The difference between vaccine acceptance and gender was statistically significant (χ^2 = 4.269; P = 0.039). Based on marital status, single and never married respondents had the highest (138 (84.8%)) COVID-19 vaccine acceptance rate. The difference in the acceptance of the COVID-19 vaccine with regards to marital status was statistically significant (χ^2 = 43.047; p < 0.001). Also, respondents that were never married (singles) were more likely to accept the COVID-19 vaccine compared to the married (OR = 4.387; 95% C.I = 1.861-10.338; P = 0.001).

The acceptance of the COVID-19 vaccine was significantly (χ^2 = 35.245; p < 0.001) different among the age groups. The age group 20-39 years had the highest percentage 106 (81.5%) of COVID-19 vaccine and were about four times likely to accept COVID-19 vaccine. Also, the age group fifty-nine years and above were about seven times likely (OR = 7.347; 95% C.I = 1.691-31.933; P = 0.008) compared with the age group 20-39 years. The acceptance of COVID-19 vaccine varies significantly (χ^2 = 10.916; p = 0.012) among household size. Households with a family size of more than sixteen (16) had the highest percentage, 21 (87.5%) of COVID-19 vaccine acceptance, while household size less 11-16 had the least 12 (44.4%) acceptance.

The acceptance of COVID-19 vaccine differs significantly (χ^2 = 23.220; p < 0.001) among the educational qualification. Respondents with secondary (high) school certificates had the highest percentage, 43 (93,.3%) COVID-19 vaccine acceptance, while respondents with the Doctor of Philosophy (PhD) had the lowest percentage, 24 (49.0%) COVID-19 vaccine acceptance. Respondents with the national certificate of education/diploma, Bachelor, Master, and PhD were less likely to accept

the COVID-19 vaccine than respondents with secondary (high) school certificates (Table 4). Regarding occupation, healthcare workers (HCWs) had a higher percentage 41 (77.4%) COVID-19 acceptance, than non-healthcare workers (NHCWs) 223 (63.9%). Although, the differences were not statistically significant (χ^2 = 3.699; p = 0.053), NHCWs were less likely to accept the COVID-19 vaccine (OR = 0.300; 95% C.I = 0.137-0.658; P = 0.003).

Regarding income categories, lower-income earners ($72.89USD (₦30000) per month) had the highest percentage 102 (82.9%) acceptance of COVID-19 vaccine, while the highest income earners (≥ $947.00USD (≥₦390000) per month) had the lowest percentage 12 (36.4%) acceptance of COVID-19 vaccine. The differences in COVID-19 vaccine acceptance among the income categories was statistically significant (χ^2 = 35.365; p < 0.001). And respondent who earned the highest income were less likely to accept the COVID-19 vaccine (OR = 0.075; 95% C.I = 0.019-0.294; P ≥ 0.001). Concerning employment status, students had the highest percentage, 87 (93.5%), followed by the non-governmental organization (NGOs) 24 (80.0) while local government workers had the lowest percentage, 3 (33.3%) of COVID-19 vaccine acceptance. Students and NGOs workers were about four times and five times more likely to accept the corvid-19 vaccine than the self-employed (Table 4).

Table 4: Demographic Factors Associated with the Acceptance of COVID-19 Vaccine AOR, Adjusted Odds ratio, CI, Confidence Interval.

	Univariable analysis				Multivariable analysis		
Variables	No (%	Yes (%)	χ^2	P value	AOR	95% C. I	P-value
Gender							
Male	90 (31.2)	198 (68.8)	4.269	0.039	1	-	-
Female	48 (42.1)	66 (57.9)			0.578	0.302-1.108	0.099
Marital Status							
Married	111 (47.2)	124 (52.8)	43.037	0	1	-	-
Single	24 (15.2)	134 (84.8)			4.387	1.861-10.338	0.001
Widow/Widower	3 (33.3)	6 (66.7)			2.23	0.419-11.876	0.347
Age group							
20-29	24 (18.5)	106 (81.5)	35.245	0	1	-	-
30-39	43 (33.3)	86 (66.7)			3.569	1.302-9.788	0.013
40-49	36 (52.2)	33 (47.8)			2.624	0.876-7.858	0.085
50-59	23 (59.0)	16 (41.0)			2.324	0.656-8.234	0.191
>59	9 (42.9)	12 (57.1)			7.347	1.691-31.933	0.008
Household size							
<5	48 (36.4)	84 (63.6)	10.916	0.012	1	-	-
10-May	72 (32.9)	147 (67.1)			1.611	0.860-3.019	0.137
16-Nov	15 (55.6)	12 (44.4)			1.088	0.378-3.128	0.876
>16	3 (12.5)	21 (87.5)			1.897	0.428-8.411	0.4

Education							
Secondary school (SSCE)	3 (6.7)	42 (93.3)	23.22	0	1	-	-
NCE/Diploma	24 (38.7)	38 (61.3)			0.209	0.045-0.973	0.046
First degree	44 (31.9)	94 (68.1)			0.115	0.023-0.577	0.009
Master	42 (38.9)	66 (61.1)			0.218	0.039-1.214	0.082
PhD	25 (51.0)	24 (49.0)			0.213	0.033-1.394	0.107
Occupation							
Healthcare	12 (22.6)	41 (77.4)	3.699	0.054	1	-	-
Non-Healthcare	126 (36.1)	223 (63.9)			0.3	0.137-0.658	0.003
Income category							
<30000	21 (17.1)	102 (82.9)	33.365	0	1	-	-
30000-150000	33 (34.7)	62 (65.7)			0.958	0.252-1.420	0.244
151000-270000	39 (44.8)	48 (55.2)			0.266	0.098-0.720	0.009
271000-390000	24 (37.5)	40 (62.5)			0.361	0.127-1.023	0.055
>390000	21 (63.6)	12 (36.4)			0.075	0.019-0.294	0
Employment status							
Self-employed	27 (36.0)	48 (64.0)	54.946	0	1	-	-
Private organization	11 (42.3)	15 (57.7)			0.914	0.286-2.918	0.879
NGOs	6 (20.0)	24 (80.0)			4.124	1.186-14.338	0.026
Local government	6 (66.7)	3 (33.3)			0.196	0.037-1.043	0.056
State government	21 (50.0)	21 (50.0)			0.575	0.212-1.564	0.279
Federal government	61 (48.0)	66 (52.0)			1.23	0.439-3.449	0.694
Students	6 (6.5)	87 (93.5)			4.726	1.342-16.644	0.016
Overall	138 (34.33)	264 (65.67)					

Discussion

COVID-19 Vaccine Acceptability among the Study Participants

The sustainable production of safe and viable vaccines is considered the foremost critical countermeasure to fight the COVID-19 and pivotal to lessening and mitigating the devastating health and socioeconomic impacts of the COVID-19 pandemic the world over [6]. However, the willingness of the population to accept the approved and available COVID-19 vaccines would significantly alter the epidemiological dynamics and the transmission of SARS-CoV-2 among the population.

Overall, our study recorded 65.67% (264/402) COVID-19 vaccine acceptance among the study participants. However, about one-third of the participants were hesitant or unwilling to accept COVID-19 vaccines. A substantial percentage of the Nigerian population needs to be vaccinated against COVID-19 to achieve herd immunity against COVID-19 disease. Being the most populous African country (with > 200 million people), the Nigerian National Primary Healthcare Development Agency (NPHCDA) has so far vaccinated only about 6 million people as at the time the article was developed and since COVID-19 vaccines became available [17]. The reasons for the low acceptance rate recorded in this study may be because of belief systems, misinformation and poor COVID-19 education [14,18]. In a similar multinational study assessing country-specific COVID-19 vaccines acceptance rate, Hawlader et al. [19] reported 74.0, 71.5, 65.7 and 65.0% COVI-19 vaccines acceptance rates in Nepal, Pakistan, India and Bangladesh, respectively. When comparing with our findings. Higher COVID-19 vaccine acceptance was reported in studies in Ecuador (97.0%), Malaysia (94.3%), Indonesia (93.3%), China (91.3%) and Brazil (85.4%) [20-23]. Lower rates of 23.6%, 5.7%, 41.7% and 63.0%, were reported from Kuwait, Italy, Russia and the United Kingdom [24-27].

Globally, vaccine acceptance has been found to be a complex and multi-dynamic phenomenon, which often varies depending on the type of disease, place (country and region), time, community demographics, settings, and behavioral proclivities [19,25-27]. Furthermore, it is noteworthy that vaccine hesitancy in Nigeria is not exclusive to the current COVID-19 pandemic. An earlier vaccine coverage report in Nigeria showed only 53.3, 34.0, 41.8 and 39.0% vaccine coverage for tuberculosis, polio, measles and yellow fever, respectively [28]. Also, in an epidemiological survey during the initial national lockdown to curtail the spread of COVID-19 in April 2020, only 29.0% of the study population indicated their willingness to accept COVID-19 vaccines when available [24].

Knowledge about COVID-19 and Acceptance of the COVID-19 Vaccine

The level of COVID-19 knowledge is a major factor that is affecting the acceptability of the COVID-19 vaccine in Nigeria and globally. Our findings revealed that the mean knowledge score was high among the study population (mean 6.26±0.9; range = 0-8). The mean knowledge score obtained in this study was consistent with a previous study in Vietnam in which a 7.11 (0-9) mean knowledge score was reported among high-risk group [29]. Also, the values reported in this study were lower than in a previous study among healthcare workers in Nigeria [14]. The differences seen in this study may be because of the difference in the study population. By their level of knowledge regarding COVID-19, healthcare workers are more likely to be better informed about COVID-19 than the public.

Knowledge plays an essential role in the understanding of the COVID-19 pandemic threat. The study participants' knowledge about the availability of the COVID-19 vaccine was poor. Only one hundred and eighty-five (46.1%) were aware of the availability of the COVID-19 vaccine at the time of collecting the data. Therefore, the general public should be continually educated through popular media such as social media and television [14] and other sources of information about COVID-19 [9,29,30].

This study revealed that the acceptance of the COVID-19 vaccine was affected by misinformation and poor knowledge. Participants that believed that the 5G network was the cause of the COVID-19 pandemic were less likely to accept the COVID-19 vaccine. Also, respondents who said that the COVID-19 always give symptoms and respondents who said there was no vaccine against COVID-19 were less likely to accept the vaccine. The emergence of COVID-19 was associated with immense misinformation, misgivings and mistrust regarding its epidemiology and transmission, pathogenesis and clinical manifestations, and control and prevention measures among the Nigerian population [9].

These undoubtedly contributed to increased information gaps, negative beliefs and mistrust in approved and available COVID-19 vaccines, generally expected in developing countries, including Nigeria. Although the Federal government has criminalized fake news and misinformation [31], there is a need better to counter misinformation regarding the COVID-19 vaccine and future pandemics. Criminalizing false information was regarded as suppressing freedom of expression. For example, Zambia, Zimbabwe, Uganda, Canada held that prohibiting fake news was unconstitutional violates the right to freedom of expression (Centre for Law and Democracy, 2021) [32]. However, in recent times, because of the COVID-19 pandemic, nations have passed amendments to their laws criminalizing fake news and misinformation (Centre for Law and Democracy, 2021). Pomeranz and Schwid [33] addressed the issues of COVID-19 misinformation by stating that "the goal of addressing COVID-19 misinformation is best served by protecting expression, disseminating factual information, ensuring strong protection for whistleblowers, and supporting independent media environment".

Demographic Factors Associated with the Acceptance of COVID-19 Vaccine

Our study also explored the relationships between demographic factors with COVID-19 vaccine acceptance among the Nigerian population. We found an association between gender and vaccine acceptance. Unwillingness to take COVID-19 vaccines among females was higher than male participants. Our study identified the male gender as a positive predictor for COVID-19 vaccine acceptance, which agrees with many other studies globally [34-36]. In most Nigerian states, traditional patriarchal norms are the primary factor in creating a disparity in vaccine acceptance and coverage in Nigeria. Additionally, scientific evidence suggests higher risks for COVID-19 infection, complications and death among males [37-40]. This gender-based disparity in COVID-19 morbidity and mortality may have contributed to increased vaccine acceptance among males in Nigeria.

Our study also revealed marital status as a predictor for COVID-19 vaccine acceptance. Participants who were never married (single) or widow/widower were more likely to be vaccinated against COVID-19 than those married. Attitudes and perceived risks for a disease or health condition often differ with the status of relationships, which determines subsequent decisions for vaccine acceptance [41]. Although two separate studies found an association between COVID-19 vaccine acceptance and marital status, however, contrariwise, both studies found that married individuals were more interested in being vaccinated [42, 43].

Interestingly, individuals within the age group 20-39 years old were four times more likely to accept COVID-19 vaccines than other age groups. This corroborated a similar report showing negative attitudes toward COVID-19 vaccination among the ageing Bangladeshi population [42]. Although the ageing population is at considerable risk of COVID-19 complications, most of them are conservatives (often resorting to traditional treatment) whose perceptions of the COVID-19 pandemic and vaccine acceptability cannot be easily influenced. This may be a significant public health concern in developing countries since the ageing population is most vulnerable to COVID-19. Conversely, the older people in Hong Kong, Saudi Arabia and the USA showed a higher willingness for COVID-19 vaccine acceptance [23,43,44].

Our findings revealed that respondents from large household sizes were more willing to accept the COVID-19 vaccine than smaller households' size. The reason may be because their fear of infecting other family members outweighs the perceived fear of the adverse effect that may result from the novel COVID-19 vaccine. This finding is consistent with an earlier study in which healthcare workers were concerned about infecting their family members [13]. Surprisingly, we found that participants with only higher educational qualifications (NCE/Diploma, first degree, master's, and PhD) were less likely to be willing to be vaccinated against COVID-19 than those with only secondary school education. We supposed that due to the media overhype of the COVID-19 pandemic and associated misinformation, individuals with higher education could have been overly cautious of emerging concerns attributed to vaccines safety and post-vaccination adverse reactions related to COVID-19 vaccines [6,9].

Similar trends were previously reported in India and Pakistan [19]. In sharp contrast with our finding, several studies worldwide showed associations between higher educational qualification and COVID-19 vaccine acceptance [35,45-47]. This association is often supported by the argument that individuals with higher academic qualifications better understand COVID-19 and vaccinations than individuals with lower education [45]. Howbeit, our study disproved this famous claim despite population and region-specific studies are expected to yield divergent and community-specific outcomes. Therefore, there is a need to re-educate the educated elite in the study population about the COVID-19 pandemic and COVID-19 vaccine.

Compared with the general population (in this case, NHCWs), HCWs had more willingness to be vaccinated against COVID-19, as recorded in our study. Similar trends were reported in a regional survey involving six Asia-Pacific countries, including Bhutan, China, India, Indonesia, Singapore and Vietnam [48], as well as other separate studies in India [19], Canada [49], Hong Kong [50], France [51,52], and the USA [53]. The most important and independent factors often associated with COVID-19 vaccine hesitancy among HCWs include concerns regarding risks and safety [52]. Still and all, with increased clinical studies and the availability of additional public health information about COVID-19 vaccines risks and safety, vaccine acceptance over time may vary [49].

Furthermore, we found that participants with higher income were more likely to be unwilling to be vaccinated when compared with participants with lower income. In Nigeria, low-income earners are at an increased risk of contracting infectious diseases, including COVID-19 due to crowded living conditions and slums, poor personal and community hygiene, reliance on crowded public utilities including transport, their inability to access better healthcare services, and their increased tendency to continue regular work and business outside their homes [38,54]. Regarding employment status, students and NGOs workers were more likely to be willing to be vaccinated when compared with participants with other employment statuses. Since most students are young adults, this finding supports our earlier established relationship between youthful age and COVID-19 vaccine acceptance stated above [55-58].

Conclusion

Our results showed that the study participants had sound knowledge about COVID-19. However, the acceptance of the COVID-19 vaccine was poor. Several factors, including demographic characteristics such as old age, low income, single and student and NGO workers, were positive predictors of COVID-19 vaccine

acceptance. In contrast, high income, high academic qualification, married, youthful age and poor knowledge of COVID-19 were associated with unwillingness to accept the COVID-19 vaccine. Continuous public health education and re-education of the target population sets with a low COVID-19 vaccine acceptance rate are needed to change their belief about COVID-19 and COVID-19 vaccine, improve vaccine acceptance and bring an end to the pandemic [59-61].

Ongoing public health enlightenment campaigns among the Nigerian population are necessary to improve their knowledge of COVID-19, assuage their fears and negative beliefs towards COVID-19, and boost their confidence and willingness to accept available COVID-19 vaccines. Increased COVID-19 vaccine acceptance within the population would significantly reduce transmission and severity of the disease hence, mitigating the pandemic.

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