RESEARCH ARTICLE

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Sociodemographic predictors associated with COVID-19 vaccine acceptance among veterinary professionals in Nigeria

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Vaccines are one of the most effective and successful strategies employed to date to prevent and increase the population's immunity against several viral diseases. However, vaccine hesitancy among populations poses a potential danger to global health. This study focused on determining the vaccine acceptance rate and associated key determinants among veterinarians. A cross-sectional study using a web-based survey among veterinarians was conducted in the month of April 2021. A multivariate logistic regression model was performed to identify key predictors for vaccine acceptance among veterinarians. A total of 305 veterinarians participated in this survey, of whom 39 respondents (12.8%) had received the COVID-19 vaccine. The vaccine acceptance rate among respondents was 38.3% (excluding those that have taken the vaccine). Only 37.0 % of the respondents were confident about the safety and efficacy of the Oxford–AstraZeneca vaccine in circulation in the country. Major perceived drivers for vaccine acceptability were safety (91.8%), possible adverse reactions (85.6%) and global acceptability (75.7%). The adjusted odds ratio (aOR) of vaccine acceptance increased by 2.3 times among male veterinarians than females (95% CI: 1.358-3.900; p = 0.002) in the multivariate model. In Nigeria, little is known about COVID-19 vaccine acceptance (VA)

Introduction

The harm being inflicted by the COVID-19 pandemic on humanity has prompted collective efforts by several developed countries to developing vaccines as a strategy to control the epidemic. As soon as SARS-CoV-2 was identified as the causative agent and the first genome sequence was published, several vaccine candidates were developed through unprecedented global collaboration among governments, vaccine manufacturers, and researchers (Harapan *et al*., 2020; Paltiel *et al*., 2021). According to Coalition for Epidemic Preparedness Innovations (CEPI), three hundred and twenty-one (321) COVID-19 vaccine candidates were in development worldwide as of September 2020, and several COVID-19 vaccines in the Phase III trials have demonstrated efficacy rates of as high as 95% in preventing symptomatic COVID-19 infections (Paltiel *et al*., 2021). As of March 2021, twelve (12) vaccines were authorised, which included the Pfizer–BioNTech, Moderna, BBIBP-CorV, CoronaVac, Covaxin, CoviVac, Sputnik V, the Oxford–AstraZeneca, Convidecia, the Johnson & Johnson, EpiVacCorona, and RBD-Dimer (Shrotri *et al*., 2021). Global high vaccination coverage is required to stop the COVID-19 pandemic (Shrotri *et al*., 2021). However, achieving the global community coverage may be hindered by vaccine hesitancy among populations. Vaccine hesitancy has been identified by the WHO as one of the top ten global health threats in 2019 (Lazarus *et al*., 2021). However, vaccine efficacy and safety perceptions are critical and could impact people's willingness to be vaccinated (Harapan *et al*., 2020).

On the 14th January 2021, the African Union (AU) pre-ordered 270 million COVID-19 vaccine doses from Pfizer, Johnson & Johnson and AstraZeneca for Africa through its COVID-19 African Vaccine Acquisition Task Team (AVATT), the Africa Medical Supplies Platform (AMSP), and the Africa Centres for Disease Control and Prevention (ACDC). The ACDC aims to vaccinate 30% of the continent's population by the end of 2021. In Nigeria, the Oxford-AstraZeneca COVID-19 vaccine (16 million doses) was approved by National Agency for Food and Drug Administration and Control (NAFDAC), and rolled out in March 5, 2021. Since vaccine acceptancy is context-specific and varies with geography, culture, and sociodemography, we aim to understand the willingness to take the COVID-19 vaccine among veterinary professionals in Nigeria. Data generated could be useful to enhance effective risk communication and literacy about COVID-19 and the vaccination programme among various professionals and the public.

Materials and Methods

Study area

Nigeria is in West Africa and borders Niger in the north, Chad in the northeast, Cameroon in the east, and Benin in the west. Its southern coast is on the Gulf of Guinea in the Atlantic Ocean. Nigeria comprises 36 states categorised into six geopolitical zones - North Central, North East, North West, South West, South East, South-South, and the Federal Capital Territory (FCT). Respondents from across thirty-three (33) states and the FCT participated in the survey.

Study participants and questionnaire

In order to maintain social and physical distancing as amongst COVID-19 recommendations by the World Health Organisation, a cross-sectional web-based survey was designed using the Google Forms Platform (Mountain View, CA, USA). Veterinarians were recruited by invitations sent to the WhatsApp platforms of the College of Veterinary Surgeons, Veterinary Schools, Veterinary Teaching Hospitals and the Nigerian Veterinary Medical Association. Veterinarians were encouraged to share the link with as many colleagues as possible (chain referral sampling strategy). However, duplicate entries were avoided by preventing users with the same internet protocol (IP) address access to the survey twice. The sample size was estimated to be 385 based on the following assumption: that COVID-19 vaccine acceptance rate among respondents was 50%, an acceptable error of 5%, and an absolute precision of 95% confidence interval (WinEpi v.2.0). The online questionnaire consisted of two sections (2 pages). Sections one and two gathered information on demographics and the willingness of veterinarians to accept the COVID-19 vaccine. Closed-ended questions with responses based on 5- Likert scale format was employed. The questionnaire was

anonymous to maintain the privacy and confidentiality of all information collected in the study. The online survey was conducted based on the Checklist for Reporting Results of Internet E-Surveys (CHERRIES), and guidelines for good practice in the conduct and reporting of online research (Eysenbach, 2004). It took less than five minutes to complete the questionnaire.

Ethical aspects
The study was approved by the College of Veterinary Medicine, Federal University of Agriculture, Abeokuta Research Ethics Committee (reference number: FUNAAB/COLVET/CREC/2021/01/01). This study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Participation in the study was strictly voluntary and considered as consent for taking part in the study. We made participants fully aware of their right to withdraw their participation prior to the completion of the questionnaire. The confidentiality and tracing of the identity of the subjects were protected. No advertisement of this study was done or incentives provided for respondents.

Data analysis
Descriptive statistics were conducted for all variables and presented in forms of frequencies and proportions/percentages using Microsoft Excel[R] (2013; Microsoft Corporation, Redmond, WA). Using univariate analysis (Pearson's Chi Square), association between the sociodemographic characteristics and vaccine acceptance was determined. Variables significant at $p \leq 0.25$ from the univariate analysis were processed further by multivariate logistic regression model using a stepwise backward elimination process (SPSS 23.0). The decision for a liberal p-value ($p \leq 0.25$) at this step was to ensure important potential predictor/risk variables were included in the model. A $p < 0.05$ was considered statistically significant, and the adjusted odds ratios (aOR) were computed to determine the strength of associations between variables at 95% confidence intervals (CIs). SPSS version 23.0 (IBM Corp., Armonk, N+Y, USA) was used for statistical analysis.

Results
A total of 305 veterinarians participated (participation and completion rates being 79.2% and 100% respectively). The male respondents (215, 70.5%) were more than the females (90, 29.5%), and majorly within the age category 30 – 39 years (34.8%). Also, majority worked in the public sector (191,

62.6%). Veterinarians in the public sector worked mainly with the universities (49.7%) and the state government (24.1%), while those in the private sector worked as mixed animal veterinarians (66.0%) (Table 1).

At the univariate level, COVID-19 vaccine acceptance was associated with age ($p = 0.054$), sex ($p = 0.002$), and religion ($p = 0.159$). Table 2 represents potential sociodemographic characteristics associated with COVID-19 vaccine acceptance among participants. Higher rates of vaccine hesitancy were reported among the age group 40-59 (59.1%), females (67.8%), in the south east region of Nigeria (61.5%), and Christians (56.0%). Overall vaccine acceptance rate was 38.3% excluding those that have taken the vaccine (12.8%). Furthermore, major perceived drivers of vaccine acceptance among veterinarians were safety (91.8%), possibility of developing adverse reactions (85.6%) and if vaccines were globally acceptable (75.7%). The least perceived driver was faith/religious organisations (26.2%). Smaller percentages of the respondents indicated confidence in the safety and efficacy of the Oxford-AstraZeneca vaccine circulating in Nigeria (37.0%) Further multivariate regression analysis showed OR of vaccine acceptance increased by 2.3 times among male veterinarians than females (95% CI: 1.358-3.900; $p = 0.002$; Table 3). Hence, a strong determinant of vaccine acceptability among veterinarians was gender. Although not significant, respondents who are above the age of 60 years' have an increased odd (aOR 4.39, 95%: 0.486-39.676; $p= 0.188$) of accepting the vaccine than other age categories.

Discussion
Vaccine acceptancy vary with locations, time, social class, ethnicity, and contextual human behaviour (Al-Mohaithef & Padhi, 2020). We report a low rate of acceptability of COVD-19 vaccine. The low response by veterinarians to accept the vaccine in our findings is not surprising. There are many conspiracy theories, beliefs and misinformation about the COVID-19 pandemic and vaccine safety, which are worsened by social media propagation (Adenubi *et al*., 2021). For instance, vaccine hesitancy among Africans have been associated with the beliefs that the vaccine was designed by foreign countries to use them as guinea pigs, cause infertility and control African population (Gcwabe, 2021). To buttress this, the safety and efficacy of the vaccine was the utmost consideration by participants in this study before accepting to take the vaccine. Although high variability in responses

between countries on COVID-19 vaccine acceptance has been reported (Kahn, 2006; Williams *et al*., 2020; Lazarus *et al*., 2021), substantial vaccine hesitancy among Africans living in Africa as well as in the diaspora have been documented by previous surveys reporting COVID-19 vaccine acceptance rates of 15% to 65% in several African countries including Nigeria (Kahn, 2006). A recent study from the United States also confirmed that the willingness to receive a COVID-19 vaccination was lowest among Black/African Americans (Yasmin *et al*., 2021; Anjorin *et al*., 2021). On the other hand, a survey among 19 developed countries to determine potential acceptance rates of a COVID-19 vaccine reported as high as 71.5% of participants were likely take a COVID-19 vaccine (Lazarus *et al*., 2021). Differences in acceptance rates ranged from almost 90% (in China) to less than 55% (in Russia) from the study (Lazarus *et al*., 2021). A relatively high tendency in some middle-income countries such as Brazil, India and South Africa were also observed (Lazarus *et al*., 2021). Our findings also

Table 1: The details of respondents' demographics (n=305)

S/N	Variables	Proportions (%)
1	Age in years	
	20 – 29	44 (14.4)
	30 – 39	106 (34.8)
	40 – 49	105 (34.4)
	50 – 59	44 (14.4)
	60 – 69	5 (1.6)
	> 70	1 (0.3)
2	Sex	
	Female	90 (29.5)
	Male	215 (70.5)
3	Marital Status	
	Single	61(20.0)
	Married	241(79)
	Widowed	2 (0.7)
	Divorced	1 (0.3)
4	Religion	
	Christianity	234 (76.7)
	Islam	69 (22.6)
	Others	2 (0.7)
5	Educational qualification	
	*DVM only	111(36.4)
	Master's	119 (39.0)
	PhD	75 (24.6)
6	Years of work experience post	
	DVM	118 (38.7)
	1 – 10	123 (40.3)
	11 - 19	47 (15.4)
	20 - 29	17 (5.6)
	>30	
7	Geopolitical regions of residence during the lockdown	
	North Central	106 (34.8)
	North East	22 (7.2)
	North West	34 (11.1)
	South East	26 (8.5)
	South-South	28 (9.2)
	South West	89 (29.2)

*DVM – Doctor of Veterinary Medicine

reported that vaccine acceptability was gender associated. On the contrary, a meta-analysis report on vaccination-related moderators explained that the intention to accept the COVID-19 vaccine was equal among men and women (Xiao & Wong, 2020). However, the authors recommended caution in the interpretation of the findings, given the small number of independent effect sizes for male samples (Xiao & Wong, 2020). However, data from our study agreed with several pieces of evidence from other countries that vaccine acceptance of the COVID-19 vaccine was gender-related (Williams *et al*., 2020; Malik *et al*.,

2020; ACDC, 2021). The study outcome showed that male veterinarians were 2.3 times more likely to take the COVID-19 vaccine than females, which is similar to reports from the US, UK and Ireland (Malik *et al*., 2020; Kerr *et al*., 2021; Stern *et al*., 2021). In particular, women were significantly less likely to say they would accept a vaccine – with 20% indicating high levels of uncertainty, according to a study by the National University of Ireland and the University of Huddersfield, UK (Kerr *et al*., 2021). Women may become more cautious when accepting new genetic technologies such as new vaccine or genetically

Table 2: Sociodemographic factors associated with COVID-19 vaccine acceptance among participants using univariate analysis (n =305)

Variable	Category	Vaccine acceptance		P value
		Yes n (%)	No n (%)	
Age group (in years)	20-39	75 (50.0)	75 (50.0)	
	40-59	61 (40.9)	88 (59.1)	0.054*
	≥ 60	5 (83.3)	1 (16.7)	
Sex	Female	29 (32.2)	61 (67.8)	
	Male	112 (52.1)	103 (47.9)	0.002*
	North Central	50 (47.2)	56 (52.8)	
	North East	11 (50.0)	11 (50.0)	
Region	North West	16 (47.1)	18 (52.9)	
	South East	10 (38.5)	16 (61.5)	0.899
	South South	15 (53.6)	13 (46.4)	
	South West	39 (43.8)	50 (56.2)	
	DVM only	55 (49.6)	56 (50.4)	
Education	Master's	52 (43.7)	67 (56.3)	0.663
	Ph.D.	34 (45.3)	41 (54.7)	
Experience post DVM (in years)	1-10	53 (44.9)	65 (55.1)	
	11-19	55 (44.7)	68 (55.3)	0.629
	≥ 20	33 (51.6)	31 (48.4)	
Work category	Private	45 (47.9)	49 (52.1)	
	Public	87 (45.5)	104 (54.5)	0.928
	Both	9 (45.0)	11 (55.0)	
Marital status	Single	27 (44.3)	34 (55.7)	
	Married	114 (46.7)	130 (53.3)	0.73
Religion	Christianity	103 (44.0)	131 (56.0)	
	Islam	38 (53.5)	33 (46.5)	0.159*

*: Variables significant at p ≤ 0.25**;** DVM – Doctor of Veterinary Medicine

Table 3: Logistic Regression Analysis for Sociodemographic Predictors for COVID-19 vaccine acceptance among participants in Nigeria (n=305)

Variable	Category	Vaccine acceptance status		aOR	95% CI	P-value
		Yes n (%)	No n (%)			
Age group (in years)	20-39	75 (50.0)	75 (50.0)	1.00 (Ref)	-	-
	40-59	61 (40.9)	88 (59.1)	0.66	0.414-1.062	0.088
	≥ 60	5 (83.3)	1 (16.7)	4.39	0.486-39.676	0.188
Sex	Female	29 (32.2)	61 (67.8)	1.00 (ref)	-	-
	Male	112 (52.1)	103 (47.9)	2.30	1.358-3.900	0.002*
Religion	Christianity	103 (44.0)	131 (56.0)	1.00 (Ref)	-	-
	Islam	38 (53.5)	33 (46.5)	1.23	0.705-2.129	0.472

*: Variables significant at p ≤ 0.05

engineered foods, unlike men who are known to take risks (Kerr *et al.*, 2021). Men are seen to be more courageous and adventurous, which would make them feel responsible even if they nurse fears. Another reason for a low response of acceptance by females may be due to findings by researchers at the CDC. They have shown that women tend to have stronger side effects to COVID-19 vaccines than men

due to oestrogen, which elicits a stronger immune response and anxiety (Callaghan *et al.*, 2021; Hesse, 2021; Brent, 2021). Based on our findings, it is crucial to identify and understand those groups of individuals in the population likely to refuse vaccination and develop effective targeted health communications, literacy and policies toward reducing vaccine refusal and promoting vaccination coverage (Malik *et al.*,

2020). Despite this work providing the first data on vaccine acceptance among health professionals in Nigeria, it is also important to note that it had several limitations that restrict our findings' external generalisation. The non-probabilistic sampling approach, which is convenient and voluntary, may have contributed to the national survey's uneven coverage and participation among veterinarians. This may not represent the true picture of study participants, and caution should be taken in interpreting the findings. For the study to comply with the COVID-19 non-pharmaceutical measures, an online-based survey was employed. This study design may have contributed to the under-representation of veterinarians due to poor internet connectivity in the country.

In conclusion, the low vaccine acceptance rate among veterinarians may be a reflection of the population's behavioural perceptions and myths about the vaccine. Therefore, there is a need for one health collaborative effort to dispel misconceptions about the vaccine and improve vaccine literacy and coverage. There must be efforts to ensure that vaccines are accessible to all communities as much as possible. Furthermore, there is still the need to continue to promote trust, evidence-based community communication and targeted education to improve vaccine uptake.

Conflict of Interest
The authors declare that there is no conflict of interest.

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