

# Level of Knowledge, Attitude and Perception About COVID-19 Pandemic and Infection Control: A Cross-Sectional Study Among Veterinarians in Nigeria

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## Abstract

### Objectives

Coronavirus disease (COVID-19) has caused mankind serious confusion, economic havoc and psychological distress. This study evaluated the level of knowledge, attitude and perception about COVID-19 pandemic, infection control and impact among veterinarians in Nigeria.

### Methods

A cross-sectional online survey was used to collect data from consenting respondents during implementation of lockdown in the country (April 23 - May 31, 2020). Purposive and chain referral sampling techniques were used to recruit 368 respondents from various sectors of the profession.

### Results

The proportion of respondents surveyed 197/368 (53.5 %) were from the public sector, 35.3 % from private sector, 1.1 % were unemployed and 0.8 % retired. Majority of the respondents were males (72.8 %), within 30 – 39 years (39.7 %) and had 1 – 10 years work experience. Respondents displayed good level of knowledge about COVID-19 ( $72.4 \% \pm 9.9 \%$ , range 44.1-91.2 %), with information mostly derived from TV/Radio (81.5%) and social media (81.0 %). The overall attitude level was poor and various determinants for good attitude among respondents were if they were above 60 years ( $p = 0.013$ ), possessed postgraduate qualification ( $p = 0.031$ ), worked over 30 years post DVM ( $p = 0.001$ ), had household members between 5 and 10 ( $p = 0.012$ ), and were resident in states on total lockdown ( $p = 0.024$ ). There was no correlation between the knowledge level score and respondents' attitude towards the pandemic ( $p = 0.12$ ).

### Conclusion

With increasing rate of COVID-19 transmission, research data are needed to develop evidence-driven strategies, policies and effective risk mitigations to reduce the pandemic's adverse impacts.

**Keywords:** COVID-19, Risk, Knowledge, Attitude, Perception, Veterinarian, Nigeria

## Introduction

After the Ebola outbreak (causative agent: Ebola virus) in 2014, avian influenza epidemic (causative agent: H5N1 virus) in 2015, ongoing Lassa fever outbreak (causative agent: Lassa virus), a more devastating, novel, zoonotic coronavirus disease (COVID-19) pandemic caused by SARS-CoV-2, is ravaging Nigeria, as in many parts of the world (Olapegba et al., 2020). The disease is traced back to December 2019 in Wuhan, Hubei, China and was associated with wildlife animals and a seafood market where the infected persons had worked or visited (Tomar et al., 2020). As of July 13, 2020, over 12 768 307 confirmed cases with 566 654 deaths have been reported globally (WHO, 2020).

Based on the World Health Organisation (WHO) guidelines, many governments including the Nigerian government, imposed nationwide lockdown/curfew to help curb the virus and save health systems across the world from complete collapse (Lloyd and Blakemore, 2020). The lockdown involved restrictions on international, national and inter-state transport links, market, office or business transactions, educational institutions (primary, secondary and tertiary), sports, religious and all other related social gatherings (Olapegba et al., 2020). Lockdown was imposed in some states in Nigeria from March 30 and has been gradual eased from May 4. Despite this, COVID-19 infection had spread to 35 states of the country and the federal capital territory (FCT) by May 31. As at July 13, all the 36 states and the FCT have been affected with a total of 33 153 confirmed cases, 13 671 discharges and 744 deaths (case fatality rate 2.2%) (NCDC, 2020).

During and after the lockdown, essential services such as hospitals, emergency services, security services, health workers, pharmacies, electricity and gas, food supply chains and veterinary establishments were in operation (NCDC, 2020). Veterinarians are at the forefront for healthcare provision for animals including diagnosis and treatment, vaccine administration, drug distribution, health education and providing direct patient care. This means that close contact with animal owners may be unavoidable. Also, many veterinarians were seconded by the Nigeria Centre for Disease Control (NCDC) for contact tracing of suspected infected persons. The incubation period of COVID-19 of up to 14 days (median - 5.1 days, 95% CI 4.5-5.8) before symptoms could even be detected (Lauer et al., 2020), makes it further challenging and the disease a great threat to veterinarians and other members of the medical team. As the virus is mainly spread by respiratory droplets produced when an infected person coughs or sneezes, which quickly settle on surfaces, the veterinary clinics are not an exception for a possibility of transmitting the infection among persons. Veterinarians should, therefore, entertain a high level of knowledge and integrity to deal with the disease and be able to control its spread.

There are about 3000 active veterinarians who play a pivotal role in several organizations in Nigeria contributing significantly to the country's economy (Achoja et al., 2010). Such are in the eleven Veterinary Schools, Veterinary Teaching Hospitals, Federal and States Ministries of Agriculture and Rural Development, Research Institutes, Army, Navy, Police force, Customs Service, Correctional Services, Immigration, Civil defence, National Agency for Food Drug Administration and Control (NAFDAC) and National Drug Law Enforcement Agency (NDLEA). They are also in agricultural research councils, agricultural banks, private veterinary establishments, livestock farms and agro-allied services (Adewunmi and Ebotmanchang, 2004). Upon graduation with a Doctor of Veterinary Medicine (DVM)

degree, veterinarians are registered and their activities regulated by the Veterinary Council of Nigeria (VCN).

With the increasing community transmission of COVID-19, knowledge concerning the virus and infection which can affect an individual's attitude and behaviour should be determined promptly. This information can be used to inform relevant training and policies during the outbreak. It will also guide veterinarians in shaping their risk perceptions and communication practices thereby avoiding exposure. This will help them contribute at a population level, in the prevention and control of the disease and health care response whenever the need arises (Karasneh et al., 2020). To the best of our knowledge, this study represents the first aimed at assessing the level of knowledge, attitude and perception (KAP) about COVID-19 pandemic and infection control among veterinarians in Nigeria.

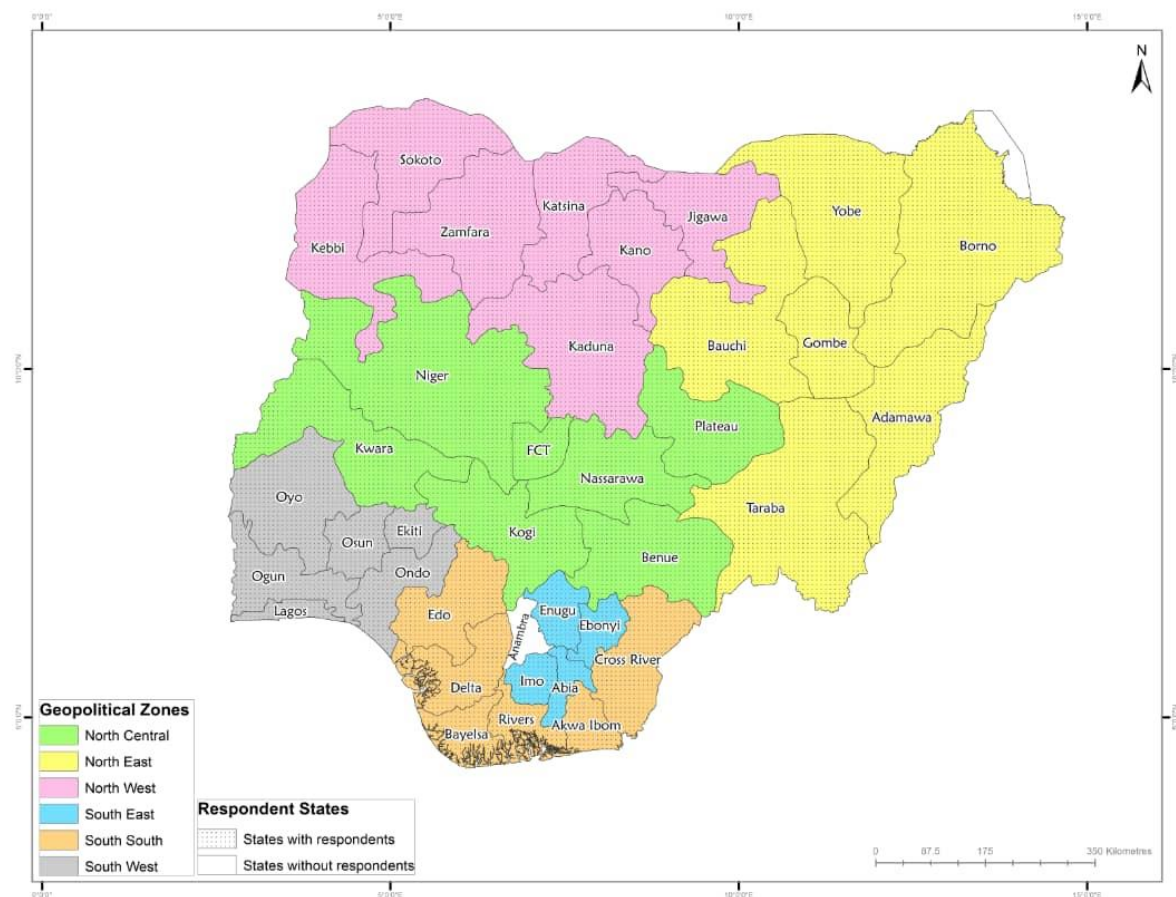
## **Materials and methods**

### ***Ethical approval***

The study was approved by the College of Veterinary Medicine, Federal University of Agriculture Research Ethics Committee (reference number: FUNAAB/COLVET/CREC/2020/04/02). Participation in the study was strictly voluntary as stipulated in the questionnaire sent to respondents. Precautions were taken to ensure that confidentiality and tracing of the identity of the subjects were not possible.

### ***Study area***

This study was conducted in Nigeria, a West African country, comprised of 36 states categorised into six geopolitical zones - North Central, North East, North West, South West, South East, South South, and the FCT. There were respondents from 35 of the 36 states and the FCT (Figure 1).



**Figure 1: Spatial representation of veterinarians who participated in an online KAP survey between April 23 and May 31, 2020 in Nigeria.**

***Study design and sampling***

A cross-sectional study based on a self-reported online questionnaire was performed. This method was used due to the COVID-19 health crisis and as it was very difficult to physically access people at the time of data collection due to the lockdown. The questionnaire was developed using the Google Forms Platform (Mountain View, CA, USA) to facilitate the completion and collection of data. All registered veterinarians currently based and working in Nigeria were the target population. Invitations were sent to veterinarians nationwide to participate in the study using the WhatsApp platforms of the College of Veterinary Surgeons, Veterinary Schools, Veterinary Teaching Hospitals and the Nigerian Veterinary Medical Association. The questions for the online survey were in English and developed after reviewing pertinent literature using international guidelines (Malhotra, 2006). The link to the survey questionnaire was included in the sent invitations and a brief description of the purpose of the study was provided. The questionnaire was anonymous to maintain the privacy and confidentiality of all information collected in the study. The online survey was conducted from April 23 to May 31, 2020.



### ***Questionnaire and data collection***

The questionnaire comprised a total of 56 questions of which 14 were on socio-demographic profiles and the other 42 questions were on KAP of veterinarians towards COVID-19 pandemic and infection control. The questionnaire was piloted by collecting data from five veterinarians not included in the study sample. Feedback on how they understood each question was received and questions were adjusted accordingly. The average completion time of the questionnaire was 12 minutes. The final questionnaire had structured, closed-ended questions with responses based on multiple-choice and 5- Likert scale formats.

The questionnaire was divided into four sections. The first section consisted of questions assessing socio-demographic and profession-related profiles which were age, sex, educational qualification, number of years post DVM, work category, marital status, religion, number of persons in a household, states of residence during the lockdown, and type of lockdown instituted. The second section assessed general knowledge about COVID-19. It consisted of 14 questions regarding the source of infection, modes of transmission, role animals play in the spread of infection, symptoms, susceptible individuals and methods of prevention, control and treatment.

In section three of the questionnaire, the respondents' attitude was assessed by 15 questions. The questions were structured to evaluate their attitudes towards adherence to the non-pharmaceutical intervention and social distancing regulations implemented by the government, if going out during the lockdown was acceptable, attitudes towards seeking updates on COVID-19, dispositions to certain activities during the lockdown and prophylactic drugs (orthodox or herbal) taken. The 5-point Likert scale (1-lowest negative effect, 5- highest negative effect) was used to measure the impact of the lockdown on the social, financial, physical, and mental well-being of the respondents. The effect of the lockdown on their sexual performances was also assessed.

The final section focused on the perception of the veterinarians. They were asked on a scale of 1 to 5 about their opinion on the impact of the pandemic on veterinary services and delivery in the country. The section evaluated which of the impacts of the pandemic veterinarians were most concerned about e.g., impact on business/economy, veterinary care delivery, zoonosis, the spread, the actions or inactions of the Nigerian government and/or international bodies. The rate of satisfaction to current measures taken by the Nigerian government and the veterinarians' roles in the pandemic were also assessed.

The survey was available online for five weeks to ensure that as many veterinarians as possible participated. Detailed information on the questionnaire is presented in the Supplementary Appendix.

### ***Data analysis***

Descriptive statistics were conducted for all variables in the forms of frequencies and proportions/percentages using Microsoft Excel<sup>R</sup> (2013). A correct response to an item was assigned one point, while an incorrect or uncertain response was assigned 0 point. Respondents' knowledge and attitude levels towards COVID-19 was arrived at by summing correct responses, generating maximum possible scores of 34 and 17 respectively. The knowledge and attitude scores were thereafter converted to percentages and cut-off points of < 70 % and ≥ 70 % were used to categorise respondents as having poor and good levels, respectively. Normality tests were conducted on continuous variables using Kolmogorov-Smirnov (> 0.05) and Shapiro-Wilk (> 0.05) and data expressed as mean and standard deviation (Mean ± SD). Independent samples t-tests and one-way analysis of variance

(ANOVA) were utilised to determine the differences in knowledge and attitude scores between categories of demographic variables.

All variables were recoded into binary outcomes for further analysis. Associations between the socio-demographics of respondents and knowledge as well as attitude levels were determined using chi-square tests. Variables significant at  $p \leq 0.25$  were processed further by binary logistic regression analysis (BLRA) using Stata 12.0. A  $p < 0.05$  was considered statistically significant and crude odds ratios were computed to determine the strength of associations between variables at 95 % confidence intervals (CIs). All illustrations were performed with Graphpad prism 8.0.

## Results

### *Respondents' socio-demographics*

A total of 368 veterinarians from 35 states and the FCT participated in the study. Of this, 367 (99.7 %) of them resided in states where confirmed COVID-19 cases had been reported within the study period. Most representation was from the South West (35.3 %, 95 % CI, 30.6 - 40.3), followed by the North Central (23.4 %, 95 % CI, 19.3 - 28.0), and the least from the South East (4.3 %, 95 % CI, 2.6 - 7.0). Of the respondents, 268 (72.8 %) were males and the majority were within the age category 30 – 39 years (39.7 %), 273 (74.2 %) were married, 265 (72.0 %) identified being Christians, and 180 (48.9 %) had less than five household members (Table 1).

A total of 133 (36.2 %) and 70 (19.0 %) had completed their Master's and PhD degrees, respectively in addition to the DVM degree. Respondents with years of work practice post DVM within 1 – 10 years (46.5 %) constituted the highest, followed by those within 11 - 19 years (29.9 %). About 53.5 % were employed into the public service, 35.3 % private practice and 1.1 % indicated they were unemployed (Table 1).

The majority indicated a partial lockdown 235 (63.8 %) in their states of residence while others experienced a total lockdown 122 (33.2 %). Self - reported states with total lockdown included Lagos, Ogun, Adamawa, Plateau, Nassarawa, Kaduna, Katsina, Kwara, Niger, Benue, Delta, Kano, Enugu, Taraba, Rivers, Osun, Borno and FCT.

**Table 1. Socio-demographic profile of veterinarians in Nigeria who participated in an online KAP study from April – May 2020 (n = 368).**

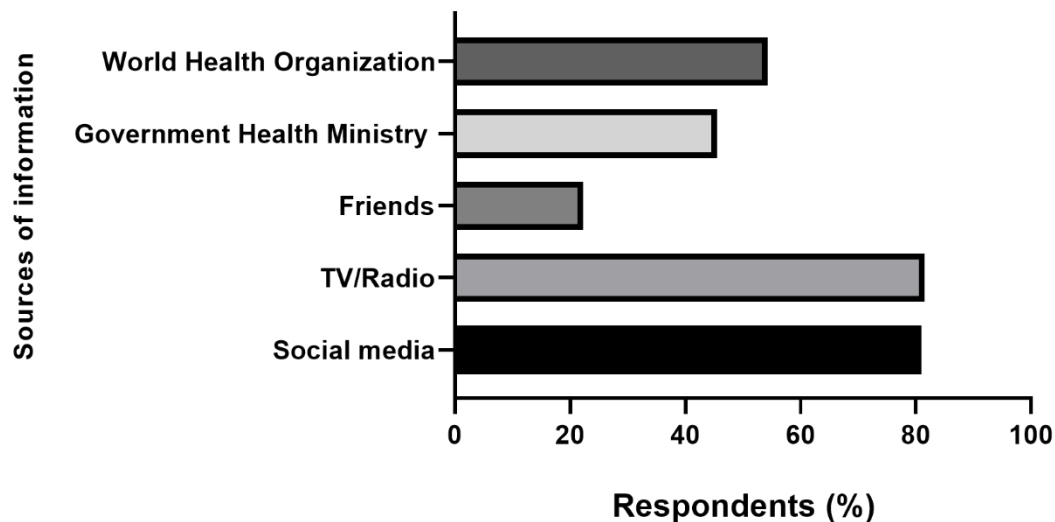
S/N	Variables	Proportions (%)	95 % CI
<b>1</b>	Age in years		
	20 - 29	54 (14.7)	11.4 - 18.7
	30 – 39	146 (39.7)	34.8 - 44.7
	40 – 49	103 (28.0)	23.6 - 32.8
	50 – 59	50 (13.6)	10.4 - 17.5
	60 – 69	15 (4.1)	2.4 - 6.7
<b>2</b>	Sex		
	Female	100 (27.2)	22.9 - 31.9
	Male	268 (72.8)	68.1 - 77.1
<b>3</b>	Marital Status		
	Single	91 (24.7)	20.6 - 29.4
	Married	273 (74.2)	69.5 - 78.4
	Widowed	3 (0.8)	0.16 - 2.5
	Divorced	1 (0.3)	<0.01 - 1.7
<b>4</b>	Religion		
	Christianity	265 (72.0)	67.2 - 76.4
	Islam	100 (27.2)	22.9 - 31.9
	Others	3 (0.8)	0.16 - 2.5
<b>5</b>	Educational qualification		
	DVM only	165 (44.8)	39.3 - 49.4
	Master's	133 (36.2)	32.0 - 41.72
	PhD	70 (19.0)	15.3 - 23.4
<b>6</b>	Years of work experience post DVM		
	1 – 10	171 (46.5)	41.4 - 51.6
	11 - 19	110 (29.9)	25.4 - 34.8
	20 - 29	66 (17.9)	14.3 - 22.2
	>30	21 (5.7)	3.7 - 0.9
<b>7</b>	Work background		
	Private	130 (35.3)	30.6 - 40.3
	Public	197 (53.5)	48.4 - 58.6
	Both	27 (7.3)	0.5 - 10.5
	Retired	3 (0.8)	0.2 - 2.5
	Others	11 (3.0)	1.6 - 5.3
<b>8</b>	Number of household members		
	Less than 5	180 (48.9)	43.8 - 54.0
	5-10	174(47.3)	42.2 - 52.4
	>10	14 (3.8)	2.2 - 6.3
<b>9</b>	Geopolitical regions of residence during the lockdown		
	North Central	86 (23.4)	19.3 - 28.0
	North East	20 (5.4)	3.5 - 8.3
	North West	69 (18.8)	15.1 - 23.1
	South East	16 (4.3)	2.6 - 7.0
	South South	48 (13.0)	10.0 - 16.9
	South West	129 (35.1)	30.4 - 40.1
<b>10</b>	Type of lockdown where resident		
	Partial	235 (63.8)	58.8 - 68.6
	Total	122 (33.2)	28.5 - 38.1
	Not Sure	11(3.0)	1.6 - 5.3

DVM – Doctor of Veterinary Medicine



### Knowledge of COVID-19

Channels of information or updates on COVID-19 reported by respondents were majorly from TV/Radio (81.5 %) and social media (81.0 %) and depended less on information from friends (22.3 %). Other sources used were the NCDC and WHO websites (Figure 2).



**Figure 2. Various channels or sources veterinarians in Nigeria relied on for information and updates about COVID-19 pandemic and infection control (n= 368).**

Of the 368 respondents, 95.7 % correctly identified the acronym for COVID-19. Only 20.6 % of the respondents reported that COVID-19 was similar to MERS-CoV and SARS-CoV. The majority (94.4 %) indicated the incubation period for the pathogen was between 2 – 14 days and that currently, there is no cure for the disease (91 %). Sources of virus transmission identified were contact with an infected person when they cough or sneeze (97.8 %) and touching eyes, nose and mouth after contact with contaminated surfaces (98.6 %). The elderly (92.9 %), people with underlying infections (91.3 %), and frontline health workers (86.6 %) were indicated as more likely to be susceptible to the virus than veterinarians (35.6 %), children (34.8 %), pregnant women (29.9 %) and pet owners (17.7 %). The use of facemask in public was agreed by 81.5 % of the respondents to assist in curbing the spread of the virus (Table 2).

Up to 60.6 % of respondents opined that there was scientific evidence for the original route of transmission to humans. Majority of the participants (96.7 %) supported that the current status and spread of the pathogen is a result of human to human transmission (community propagation), as people with no history of travelling to affected countries now get sick with the virus. Of the 368 responses, 85.3 % reported that animals could become infected through close contact with infected humans. A little above average (51.4 %) of the respondents supported that owners infected with the virus can still care and handle their animals. Hand washing before being around or handling animals, their food, or supplies (66.3 %), avoiding kissing, licking or sharing food with pets (57.3 %), allowing other members of the household

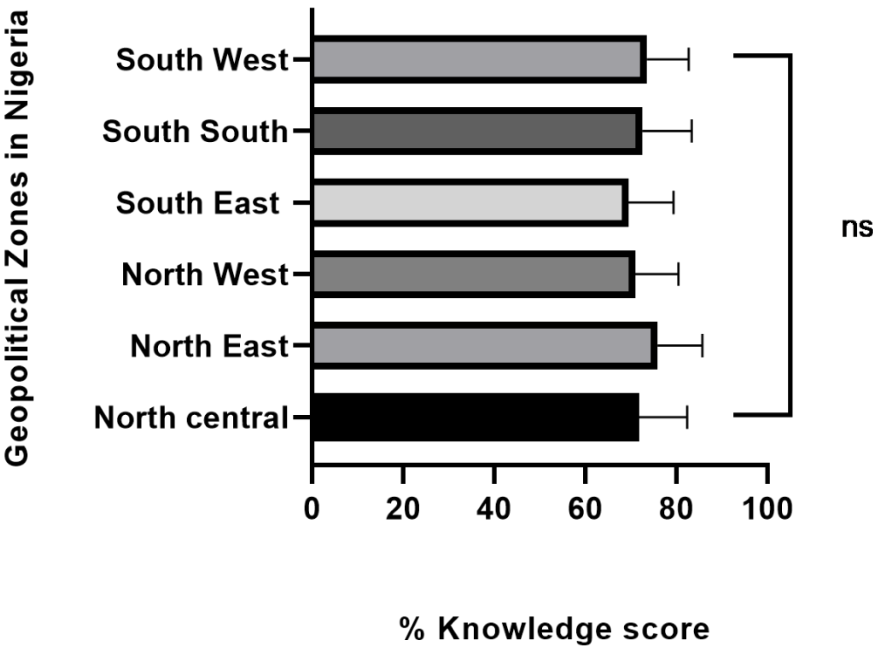
care for animals (54.9 %), maintaining good hygiene practices (66.8 %), wearing a face mask if possible (63.3 %), and keeping pets indoors by owners infected with COVID-19 (50.8 %) were precautionary measures mentioned to prevent cross-infection (Table 2).

**Table 2:** Different sources of information and distribution of the knowledge responses towards COVID-19 pandemic and infection control by veterinarians in Nigeria (n = 368).

S/N	Variables	Proportion (%)
1.	Source of information and updates on COVID-19. Tick as many that apply	
	Social media	291 (81.0)
	TV/Radio	300 (81.5)
	Friends	82 (22.3)
	Government Health Ministry	167 (45.4)
	World Health Organization	200 (54.3)
2	COVID-19 is acronym for Virus. Tick as many that apply	
	Corona virus debacle - 19	2 (0.5)
	Corona virulent disease version 19	12 (3.3)
	Corona venom disease number 19	2 (0.5)
	Corona virus disease – 19	352 (95.7)
3	COVID- 19 is similar to Infectious disease. Tick as many that apply	
	Common flu	112 (30.4)
	MERS-CoV	144 (39.1)
	SARS-CoV	347 (94.3)
	Don't know	5 (1.4)
4	Scientific evidence to identify the source of COVID-19 transmission to humans	
	Yes	223 (60.6)
	No	81 (22.0)
	Don't know	64 (17.4)
5	Spread of COVID-19 is a result of human to human transmission	
	Yes	356 (96.7)
	No	11 (3.0)
	Don't know	1 (0.3)
6	A person can get infected with the virus while caring for his/her pet	
	Yes	189 (51.4)
	No	153 (41.6)
	Don't know	26 (7.0)
7	If yes, what precautionary measures should be taken for a companion or other animals?	
	Tick as many that apply	244 (66.3)
	Hand washing before being around or handling animals, their food, or supplies	211 (57.3)
	Avoid kissing, licking or sharing food	202 (54.9)
	Other members of their household can care for animals	246 (66.8)
	Maintaining good hygiene practices	233 (63.3)
	Wearing a face mask if possible	
	Animals belonging to owners infected with COVID-19 should be kept indoors as much as possible	187 (50.8)
	Contact with other pets/animals can still be allowed	21 (5.7)
	Don't know	1 (0.3)
8	COVID-19 is spread by (Tick as many that apply)	
	Contact with an infected person when they cough or sneeze	360 (97.8)
	Touching eyes, nose and mouth after contact with contaminated surfaces	363 (98.6)
	Consumption of wildlife (bushmeat)	62 (16.8)
	Contact with pets	49 (13.3)

S/N	Variables	Proportion (%)
	From pregnant mother to baby	43 (11.7)
9	Who is more likely to develop COVID-19? Tick as many that apply	
	The elderly	342 (92.9)
	Children	128 (34.8)
	People with underlying infections	336 (91.3)
	Frontline health workers	326 (88.6)
	Veterinarians	131 (35.6)
	Pet owners	65 (17.7)
	Pregnant women	110 (29.9)
	Anyone	139 (37.8)
10	How long does it take to develop COVID-19 symptoms?	
	1-2 days	2 (0.5)
	3-7 days	6 (1.6)
	2 - 14 days	347 (94.4)
	14 - 28 days	13 (3.5)
	1-2 months	0
11	Wearing of facemasks in public curbs the virus spread?	
	Yes	300 (81.5)
	No	67 (18.2)
	I don't know	1 (0.3)
12	Personal protective equipment must be worn by	
	Frontline workers	228 (62.0)
	Caregivers	73 (19.8)
	Everyone	67 (18.2)
13	Is there a cure/vaccine for COVID-19?	
	Yes	14 (3.8)
	No	335 (91.0)
	I don't know	19 (5.2)

The overall knowledge mean score was 24.6 (SD  $\pm$ 3.4; score 0  $\rightarrow$  34), suggesting an overall of 72.4 % (SD  $\pm$ 9.9%, range 44.1 - 91.2%). The general knowledge about COVID-19 among veterinarians was good and almost 64 % of the respondents had  $\geq$  70 %, which is acceptable. The knowledge level based on geopolitical zoning was  $71.8 \pm 10.5$ ,  $75.9 \pm 9.8$ ,  $71.0 \pm 9.5$ ,  $69.5 \pm 9.9$ ,  $72.5 \pm 10.8$ , and  $73.5 \pm 9.2$  for North Central, North East, North West, South East, South South and South West respectively. This indicates that the knowledge level on COVID-19 was similar across the geopolitical zones ( $p = 0.20$ , Figure 3). Overall, there was no association between the respondents' knowledge level and their socio-demographic profiles ( $p > 0.05$ ; Table 3).



**Figure 3.** The knowledge score of veterinarians in Nigeria towards COVID-19 pandemic and infection control based on geopolitical zones (n = 368).

**Table 3.**

**Univariate analysis of the levels of knowledge and attitude towards COVID-19 pandemic and infection control among veterinarians in Nigeria in relation to their socio-demographic characteristics (n=368).**

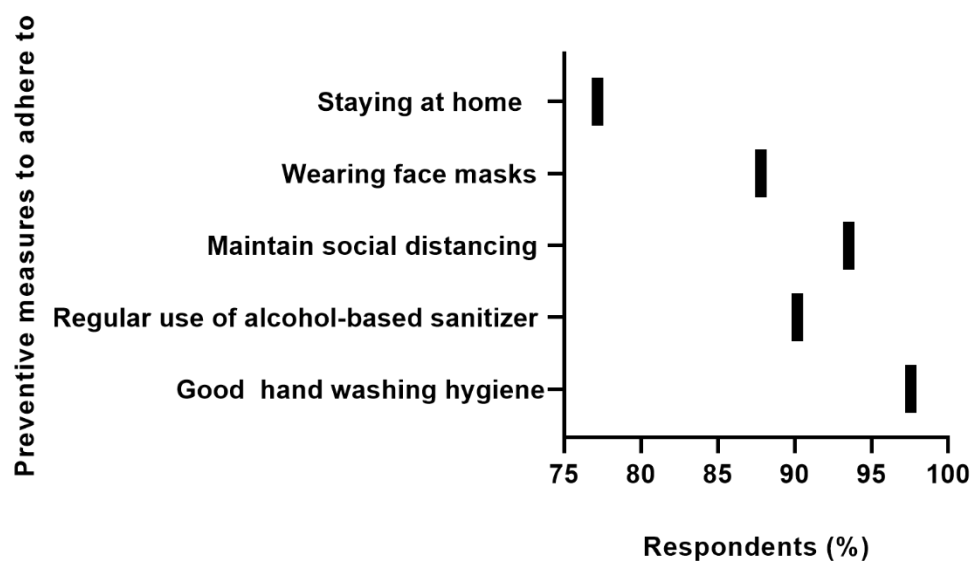
Variable	Category	Knowledge			Attitude		
		Good n (%)	Poor n (%)	P value	Good n (%)	Poor n (%)	P value
Age	20-39	128 (64.0)	72 (36.0)	0.716	76 (38.0)	124 (62.0)	0.019*
	40-59	96 (62.7)	57 (37.3)		69 (45.1)	84 (54.9)	
	≥ 60	11 (73.3)	4 (26.7)		11 (73.3)	4 (26.7)	
Sex	Male	171 (63.8)	97 (36.2)	0.973	116 (43.3)	152 (56.7)	0.571
	Female	64 (64.0)	36 (36.0)		40 (40.0)	60 (60.0)	
Education	DVM	106 (65.0)	57 (35.0)	0.616	59 (36.2)	104 (63.8)	0.092*
	Postgraduate	102 (64.6)	56 (35.4)		76 (48.1)	82 (51.9)	
	Advanced Professional	27 (57.4)	20 (42.6)		21 (44.7)	26 (55.3)	
Work experience post-DVM	1-10	114 (66.7)	57 (33.3)	0.400	62 (36.3)	109 (63.7)	0.005*
	11-19	63 (57.3)	47 (42.7)		49 (44.5)	61 (55.5)	
	20-29	44 (66.7)	22 (33.3)		29 (43.9)	37 (56.1)	
	≥ 30	14 (66.7)	7 (33.3)		16 (76.2)	5 (23.8)	
Marital status	Single	63 (67.7)	30 (32.3)	0.579	33 (35.5)	60 (64.5)	0.271
	Married	172 (62.5)	103 (37.5)		123 (44.7)	152 (55.3)	
Religion	Islam	67 (65.7)	35 (34.3)	0.651	43 (42.2)	59 (57.8)	0.955
	Christianity	168 (63.2)	98 (36.8)		113 (42.5)	153 (57.5)	
Work type	Private	98 (68.1)	46 (31.9)	0.396	57 (39.6)	87 (60.4)	0.084*
	Public	121 (61.4)	76 (38.6)		92 (46.7)	105 (53.3)	
	Both	16 (59.3)	11 (40.7)		7 (25.9)	20 (74.1)	
Number of persons per household	<5	120 (66.7)	60 (33.3)	0.519	66 (36.7)	114 (63.3)	0.011*
	5-10	107 (61.5)	67 (38.5)		87 (50.0)	87 (50.0)	
	>10	8 (57.1)	6 (42.9)		3 (21.4)	11 (78.6)	
Type of lockdown	Partial	149 (63.4)	86 (36.6)	0.745	90 (38.3)	145 (61.7)	0.070*
	Total	80 (65.6)	42 (34.4)		62 (50.8)	60 (49.2)	
	Unsure	6 (54.5)	5 (45.5)		4 (36.4)	7 (63.6)	

\*: Variables significant at  $p \leq 0.25$

### *Attitude during the lockdown*

Regarding attitudes on preventive measures towards COVID-19, the respondents thought they should adhere to good handwashing hygiene, maintain social distancing and regular hand sanitisation using alcohol-based sanitisers (Figure 4). Majority of the respondents (77.2 %) thought they should keep at 1 - 3 meters when social distancing from people, while others considered less than 1 meter (6.5 %) or more than 4 meters (16.3 %) was sufficient. For frequency of going out, up to 66.5 % of the respondents reported leaving the house about 2 - 5 times a week or every day during the lockdown was no problem. Majority of the respondents did not view visiting human clinics (90.8 %), religious places (89.4 %), home visits/ambulatory (84.2 %) and farms (72.3 %) as places of risk exposure (Table 4).

Of the 386 respondents, 326 (88.6 %) thought it was necessary to regularly listen to updates on COVID-19 pandemic. Interestingly, lesser number spent time with their pets (2.2 %) and about 47.0 % self-reported they worked from home. Respondents indicated they passed their time majorly by watching TV/Movies, being on social media, and reading. The respondents also indicated the pandemic made them feel more anxious/worried/restless/afraid (66.8 %). Averagely (56.0 %) were optimistic, while 2.7 % were pessimistic about the situation. Almost half (42.6 %) were taking herbal mixtures, antibiotics, vitamins and immune boosters, aspirin and fruits as preventive measures against COVID-19 (Table 4).



**Figure 4: Preventive measures veterinarians in Nigeria adhered to towards COVID-19 pandemic and infection control (n = 368).**



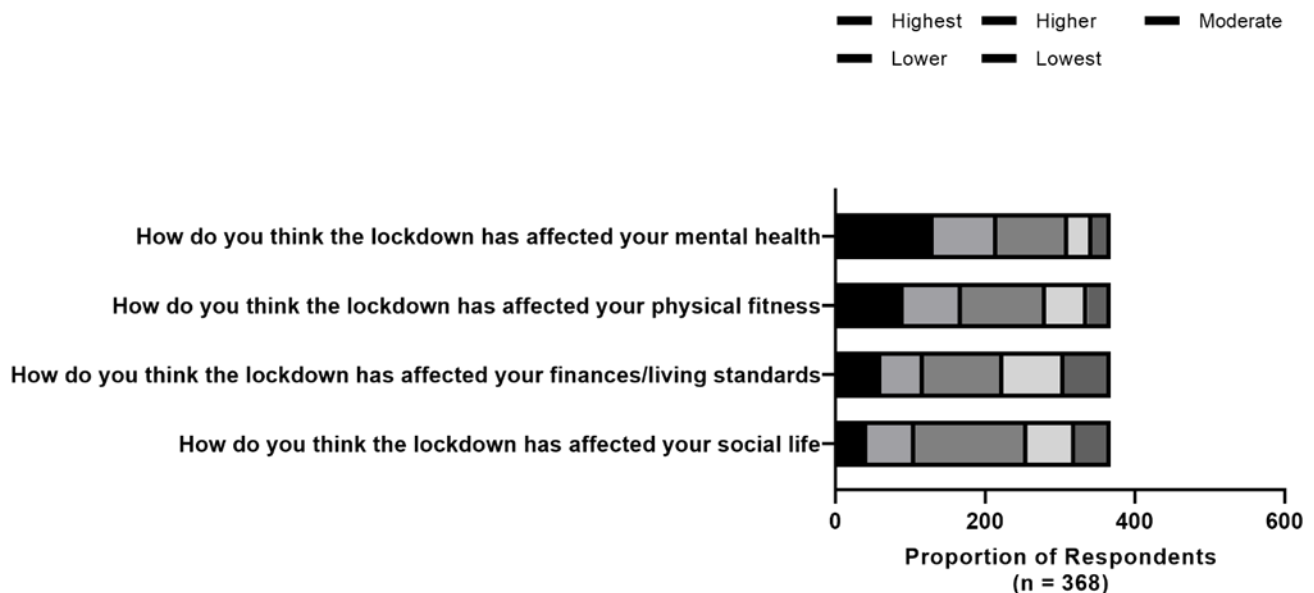
**Table 4.**

**Attitude responses of veterinarians in Nigeria towards COVID-19 pandemic and infection control (n = 368).**

<b>S/N</b>	<b>Variables</b>	<b>Proportion (%)</b>
<b>1.</b>	I do not think I should adhere to any of these non-pharmaceutical interventions, except. Tick as many that apply	
	Good hand washing hygiene	359 (97.6)
	Rubbing hands regularly with alcohol-based sanitiser	332 (90.2)
	Social distancing	344 (93.4)
	Staying at home	284 (77.2)
	Wearing face masks when going out	323 (87.8)
<b>2</b>	I think I should keep a distance of ----- during social distancing	
	Less than 1 meter	24 (6.5)
	1- 3 meters	284 (77.2)
	4-6 meters	35 (9.7)
	More than 6 meters	10 (2.7)
	I don't know	15 (4.1)
<b>3</b>	For me, going out .....is not a concern during the lockdown	
	Not at all	28 (7.8)
	Once a week	95 (25.8)
	2-5 times a week	147 (39.9)
	Everyday	98 (26.6)
<b>4</b>	Going to these areas during the lockdown was not a concern for me. Tick as many that apply	
	Workplace	204 (55.4)
	Market	160 (43.5)
	Religious places	39 (10.6)
	Human clinic	34 (9.2)
	Vet clinic	150 (40.8)
	Farms	102 (27.7)
	Home visits/ambulatory	58 (15.8)
	Others	16 (4.3)
<b>5</b>	I think I should listen to updates on COVID-19	
	Yes	326 (88.6)
	Sometimes	41 (11.1)
	Not at all	1 (0.3)

S/N	Variables	Proportion (%)
6.	I caught my fun doing the following. Tick as many as apply	
	Watching TV/Movies	239 (64.9)
	Reading books	220 (59.8)
	Exercising	174 (47.3)
	Following social media (WhatsApp, Instagram, Facebook, Twitter etc.)	223 (63.3)
	Visiting friends	10 (2.7)
	Spending time with the family	181 (49.2)
	Working from home	171 (46.5)
	Playing with pets	8 (2.2)
	Others	14 (3.8)
7	Taking such drugs to prevent COVID-19 is appropriate for me. Tick as many as apply	
	Antibiotics	5 (1.4)
	Herbs	16 (4.3)
	Antimalarial	2 (0.5)
	Blood tonic	1 (0.3)
	Vitamins	121 (32.9)
	Others	12 (3.3)
	None	209 (56.8)
8	I felt mentally ----- towards the lockdown	
	Anxious/Afraid/ Restless/ Worried	246 (66.8)
	Angry	15 (4.1)
	Stressed	74 (20.1)
	Lonely	45 (12.2)
	Bored	127 (34.5)
	Optimistic	206 (56.0)
	Pessimistic	10 (2.7)
	Depressed	25 (6.8)
9	Reducing my contact with animals or taking preventive measures is very vital to prevent COVID-19?	
	Yes	217 (59.0)
	No	135 (36.7)
	Not sure	16 (4.3)

The lockdown had a moderate impact on the social (40.8 %), financial (28.8 %) and physical (30.4 %) status of veterinarians. However, the lowest impact (35.6 %) was recorded for the mental health of respondents (Figure 5). Sexual performance during this period was described by the respondents as the same as before the lockdown (52.4 %), low (14.1 %), high (12.2 %) or not at all (21.2 %).



**Figure 5: The impact of COVID-19 pandemic on the social, financial, physical and mental well-being of veterinarians in Nigeria (n = 368).**

The overall attitude mean score was 11.1 (SD  $\pm$  1.66; score: 0→17), suggesting an overall 65.4 % (SD  $\pm$  10.8; range 35.3 % - 94.1%), which was categorised as being poor towards the pandemic. Univariate analysis shows that respondents' attitude level was associated with most of the socio-demographic variables, including age ( $p = 0.019$ ), education ( $p = 0.092$ ), work experience post DVM ( $p = 0.005$ ), work type ( $p = 0.084$ ), number of persons per household ( $p = 0.011$ ) and type of lockdown ( $p = 0.070$ ) (Table 3).

Further analysis using bivariate logistic regression reveals that respondents aged  $\geq 60$  years were about 4.5 times more likely to demonstrate good attitudes towards COVID-19 pandemic and infection control (OR = 4.49, 95 % CI: 1.379-14.594) than those aged between 20-39 years. Also, those who had received postgraduate training were about 1.6 times more likely to demonstrate good attitudes (OR = 1.63, 95 % CI: 1.045-2.553) than those who only had DVM degree. Similarly, respondents with  $\geq 30$  years' work experience post DVM were about 5.6 times more likely to demonstrate good attitudes (OR = 5.63, 95 % CI: 1.966-16.100) than respondents within 10 years work experience post DVM (Table 5).

The odds of developing good attitudes towards COVID-19 pandemic and infection control was about twice lower among respondents with more than 10 persons per household (OR = 0.47; 0.127-1.750) than those with less than 5 persons per household, although not statistically significant. In the same vein, the odds of demonstrating good attitudes was about 1.7 times higher among respondents' resident in states where there was total lockdown (OR = 1.66, 95% CI: 1.070-2.590) than those in states with partial lockdown (Table 5).

**Table 5. Bivariate analysis of significant factors for level of attitude among veterinarians in Nigeria towards COVID-19 pandemic and infection control (n=368).**

Variable	Category	Attitude		OR	95% CI	P value
		Good n (%)	Poor n (%)			
Age	20-39	76 (38.0)	124 (62.0)	1.00 (Reference)	-	-
	40-59	69 (45.1)	84 (54.9)	1.34	0.873-2.056	0.18
	≥ 60	11 (73.3)	4 (26.7)	4.49	1.379-14.594	0.013*
Education	DVM	59 (36.2)	104 (63.8)	1.00 (Reference)	-	-
	Postgraduate	76 (48.1)	82 (51.9)	1.63	1.045-2.553	0.031*
	Advanced Professional	21 (44.7)	26 (55.3)	1.42	0.737-2.749	0.293
Work experience post DVM	1-10	62 (36.3)	109 (63.7)	1.00 (Reference)	-	-
	11-19	49 (44.5)	61 (55.5)	1.41	0.867-2.302	0.166
	20-29	29 (43.9)	37 (56.1)	1.38	0.773-2.458	0.277
	≥ 30	16 (76.2)	5 (23.8)	5.63	1.966-16.100	0.001*
Work type	Private	57 (39.6)	87 (60.4)	1.00 (Reference)	-	-
	Public	92 (46.7)	105 (53.3)	1.34	0.865-2.068	0.191
	Both	7 (25.9)	20 (74.1)	0.53	0.212-1.345	0.183
No. of persons/household	<5	66 (36.7)	114 (63.3)	1.00 (Reference)	-	-
	5-10	87 (50.0)	87 (50.0)	1.73	1.130-2.641	0.012*
	>10	3 (21.4)	11 (78.6)	0.47	0.127-1.750	0.261
Type of lockdown	Partial	90 (38.3)	145 (61.7)	1.00 (Reference)	-	-
	Total	62 (50.8)	60 (49.2)	1.66	1.070-2.590	0.024*
	Unsure	4 (36.4)	7 (63.6)	0.92	0.262-3.234	0.897

### ***Perception and concerns about COVID-19***

Less than one-third (28.0 %, 103 respondents) indicated veterinary services would be moderately affected by the pandemic, while 41.1 % and 31.0 % believed the pandemic would have a high and less impact on veterinary services respectively. About half of the respondents (50 %), envisaged many veterinary practices in the country would not close down during and post-pandemic, while 34.3 % viewed otherwise. The major concerns raised by veterinarians about the pandemic was the impact on the economy (96.2 %). The misinformation about COVID-19 going around social media (58.4 %), impact on children's education (53.5 %) and mental wellbeing of Nigerians (53.0 %) were also mentioned. About 29.6 % of the respondents were moderately worried, while 39.7 % and 30.7 % were less and more concerned about contracting the virus through zoonosis respectively. Other concerns raised were that the pandemic would increase unemployment and job insecurities, poverty and hunger, crime rate, unwanted pregnancies, domestic violence, stigmatisation against COVID-19 patients and recoverees, corrupt practices at different governmental agencies, the burden on health care system and community spread of the disease.

The lockdown in the country was agreed to be necessary by most respondents (78.5 %). However, 66.3 % were dissatisfied with the government's (federal, state and local) implementation and measures to mitigate disease spread within the country. Respondents suggested containment measures for the spread of COVID-19 in the country would improve if the government would liaise with national medical and veterinary laboratories (96.7 %), national researchers (87.8 %), international health agencies (83.7 %) and non-governmental organisations (70.1 %). Moreover, many veterinarians (68.5 %) opined that the profession has not been effectively involved in government intervention plans and decisions against the pandemic. Several areas many perceived to be veterinarians' roles in this pandemic were as follows: to initiate multi-stakeholders (one health) approach to tackling the community transmission, ensure coherent and appropriate risk management and communication, and support surveillance screening and testing of human samples. A total of 98.4 % veterinarians showed they were ready to willingly contribute their quota to combat the pandemic whenever the need arises or when summoned to do so.

### **Discussion**

This survey provides an insight into the KAP of veterinarians in Nigeria about COVID-19 pandemic and infection control. For veterinarians to thrive during and post COVID era, adequate knowledge and attitude towards the disease that caused the pandemic is required. Such knowledge can help to contain the pandemic by adopting the right attitude and precautionary measures, which will invariably boost both the physical and mental health of veterinarians and the society at large.

In our study, males were predominant (72.8 %) and this might be because veterinary medicine is still considered a male-dominated profession in many African states (Adebowale et al., 2020). The culture of the profession values masculine characteristics especially in large animal handling and freedom from familial responsibilities. Females are clustered primarily in the lesser paid speciality of companion animal medicine and are less likely to own their practices (Lofstedt, 2003). However, in Canada, the United States of America and the United

Kingdom, a significant increase in the number of females studying at veterinary colleges and practising in all fields of the profession has been reported (Lofstedt, 2003; Begeny and Ryan, 2018). Also worthy of note is the fact that most female veterinarians are encumbered with family responsibilities and lag in improving their career perspectives (Balogh, 2000). During disease outbreaks, females endure additional burdens in unpaid care work, reproductive work and community activities. This was also reported by McLaren et al. (2020) in a study focussing on the gendered burdens of COVID-19 pandemic in Sri Lanka, Malaysia, Vietnam and Australia. Public policy and health efforts should be geared towards addressing the issues concerned with the associations between gender and disease outbreaks.

The highest representation of respondents was within the age category 30 - 39 years (39.7 %), many of who fell within 1 - 10 years post DVM work practice (46.5 %). This could be because they are more agile, versatile, internet and social media networks compliant (the medium used for the survey). This agrees with other reports of online surveys in Nigeria (Olapegba et al., 2020; Reuben et al., 2020).

Knowledge is a prerequisite for establishing good prevention beliefs, forming positive attitudes, promoting positive behaviours and individual cognition of their coping strategies to a certain extent (McEachan et al., 2016). The general knowledge about the cause, transmission, incubation period and susceptible individuals to COVID-19 among veterinarians was good as almost 64 % of the respondents scored higher than 70 %. Over 90 % of the respondents could identify the main symptoms of COVID-19, which could help to recognize the threat and take necessary actions to curb its spread. This is similar to reports of knowledge of COVID-19 among health workers in China, Pakistan and Guinea (Zhou et al., 2020; Gao et al., 2020; Saqlain et al., 2020; Shi et al., 2020; Camara, 2020), dentists (Youssef-Khader et al., 2020) and pharmacists in Jordan (Karasner et al., 2020). This may be due to the educational status of the respondents and agrees with previous studies assessing the effect of level of education during epidemics/pandemics (Brug et al., 2004; Choi and Yang, 2010; Hussain et al., 2012).

Our study also identified the mass media - TV/Radio (81.5 %) and social media (81.0 %) as the major sources of information about COVID-19. This is consistent with other findings that reported the use of social media as a major tool for COVID-19 information dissemination in Nigeria (Olapegba et al., 2020; Reuben et al., 2020). About 85.49 million internet users were recorded within the first quarter of 2020 of which more than 70 % are youth (18 - 35 years). (Reuben et al., 2020). Many of the respondents in this study fell within this age category and despite having adequate knowledge about the disease, this age group are largely influenced by media information. The importance of the media in providing vital information during outbreaks has been confirmed by several researchers (Lau et al., 2003; Varti et al., 2009; Voeten et al., 2009). Reliable guidelines and information on COVID-19 should be made available regularly by WHO and NCDC through this route. This could help dispel misinformation, misconception and citizenry ignorance about COVID-19 pandemic (Adenubi et al., 2020).

Respondents passed their time majorly by watching TV/Movies, being on social media, and reading. This gave them ample time to seek correct information on COVID-19. Pandemics have a significant psycho-social impact. Health anxiety, panic, adjustment disorders, depression, chronic stress and insomnia are the major offshoots. This may have also informed



the reduced (14.1 %) and total lack (21.2 %) of interest in sexual activity as shown by few. Misinformation, underreporting and uncertainty give rise to mass hysteria and mistrust (Banarjee, 2020). Averagely, 56.0 % were optimistic about the situation. This is good as once a large proportion of the population becomes anxious and paranoid, stress, rumours, panic buying and exhaustion of available resources ensue.

Close to half (42.6 %) of the respondents took herbal mixtures, antibiotics, vitamins and immune boosters, aspirin and fruits as preventive measures against COVID-19. Self - isolation, social distancing and the wild misconceptions about the disease might have contributed to the mental health and psyche of the respondents (Olaseni et al., 2020). This indicates that despite possessing significant knowledge about COVID-19, veterinarians are still largely influenced by media misinformation and misconception, rumours, superstitions and religious beliefs.

Majority of the respondents adhered to different precautionary measures including good handwashing hygiene, wearing of face masks and maintaining social distancing. This is similar to the report recorded from an Indian population in response to the COVID-19 pandemic (Roy et al., 2020). However, for this study, the overall attitude was categorised as being poor towards the pandemic (65.4 %). Up to 66.5 % of the respondents reported leaving the house about 2 - 5 times a week or every day during the lockdown. Majority of the respondents did not view visiting human clinics (90.8 %), religious places (89.4 %), home visits/ambulatory (84.2 %) and farms (72.3 %) as a risk. This finding is consistent with the strict religious beliefs, culture and tradition among Nigerians which foster increasing carefree and lackadaisical attitudes of the populace (Reuben et al., 2020). The involvement of religious leaders in the fight against COVID-19 pandemic may aid in the dissemination of correct information about COVID-19 to their followers.

We further investigated the determinants for a good attitude towards the pandemic and infection control among veterinarians in Nigeria. We report that respondents aged  $\geq 60$  years (most had  $\geq 30$  years' work experience post DVM) was about 4.5 times more likely to demonstrate good attitudes towards COVID-19 pandemic and infection control. This is because they understand that the elderly and those with underlying conditions are especially vulnerable to the virus and its severity. A study by the CDC China (2020) suggests a person's chances of dying from the disease increase with the age and showed that of the 1 023 deaths recorded, majority had been  $\geq 60$  years of age and/or had pre-existing, comorbid conditions such as hypertension, cardiovascular disease, and diabetes. Ageing comes with a myriad of psychological, social and environmental vulnerabilities. Frailty in older adults brings in the risk of opportunistic infections and decreased immunity. Besides, the elderly have multiple co-morbidities and increased hospitalizations which increase the chance of contracting the infection during a pandemic (Banarjee, 2020).

A household has been defined as spatial units, where members live in the same dwelling and share basic domestic and/or reproduction activities such as cooking and eating. Crowding is a state in which the restrictive and other physical aspects of limited space result in some psycho-physiological reactions (Asiyanbola, 2012). The odds of developing good attitudes towards COVID-19 pandemic and infection control was about twice lower among respondents with more than 10 persons per household than those with less than 5 persons as reported in this study. This is quite worrisome because such household with more members

and lower attitude towards the pandemic increases household transmission as well as community spread. Smaller households will prevent crowding, ensure food security and good physical and mental well-being as postulated by Titus and Adetokunbo (2007). This agrees with Williams et al. (2020) and Dauda et al. (2020) who reported the socio-economic implications of COVID-19 pandemic in Nigeria.

The odds of demonstrating good attitudes were about 1.7 times higher among respondents' resident in states where there was total lockdown. This is not surprising as there was a restriction in movement and people had to adhere to strict rules. Veterinarians who had received postgraduate training were about 1.6 times more likely to demonstrate good attitudes than those who only had DVM degree. This may be due to increased experience and exposure.

The major concerns raised by veterinarians about the pandemic were the impact on the economy (96.2 %). About 41.1 % believed the pandemic would have a high impact on veterinary services. Increase in unemployment, stigmatisation against COVID-19 patients and recoverees, corrupt practices at different governmental agencies, amongst others were also mentioned. Adequate awareness may minimize stigma and facilitate acceptance in the general population (Roy et al., 2020). Government's (federal, state and local) policies, implementation and funding should be transparent and regularly reported.

Many veterinarians (68.5 %) opined that the profession has not been effectively involved in government intervention plans and decisions against the pandemic. Coronaviruses are thought to be zoonotic and have been reported as far back as 2007 as agents of emerging and re-emerging infections (Wong et al., 2007). This brings to fore the importance of the animal, human and environment interface. Veterinarians and physicians have long dealt with many viral diseases in their daily routine, following parallel, but often non-convergent pathways. What can make a difference is an integrated control, particularly for those of zoonotic concern (Kahn, 2006). This should be geared towards effective management of COVID-19 by filling the gaps of communication between physicians and veterinarians to accelerate diagnosis, to expedite treatment decisions and the implementation of preventive measures at local, national and international levels.

Despite our findings, it is important to stress that this survey had some limitations. There was a relatively low response rate, which resulted in a smaller than expected sample size. This could have been caused by the short period of data collection (period of lockdown). During this pandemic, many were too busy watching the news for updates and taking care of personal affairs. This meant that only those who were active on social media had the opportunity to participate in the study.

Also, the lack of access to internet facilities and incompetence in filling online surveys incapacitated some veterinarians. The issue of response bias, which is prevalent in self-report surveys could have also influenced the results. Additionally, the measurement of KAP may be imprecise due to the limited number of items. Notwithstanding, this study is significant as it is the first survey to provide baseline information on the KAP of veterinarians in Nigeria about the ravaging COVID-19 pandemic and infection control. Further study is needed to expand upon and resolve these issues.

## Recommendations

- i. Initiation of multi-stakeholders (one health) approach to tackling community transmission, ensure coherent and appropriate risk management and communication.
- ii. Our healthcare and public health systems should be reinforced with the integration of veterinary services.
- iii. Based on relevant guidelines and research, veterinarians should take strict personal protection measures and avoid or minimize operations that may produce droplets or aerosols.
- iv. It is crucial to encourage veterinarians to do their usual work and rest schedule as much as possible to mitigate anguish and fear.

## 6. Conclusions

Veterinarians in Nigeria are aware of COVID-19 symptoms, mode of transmission and infection control. However, many had limited comprehension of the extra precautionary measures that protect their staff and other clients from COVID-19. Guidelines released by WHO and NCDC should be sent by the VCN and NVMA to all registered veterinarians during a crisis such as this. Policy and education should be implemented to convey the importance of possible exposure to virus. This will ensure that veterinarians are well informed about the best practices recommended for disease management approaches. It will also help when planning for effective risk communication.

## Data availability

The datasets used to support the findings of this study are available from the corresponding author upon request.

## Authors' contributions

OTA conceptualised the project, OTA and OOA wrote the manuscript, OTA, OOA, AAO and NOB designed the questionnaire, OTA, OOA, AAO, NOB and OEF collected the data, OOA, HKA, NOB and POA did the statistical analysis, AKA revised the manuscript critically for important intellectual content. All authors read and approved the final version of the manuscript.

## Conflict of interest

All authors declare no conflict of interest.

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