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Serological Evidence of Canine Rabies and Dog Owners' Response about the Disease in Selected Veterinary Clinics within Jos Metropolis, Nigeria

Konzing, L.[1*]; Kwaga, J.K.P.[2]; Nok-Kia, G.B.[2]; Kazeem.H.M.[3]

[1]Diagnostic Services Department, National Veterinary Research Institute, Vom, Plateau State, Nigeria.
[2]Department Of Veterinary Public Health and Preventive Medcine, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria, Nigeria.[3]Department Of Microbiology, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria, Nigeria*Corresponding author: Email: levivet@yahoo.com; Mobile: +234 8039737919

SUMMARY

Canine rabies is endemic in Nigeria as evident by several reports, however, it is a vaccine preven table disease in both animals and man. Dog owners' knowledge, attitude and practice (KAP) tow ard rabies is instrumental to a successful rabies prevention and control measures against transmis sion. This study determined the prevalence of rabies antibodies in owned dogs and assessed KAP of dog owners toward rabies in Jos Metropolis, Nigeria in a cross sectional study conducted betw een January, 2019 and March, 2019. Sera from 100 dog blood samples were collected but only 9 2 samples were subjected to Enzyme Linked Immunosorbent Assay (ELISA) using Rabies Virus IgG Ab (DEMEDITEC Diagnostics GmbH, Lise-Meitner Strase 2, 24145 Kiel, Germany). Zoogr aphic data obtained showed 61 (66.3%) dogs sampled were female, the dogs were kept majorly f or security (n=54) and breeding (n=28). Vaccination records revealed that 13 (14.1%) of the dog s were not vaccinated against rabies. Analysis revealed good KAP scores of the dog owners at 75 %, 95% and 95%, respectively. There was a statistically significant association between qualifica tion (no formal education) and categorised attitude scores (P = 0.003) also between no formal ed ucation and categorised practice scores (P = 0.026). In conclusion, majority (93.5%) of the dogs t ested had rabies antibodies which may indicate previous vaccination. Although dog owners KAP were good, majority (62%) were ignorant that rabies has no cure. Public health awareness on the dangers of rabies and annual dog anti-rabies vaccination toward elimination of dog-mediated human rabies, still needs to be intensified and sustained.

Keywords: Dog, Jos Metropolis, Rabies Antibodies

INTRODUCTION

Rabies is a fatal viral zoonotic disease which accounts for the death of over 59,000 people in the world every year, 55% of which occurs in Africa and Asia (WHO, 2010; WHO, 2018). Published studies have indicated occurrence of rabies in some vaccinated dogs (Oboegbulem *et al.,* 1987; Adedeji *et al.,* 2010). Vaccination against the rabies virus is the best proven effective method for preventing rabies in humans and animals (WHO, 2013). The WHO stipulates a minimum of 0.5 IU/ml serum level of rabies antibodies titre for conferment of immunity against rabies (WHO, 2005, 2013, 2018). It is also possible for humans to be infected with the rabies virus through the contamination of bruised skin, open wounds, conjunctiva, oral mucous membrane or genitalia with the saliva of a rabid animal and organ transplant (Konzing *et al.,* 2015; Zhang *et al.,* 2018).

Some developing countries including Nigeria are considered as risk areas for rabies exposure (WHO, 2010). The vaccination status of the suspected dog alone should not be taken as a major factor for considering whether to initiate post-exposure prophylaxis or not, as human deaths have resulted even from bites of dogs reported to have been certified vaccinated against rabies (WHO, 2018). Dog bite cases have been reported in some states in Nigeria, including Plateau State and the bite cases have been on the increase based on published studies (Bata *et al.,* 2011; Garba *et al.,* 2014; Konzing *et al.,* 2019; Ikye-Tor *et al.,* 2020; Okeme *et al.,* 2020;), hence, the need to investigate rabies antibodies in owned dogs became necessary. In the last two decades, research on rabies and associated problems, revealed that only about 10% of dog population in Nigeria ever received anti-rabies vaccination (Ogunkoya *et al.,* 2014). The absence of active antibody titre monitoring and surveillance system makes it difficult to state categorically the level of vaccination of dogs against rabies in Nigeria (Kolawole *et al.,* 2018).

Knowledge, attitude and practice in combination govern all aspects of life in human societies and the three components together make up a smooth system of life (Badran, 1995). Therefore, assessment of knowledge, attitude and practice of dog owners toward rabies have proven to be useful in the institution of preventive and control measures against rabies transmission (Opaleye, 2006; Ntampaka *et al.,* 2019).
Recently, the World Health Organization (WHO), the World Organization for Animal Health (OIE), the Food and Agriculture Organization of the United Nations (FAO) and the Global Alliance for Rabies Control (GARC) revealed plans for embarking on public health awareness on rabies and mass vaccination of dogs against rabies to end human deaths from dog-transmitted rabies by 2030 (WHO, 2017). This study was undertaken to determine the presence of rabies antibodies in some owned dogs and the knowledge, attitude and practice of the dog owners about rabies in Jos Metropolis Plateau State. The findings of this study will serve as additional information in the understanding of the dangers of rabies and the need to vaccinate dogs regularly among dog owners in Plateau State and Nigeria at large for efficient policy targeting rabies control.

MATERIALS AND METHODS

Study design

A cross-sectional study was undertaken for the detection of rabies antibodies to vaccination in some owned dogs and to determine the knowledge, attitude and

practice of the owners in selected veterinary clinics within Jos metropolis, Plateau State.

Study population

Blood samples were collected from 100 dogs whose owners consented to participate in the study between January, 2019 and March, 2019. For each dog owner a questionnaire was administered to assess their Knowledge, Attitude and Practice (KAP) toward rabies.

Knowledge, Attitude and Practice (KAP) of dog owners to rabies

Before the collection of blood sample from each dog whose owners participate in the study, a structured questionnaire was administered to assess respondents' KAP toward rabies. The questionnaire was validated by pretesting on 20 respondents before administration to the dog owners, but the 20 pretested questionnaires were not included in the final study.

The questionnaire had 31 items within five (5) sections, namely;

Demographic information of the respondents consisting of 6 items, Zoographic information of the sampled dogs had 8 items, Knowledge about rabies consisting of 10 items, which included questions about the virus, anti-rabies vaccination schedules, mode of transmission, clinical signs/symptoms, prevention and control, Attitude of the respondents toward rabies consisting of 4 items, Questions on practice consisting of 3 items.

A marking scheme was prepared and used to mark the responses and scores allocated. The choice type answers were "Yes'', "No'', ''don't know", and the responses were marked and scores allocated. Each correct answer was allocated one point and an incorrect answer was allocated zero point. The questionnaires were administered by the researcher in either Hausa or English languages to 100 dog owners who consented to the study.

Sample collection

One hundred dog sera were collected within Jos metropolis from 5 selected Veterinary cli nics based on location, accessibility and con sent namely; A, B, C, D and E. The dogs we re properly restrained; the site of blood colle ction (cephalic vein) was properly disinfecte d with cotton wool soaked in 7.1% chlorhexi dine (ACI Limited, Bangladesh). With the aid of sterile needle and syringe (21 G x 1, 5 ml syringe), 3 ml of blood was collected from each dog into plain labeled sample bottle without anticoagulant and allowed to clot for about 4 to 5 hours by placing the bottles in a rack on the bench (Kolawole *et al.,* 2018). The sera were gently decanted into screw capped bottles and stored at -20°C until they were processed in the laboratory (Olugasa *et al.,* 2011; Kolawole *et al.,* 2018).

Laboratory analysis of dog sera

The preserved sera were analysed at the Nati onal Veterinary Research Institute (NVRI), Vom using Rabies Virus IgG Ab (Dog) Enz yme Linked Immunosorbent Assay (ELISA) (DEMEDITEC Diagnostics GmbH, Lise-Meitner-Strase 2, 24145 Kiel, Germany). The test was based on the reaction of semi purified-virus with polyclonal dog antibodies, to this end the purified rabies antigen was pre-coated to a 96-well plate. Washing solution was used to wash the strips according to the manufacturer's protocol, the washing solution provided was diluted 200x in aqua bidest (5 MΩ water). The negative and positive controls were reconstituted directly before use in 1.0mL and 0.5mL aqua bidest (5 MΩ water) respectively, divided into aliquots, and stored immediately in the freezer at a temperature of -20°C before use. All the protocols were carried out according to the manufacturer's guidelines and the optical

density (OD) values were obtained from an ELISA Reader (Thermo Scientific Multiskan Ex).

Validation of the ELISA test (Qualitative)

The mean (MV) of the measured optical density (OD) value for the positive control (PC) must be ≥ 1.00 (1.604)

The MV of the measured OD value for the negative control (NC) must be ≤ 0.40 (0.194)

The sample/positive (S/P) ratio of sample OD to mean OD of the positive control was calculated according to the following equation:

$$S/P = \frac{\text{OD sample} - \text{MV OD}_{NC}}{\text{MV OD}_{PC} - \text{MV OD}_{NC}}$$

The results were expressed as sample/positive (S/P) ratio, that is ratio ≥0.34 to ≥ 2.00 were positive and ratio at < 0.34 were negative that is specific antibodies to rabies could not be detected (Table II).

Data analyses

Statistical package for social sciences (SPSS) version 20 (standard version SPSS Inc., Chicago, IL, USA) was used to analyse data from the questionnaires for KAP. Demographic variables, zoographic variables and responses to the questions were expressed as frequencies. Bivariate analysis was used to assess the associations between demographic variables, zoographic variables and categorized knowledge, attitude and practice scores and serological test. Odds ratio (OR) and 95% confidence levels on the OR were calculated. Chi square (χ^2) analysis was used to check for associations between categorical variables and *P*-value of < 0.05 was adopted as the level of significance. The prevalence of rabies antibodies detected was analysed and tested for association with the profile of the sampled dog.

Ethical Approval

Approval number: ABUCAUC/2020/57 was obtained from the Directorate of Academic Planning and Monitoring, Ahmadu Bello University, Zaria, Nigeria.

RESULTS

Detection of Rabies Antibodies in Sera of Owned Dogs in Jos Metropolis, Plateau State

Thirty one (33.7%) were male dogs while 61 (66.3%) were female dogs, 44 (47.3%) were between the ages of 1-5 years and majority of the dogs 54 (58.7%) were kept for the purpose of security (Table I).

TABLE I: Distribution of zoographic variables of sampled dogs for rabies antibodies detection in Jos metropolis, Plateau State, Nigeria (n = 92)

Variables	Frequency (%)
Breed	
Local dog	21(22.8)
German shepherd	10(10.9)
Rottweiler	10(10.9)
Caucasian	37(40.2)
Others	14(15.2)
Sex	
Male	31(33.7)
Female	61(66.3)
Age group	
<1	1(1.1)
1-5	15(16.3)
6-10	44(47.8)
>10	32(34.8)
Reason for keeping	
Hunting	1(1.1)
Security	54(58.7)
Breeding	28(30.4)
Pet	9(9.8)
Source of dog	
Imported	7(7.6)
Gift	12(13.0)
Breeder	54(58.7)
Dog market	19(20.7)
Vaccination	
Yes	79(85.9)
No	13(14.1)
Date of vaccination	
1 month – 1 year	63(68.5)
2 years	11(12.0)
3 years	5(5.4)
None	13(14.1)
Source of anti-rabies vaccine	

Sixty-three (68.5%) dogs were vaccinated less than 1 year ago prior to the commencement of the study, 43 (46.7%) of the dogs received foreign anti-rabies vaccine, 36 (39.1%) were vaccinated with locally produced anti-rabies vaccine and 13 (14.1%) had no vaccination history (Table I).

The assay results obtained showed that out of 92 dogs sera assayed, 86 (93.48%) tested positive for rabies antibodies and 6 (6.52%) tested negative for rabies antibodies.

Thirty-four (36.96%) of the dogs were positive for rabies antibodies at (S/P ratio) of ≥ 2.00, 37 (40.22%) dogs were positive for rabies antibodies at S/P ratio of ≥ 1.00,

15 (16.30%) dogs had rabies antibodies at S/P ratio of < 1.00 while 6 (6.50%) dogs were negative for rabies antibodies that is the S/P ratio was < 0.34 (Table II).

Seventy-nine (85.90%) dogs were vaccinated against rabies but 4 of the vaccinated dogs tested negative for rabies antibodies. It was also indicated that 13 (14.10%) dogs were not vaccinated against rabies as reported by the dog owners, but 11 of the unvaccinated dogs tested positive for rabies antibodies (Table III).

Among the dog breeds, the Caucasian had the highest number (34) of dogs that were positive for rabies antibodies and 63 dogs were certified to have been vaccinated between 1 month and 1 year ago at the time of sample collection (Table III).

TABLE II: Qualitative ELISA for anti-rabies antibodies detection in dog sera samples in Jos metr-opolis, Plateau State, Nigeria (n = 92)

Sample/Positive (SP) ratio	Frequency (%)	Result
≥ 2.00	34 (36.96)	Positive
≥ 1.00	37 (40.22)	Positive
< 1.00	15 (16.30)	Positive
< 0.34	6 (6.5)	Negative

Demographic Variables of the Dog Owners

Prior to blood sample collection, dog owners were administered questionnaires; Clinic A had the highest number of respondents 27 (29.3%) followed closely by Clinic B 25 (27.2%) (Table IV).

Majority of the respondents (70.7%) who participated in the study were male and 29.3% of the respondents were female, 65.2% of the dog owners had tertiary education but 7.6% respondents had no formal education (Table IV). Occupationally, majority of the respondents (27.2%) were civil servants, which was followed by businessmen/women respondents (22.8%) (Table IV).

TABLE III: Association between zoographic variables and rabies antibodies status in Jos Metropolis, Plateau State, Nigeria (n = 92)

Variables	Positive (%)	Negative (%)	Total	χ^2	p-values
Breed				1.633	0.803
Local dog	20(23.3)	1(16.7)	21		
German shepherd	9(10.5)	1(16.7)	10		
Rottweiler	9(10.5)	1(16.7)	10		
Caucasian	34(39.5)	3(50.5)	37		
Others	14(16.3)	0	14		
Sex					0.660
Male	30(34.9)	1(16.7)	31		
Female	56(65.1)	5(83.3)	61		

Age group				2.228	0.577
<1	31(36.0)	1(16.7)	32		
1-5	40(462.5)	4(66.7)	44		
6-10	14(16.3)	1(16.7)	15		
>10	1(1.2)	0	1		
Reason for keeping dog				2.054	0.832
Hunting	1(1.2)	0	1		
Security	49(57.0)	5(83.3)	54		
Breeding	27(31.4)	1(16.7)	28		
Pet	9(9.8)	0	9		
Source of dog				0.984	0.899
Imported	7(8.1)	0	7		
Gift	12(14.0)	0	12		
Breeder	49(57.0)	5(83.3)	54		
Dog market	18(20.9)	1(16.7)	19		
Vaccinate against rabies				1.633	0.201
Yes	75(82.2)	4(66.7)	79		
No	11(12.8)	2(33.3)	13		
Date of vaccination				2.147	0.549
1month – 1 year	59(68.0)	4(66.7)	63		
2 years	11(12.8)	0	11		
3 years	5(5.4)	0	5		
None	11(12.8)	2(33.3)	13		
Source for anti-rabies				2.085	0.353
Foreign	41(47.7)	2(33.2)	43		
Locally produced	34(39.5)	2(33.2)	36		
None	11(12.8)	2(33.2)	13		

Knowledge of the Dog Owners toward Rabies in Jos Metropolis, Plateau State

Sixty-nine of the respondents (75%) affirmed that human beings can be infected with the rabies virus, 35 (38%) knew that rabies has no cure but 57 (62%) respondents were ignorant of this basic fact about rabies (Table V).

Majority of the dog owners 71 (77.2%) knew that rabies kills both animal and man. Only 50 (54.3%) respondents affirmed that all dogs should receive their first dose of anti-rabies vaccination at 3 months of age and of interest was that majority 73 (79.3%) of the dog owners affirmed that vaccination of dogs should be repeated every year (Table V).

Association between Demographic Variables and Categorised knowledge scores of the Dog Owners

None of the demographic variables was statistically significant with the categorised knowledge scores of the dog owners; however, more male respondents 52 (80%) out of 65 (100%) males had good knowledge scores than the female respondents 17 (63%) out of 27 (100) females (Table VI).

Attitude of the Dog Owners toward Rabies in Jos Metropolis, Plateau State

Eighty-nine (96.7%) respondents affirmed that they will go to the hospital for medical attention in the event of a dog bite. Eighty-seven (94.6%) of the dog owners affirmed

that keeping dogs that are not vaccinated against rabies is dangerous (Table VII). Eighty-four (91.3%) respondents said they will not allow their children to play with neighbours dog or an unknown dog (Table VII).

Association between demographic variables and categorized attitude scores of respondents

There was a statistically significant association at $p < 0.05$ between qualification (OR = 0.023, 95% CL on OR 0.002-0.270) of respondents and categorised attitude scores (Table VIII).

Practice of the Dog Owners toward Rabies in Jos Metropolis, Plateau State

Seventy-six (82.6%) of the respondents stated that washing dog bite wounds with soap and running water before going to the hospital was necessary (Table IX). Majority of the dog owners (82.6%) indicated that they do not allow their dogs to roam and mix with other dogs in order to protect them from being infected with rabies (Table IX)

Association Between Demographic Variables and Categorised Practice Scores

For the categorised practice scores, there was a statistically significant association between qualification (OR = 0.026, 95% CL on OR 0.72-3.18) of respondents and categorized practice scores. The general practice of the respondents toward rabies prevention was good as indicated in their scores (Table X).

TABLE IV: Demographic variables of dog owners in Jos metropolis, Plateau State, Nigeria (n = 92)

Variables	Frequency (%)
Location	
A	25(27.2)
B	27(29.3)
C	19(20.7)
D	8(8.7)
E	13(14.1)
Total	92
Gender	
Male	65(70.7)
Female	27(29.3)
Total	92
Qualification	
None	7(7.6)
Primary	4(4.3)
Secondary	21(22.8)
Tertiary	60(65.2)
Total	92
Occupation	
Civil servant	25(27.2)
Businessman/woman	21(22.8)
Dog breeder	17(18.5)

Student	16(18.5)
Farmer	4(4.3)
Others	9(9.8)
Total	92
Number of dogs owned	
1	29(31.5)
2	19(20.7)
3	8(8.7)
>3	36(39.1)
Total	92
Family size of dog owner	
1-5	59(64.1)
6-10	18(19.6)
>10	15(16.3)
Total	92

TABLE V: Knowledge of dog owners toward rabies in Jos Metropolis, Plateau State, Nigeria (n = 92)

Questions	**Yes (%)**	**No (%)**	**Don't know (%)**
All human beings can be infected with the rabies virus.	69(75.0)	5(5.4)	18(19.6)
Dogs can be infected through contact with a rabid dog.	69(75.0)	6(5.4)	17(18.5)
Rabies has no cure .	35(38.0)	26(28.3)	31(33.7)
Rabies kills both animal and man	71(77.2)	7(7.6)	14(15.2)
If a dog bites you without provocation, it is likely to be a rabid dog.	64(69.6)	8(8.7)	20(21.7)
Rabies can spread through the saliva of a rapid dog .	58(63.0)	9(9.8)	25(27.2)
At what age should dogs receive the first dose of rabies vaccination	At any age 15(16.3)	3 months 50(54.3)	Don't know 27(29.3)
Should vaccination of dogs against rabies be repeated every year.	73(79.3)	7(7.6)	12(13.0)
A friendly dog that suddenly turns aggressive may have rabies.	69(75.0)	6(6.5)	17(18.5)
Dog registration and licensing help in control of rabies.	76(82.6)	1(1.1)	2(2.2)

TABLE VI: Association between demographic variables and categorised knowledge scores of dog owners in Jos Metropolis, Plateau State, Nigeria (n = 92)

Variables	Good (%)	Poor (%)	Total	Odds Ratio (95% CL)	χ^2	*P*-vale
Location						
A	19(76.0)	6(24.0)	25	0.95(0.20-4.63)	0.004	0.949
B	16(59.3)	11(40.7)	27	0.44(0.20-1.96)	1.172	0.279
C	17(89.5)	2(10.5)	19	2.55(0.36-17.96)	0.882	0.347
D	7(87.5)	1(12.5)	8	2.10(0.20-24.60)	0.349	0.555
E	10(77.0)	3(23.0)	13	Ref		
Gender						
Male	52(80.0)	13(20.0)	65	2.35(0.88-6.33)	2.871	0.090
Female	17(63.0)	10(37.0)	27	Ref		
Qualification						
None	5(71.4)	2(28.6)	7	0.83(0.15-4.75)	0.042	0.837
Primary	2(50.0)	2(50.0)	4	0.33(0.04-2.58)	1.108	0.292
Secondary	17(81.0)	4(19.0)	21	1.42(0.41-4.88)	0.305	0.581
Tertiary	45(75.0)	15(25.0)	60	Ref		
Occupation						
Civil servant	23(92.0)	2(8.0)	25	3.29(0.39-27.78)	1.193	0.837
Businessman/woman	15(71.4)	6(28.6)	21	0.71(0.11-4.47)	0.129	0.719
Dog breeder	10(58.8)	7(41.2)	17	0.41(0.07-2.58)	0.907	0.341
Student	10(62.5)	6(37.5)	16	0.48(0.21-1.93)	0.605	0.423
Farmer	4(100)	0				
Others	7(77.8)	2(22.2)		Ref		
Number of dogs owned						
1	20(69.0)	9(31.0)	29	0.63(0.21-1.93)	0.641	0.423
2	13(68.4)	6(31.6)	19	0.62(0.18-2.15)	0.569	0.451
3	8(100)	0	8			
>3	28(77.8)	8(22.2)		Ref		
Family size of dog owner						
1-5	45(76.3)	14(23.7)	59	2.14(0.65-7.08)	1.564	0.211
6-10	15(83.3)	3(16.7)	18	3.33(0.66-16.74)	2.139	0.144
>10	9(60.0)	6(40.0)	15	Ref		

TABLE VII: Attitude of dog owners toward rabies in Jos Metropolis, Plateau State, Nigeria (n = 92)

Questions	Yes (%)	No (%)	Don't know (%)
If bitten by a dog, do you go to the hospital?	89(96.7)	1(1.1)	2(2.2)
Keeping dogs that are not vaccinated against rabies is dangerous.	87(94.6)	3(3.3)	2(2.2)
Do you keep your dog in the cage or under chain to prevent roaming about in the neighbourhood	81(88.0)	11(12.0)	0(0.0)
Should children be allowed to play with neighbours dog or an unknown dog.	7(7.6)	84(91.3)	1(1.1)

TABLE VIII: Association between demographic variables and categorised attitude scores of respondents in Jos Metropolis, Plateau State, Nigeria (n = 92)

Variables	Good (%)	Poor (%)	Total	Odds Ratio (95% CL)	χ^2	*P*-value
Location						
A	24(96.0)	1(4.0)	25	2.00(0.12-34.82)	0.226	0.634
B	25(92.6)	(7.4)	27	1.04(0.09-12.66)	0.001	0.974
C	18(94.7)	1(5.3)	19	1.50(0.09-26.36)	0.077	0.782
D	8(100)	0	8			
E	12(92.3)	1(7.7)	13	Ref		
Gender						
Male	61(93.8)	4(6.2)	65	0.59(0.06-5.50)	0.218	0.640
Female	26(96.3)	1(3.7)	27	Ref		
Qualification						
None	4(57.1)	3(42.9)	7	0.02(0.002-0.27)	8.975	0.003*
Primary	4(100)		4			
Secondary	20(95.2)	1(4.5)	21	0.34(0.02-3.68)	0.566	0.452
Tertiary	59(98.3)	1(1.7)	60	Ref		
Occupation						
Civil servant	24(96.0)	1(4.0)	25	Ref		
Businessman/woman	21(100.0)	0	21			
Dog breeder	15(88.2)	2(11.8)	17	0.31(0.03-3.75)	0.841	0.359
Student	15(93.8)	1(6.2)	16	0.63(0.04-10.76)	0.105	0.746
Farmer	3(75.0)	1(25.0)	4	0.125(0.01-2.56)	1.821	0.177
Others	9(100)	0	9			
Number of dogs owned						
1	26(89.7)	3(10.3)	29	1.26(0.61-2.59)	0.391	0.532
2	19(100.0)		19			
3	8(100.0)		8			
>3	34(94.4)	2(5.6)	36	Ref		
Family size of dog owner						
1-5	56(94.9)	3(5.1)	59	2.872(0.435-18.975)	1.199	0.274
6-10	18(100.0)		18			
>10	13(86.7)	2(13.3)	15	Ref		

*** *P* < 0.05**

TABLE IX: Practice of dog owners toward rabies in Jos Metropolis, Plateau State, Nigeria (n = 92)

Questions	Yes (%)	No (%)	Don't know (%)

Washing dog bite wounds with soap and running water before going to the hospital is necessary.	76(82.6)	9(9.8)	7(7.6)
Do you allow your dog to roam and mix with the other dog?	16(17.4)	76(82.6)	0(0)
Do you take your dog to the Veterinary Clinic for regular clinical examination?	82(89.1)	8(8.7)	2(2.2)

TABLE X: Association between Demographic variables and categorised practice scores of respondents in Jos Metropolis, Plateau State, Nigeria (n = 92)

Variables	**Good (%)**	**Poor (%)**	**Total**	**Odds Ratio (95% CL)**	χ^2	***P*-value**
Location						
A	24(96.0)	1(4.0)	25	1.33(0.12-11.82)	0.034	0.485
B	24(88.9)	3(11.1)	27			
C	18(94.7)	1(5.3)	19			
D	8(100.0)		8			
E	13(100.0)		13	Ref		
Gender						

Male	61(93.8)	4(6.2)	65	1.71(0.18-15.20)	0.218	0.640
Female	26(96.3)	1(3.7)	27	Ref		
Qualification						
None	5(71.4)	2(28.6)	7	0.03(0.72-3.18)	1.212	0.026*
Primary	3(75.0)	1(25.0)	4	0.10(0.01-0.75)	2.781	0.095
Secondary	21(100.0)		21			
Tertiary	58(96.7)	2(3.3)	60	Ref		
Occupation						
Civil servant	23(92.0)	2(3.3)	25	1.52(0.72-3.18)	1.212	0.271
Businessman/woman	19(90.5)	2(9.5)	21			
Dog breeder	17(100.0)		17			
Student	15(93.8)	1(6.2)	16			
Farmer	4(100.0)		4			
Others	9(100.0)		9	Ref		
Number of dogs owned						
1	27(93.1)	2(6.9)	29	Ref		
2	18(94.7)	1(5.3)	19	1.33(0.11-15.82)	0.052	0.820
3	6(75.0)	2(25.0)	8	0.22(0.03-1.91)	1.879	0.170
>3	36(100.0)		36			
Family size of dog owner						
1-5	55(93.2)	4(6.8)	59	Ref		
6-10	17(94.4)	1(5.6)	18	1.24(0.13-11.82)	0.034	0.854
>10	15(100.0)		15			

P < .05

DISCUSSION

Seventy-nine (85.9%) of the dogs sampled in this study were vaccinated against rabies, which shows that many dog owners were aware of the dangers of rabies and the value placed on their highly priced exotic dogs. However, this study could not establish whether the rabies antibodies detected had attained protective titres or not, because the assay used was qualitative and not quantitative unlike the study by (Kolawole *et al.,* 2018). Nevertheless, this gives an important information and raises important questions especially because of the 11 dogs found to be positive for rabies antibodies but had no history of vaccination. This may be due to incorrect information from the dog owners about the vaccination status of their dogs or the presence of rabies virus in apparently heathy dogs (Fekadu *et al.,* 1982). Furthermore, it could be due to previous exposure with a less virulent strain of the rabies virus a situation that may result in the distortion of accurate information of the disease in the Nigeria (Eze *et al.,* 2020).

Majority 71 (77.2%) of the dogs sampled for rabies antibodies detection were exotic breeds (German shepherd, Rottweiler and Caucasian) consistent with a previous study (Aiyedun, 2013). This may not be unexpected because the study was conducted in Jos metropolis and majority of the residents in the metropolis had preference for exotic breeds of dogs and more importantly for economic and security reasons which conforms with the studies of (Kolawole *et al.,* 2018) in Abuja, and (Visa, 2017) in Kano.

In this study, more female dogs (66.3%) were sampled than male dogs (33.7%) which also confirms fact that one of the reasons for keeping dogs by dog owners was for breeding (30.4%) and reproduction of puppies for trade. This result however is at variance with a study earlier conducted by (Olugasa *et al.,* 2011) in Ilorin, Kwara State, which stated that more male dogs were sampled than female dogs.

In most urban areas in Nigeria, dogs are usually kept for security reasons which agrees with previous studies (Visa, 2017; Al-mustapha *et al*., 2020). The results of this study found out that 58.7% of the dogs sampled were kept for security reasons and 58.7% of dogs sampled for this study were sourced from the dog breeders, this shows that the dog owners were conscious of their security and economic well-being. In this study only one (1) dog was found to be kept for hunting, this was not surprising because in the metropolis not many people go out for hunting (Visa, 2017).

Another pointer to the fact that dog owners were conscious of the risk of rabies and had a great desire to vaccinate newly purchased and highly priced dogs (puppies) was the fact that 68.5% of the dog owners affirmed that they vaccinated their dogs before they were one-year-old. This result also corroborates the study earlier done by (Aiyedun, 2013) in Ilorin, Kwara State that dog owners promptly vaccinate highly priced dogs.

Most of the dog owners in this study were clients of Clinic A and Clinic B. The reason for this could be due to proximity to locations of clinics in relation to their residence within Jos metropolis and the quality of services rendered. Majority of the dog owners (70.7%) who participated in this study were males this may be due to the interest in dogs by majority of men as reported by (Konzing *et al.,* 2015) in Plateau State and (Kolawole *et al.,* 2018) in Abuja. Thirty-six respondents in this study indicated that they had more than 3 dogs which meant that there is a high tendency that the dogs were kept for economic reasons which is in consonance with the work of (Kolawole *et al.,* 2018) in Abuja. It was observed from this study that majority (64.1%) of the dog owners had a small family size of about 5 people. This could be due to the fact that with a large family size, the financial demand of feeding the family could be high on some individuals which may not allow for keeping dogs.

Only 35 out of 92 dog owners knew that rabies has no cure, indicating that there is still a great need to educate dog owners and the public on the dangers of rabies (Kolawole *et al.,* 2018). It is quite remarkable that 73 out of 92 respondents in this study stated that vaccination of dogs should be repeated every year which shows there is a great consciousness on the need to prevent dogs from the disease as previously reported by (Edukugho, 2014) in Abuja. Another point of interest from this study is the fact that 50 out of 92 dog owners knew that 3 months is the minimum age for the

vaccination of dogs is quite remarkable and an indication that dog owners are becoming more aware of rabies prevention.

It is possible that the respondents with no formal education must have been enlightened on the dangers of rabies by veterinarians during the World Rabies Day (WRD) and non-governmental organisations (NGO) such as War Against Rabies (WAR) in recent past which reflected in their attitude and practice scores.

CONCLUSION

Dog-mediated human rabies elimination is achievable with sustained dog vaccination coverage at 70% minimum. It can be concluded that the dog owners in this study were responsible since majority (93.5%) of the dogs tested were positive for anti-rabies antibodies. The dog owners had a good knowledge of rabies, positive attitude toward rabies and good practice toward rabies prevention, although many (62%) were ignorant of the fact that rabies has no proven cure yet.

RECOMMENDATION

It is strongly recommended that dog owners should be given more enlightenment on the dangers of rabies and the need to vaccinate dogs against rabies every year by the veterinary and health professionals at local and state levels through the mass media and workshops among others.

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