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ORIGINAL RESEARCH ARTICLE

Prevalence of Leptospira IgG Antibodies Among Dog Handlers in Jos South and Kanke Local Government Areas, Plateau State, Nigeria

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ABSTRACT

Leptospirosis is a zoonotic disease with a worldwide occurrence cause by the bacterial spirochete Leptospira. Many wild and domestic animals, including dogs, shed Leptospira in their urine and serve as sources of human infection, either directly or indirectly. The study aimed to investigate anti-Leptospira IgG antibodies among dog handlers. Blood samples were collected (in September to November, 2018) from 143 participants into plain EDTA bottles, sera were separated by centrifugation and harvested into cryovials using a sterile pipette. Demographic data for the research subjects were collected using a structured questionnaire. The detection of anti-Leptospira IgG antibodies was achieved using Diagnostic Automation Inc. (DAI) ELISA Kit USA, with 100/100 reported sensitivity/specificity. The study found prevalences of 47.8% (95% CI: 37.5–58.1) in Jos South and 54.7% (95% CI: 41.4–68.0) in Kanke LGAs. None of the sociodemographic factors were significantly associated with Leptospira IgG seropositivity on univariate analysis; however, after adjusting for confounders, occupation showed a significant association with Leptospira antibodies in the multivariable logistic regression model (p = 0.021 overall). Seropositivity to Leptospira antibodies appeared higher among veterinary practitioners (72.7%) at 95% CI (53.0–92.0) than other dog handlers, but not statistically significant (p=0.070). Additional methods, such as the microscopic agglutination test (MAT), IgM ELISA (for paired sera samples), and PCR, are needed to establish active Leptospira infection. Further studies that consider both dogs and their handlers are recommended to definitively establish the role of dogs in such a high prevalence.

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Leptospira, IgG antibodies, dog handlers, Jos South, Kanke

INTRODUCTION

Leptospirosis is a zoonotic disease with a global distribution (Sohm et al., 2023). However, tropical and subtropical conditions that favor the survival of the causative bacterium (de Vries et al., 2014) make the disease more common in tropical and subtropical climates (Espinosa et al., 2025), such as Nigeria. The disease is caused by spirochetes of the genus Leptospira (Majawa et al., 2023), with more than 250 pathogenic serovars (Kikoti et al., 2024), infecting most domestic animals, including dogs (Ohore et al., 2024), which serve as a source of human infection (Ukhovskyi et al., 2023).

The route of infection in man is mainly by direct contact with the urine of animals shedding the bacteria, or indirectly by exposure to Leptospira-contaminated soil or water (Ricardo et al., 2024). Broken skin (Esfandiari et al., 2015) as well as mucosal and conjunctival injuries serve as suitable portals of entry into the human host (Selim et al., 2024). Varying factors affect the disease dynamic in rural and urban settings; rainfall, close contact with animals, and farming favors transmission of *Leptospira* in rural areas (Gizamba and Mugisha, 2023), on the other hand, rodent infestation, poor hygiene, and overcrowding are the drivers of leptospirosis in urban slumps in developing countries (Gizamba and Mugisha, 2023; Besong et al., 2022).

Leptospirosis in man ranges from asymptomatic or undifferentiated fever to a severe condition associated with high morbidity and mortality (de Vries et al, 2014). Complications may involve multiple organs, such as the liver, kidneys, lungs, and central nervous system, due to the multiorgan tropism of *Leptospira* (Shukla et al., 2022). In mild cases, it presents overlapping symptoms with

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other endemic febrile illnesses such as malaria and typhoid, making diagnosis on clinical grounds alone difficult (de Vries et al., 2014; Majawa et al., 2023). The global annual incidence is estimated at 14.8 cases per 100,000 population, with approximately 1.1 million cases and 60,000 deaths annually (Gizamba and Mugisha, 2023).

Highly endemic regions for human leptospirosis include the Caribbean and Latin America, India, Southeast Asia, Oceania, and sub-Saharan Africa (Gizamba and Mugisha, 2023). As occupational hazards, farmers, sewer workers, livestock keepers, abattoir workers, veterinarians, and fishermen constitute major risk groups for leptospirosis (Kikoti et al., 2024). Reports have shown that the disease (leptospirosis) is endemic in dogs in Nigeria (Ohore et al., 2014), and the close relationship between humans and these companion animals results in a greater risk of zoonotic transmission (Azócar-Aedo et al., 2022). Despite the importance of dogs as agents of Leptospira transmission to humans, there is a paucity of information on leptospirosis in dogs and their handlers. This study aimed to investigate *Leptospira* IgG antibodies in dog handlers in Jos South and Kanke LGAs of Plateau State, Nigeria.

METHODOLOGY

Study Area

The study was conducted in Jos South and Kanke Local Government Areas (LGAs) of Plateau State, Nigeria (Figure 1). November to February and March to April constitute the coldest and warmest periods, respectively, in Jos South, with a mean annual rainfall ranging from 1347.5 to 1460 mm. The famous National Veterinary Research Institute (NVRI), Vom, ECWA Veterinary Clinic, and Kasuwan Kare, all located in Jos South, are suitable for recruiting dog handlers. Kanke LGA occupies a total area of 926 square kilometres and has an average temperature of 29^{0}C. The average humidity level is 59 percent in Kanke, and the LGA is home to the popular Dawaki market, well known for the buying and selling of dogs.

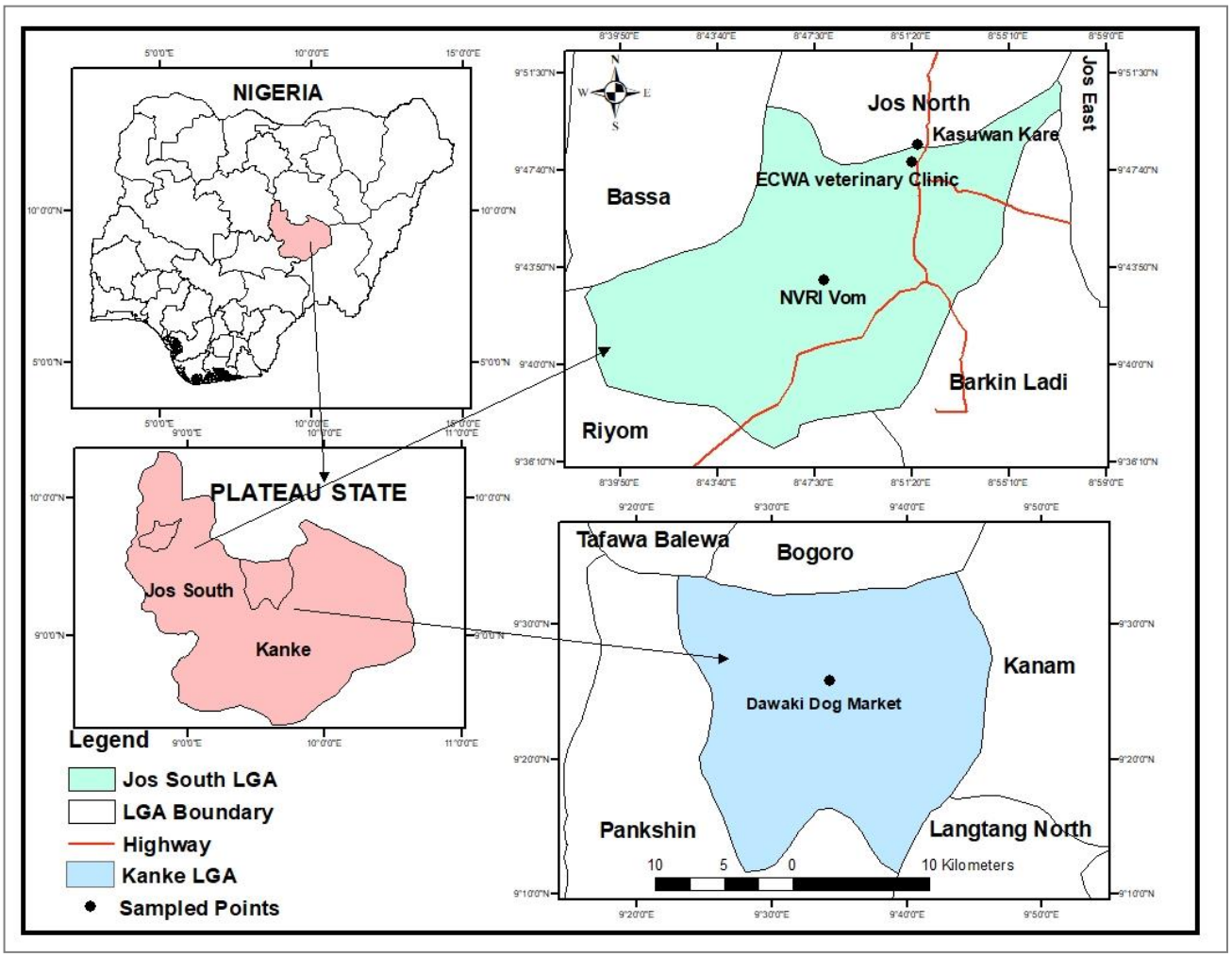

Figure 1: The map of Plateau State highlighting the study area and sampling point.

Study Design

The study is community-based and cross-sectional by design. It involves collecting serum samples from dog handlers to detect anti-Leptospira IgG antibodies.

Study Population

The target population of the study comprises dog handlers, including veterinary practitioners, dog sellers/buyers, dog meat sellers, and dog breeders. The motivation for choosing this population is the nature of

their work, which exposes them to this infectious bacterium through contact with dogs or their secretions, such as urine and blood, while doing their job.

Ethical approval

Approval of the study was obtained from the Plateau State Ministry of Health with approval number MOH/MIS/202/VOL.T/X. Consent was obtained from the dog handlers prior to sample collection.

Inclusion and Exclusion Criteria

The study considered dog handlers in Jos South and Kanke L.G.A.s who consented to participate in the research. Persons not involved in the handling of dogs in Jos South or Kanke LGAs were excluded from the study. Additionally, all individuals who failed to provide consent were excluded from the study.

Sample Size Determination

The formula $N=Z^{2*}(pq)/d^2$ (Araoye, 2003) and local prevalence of 89.7% (Abiayi et al., 2015) were used to arrive at a minimum sample size of 142 as follows;

Where:

N = minimum sample size

Z = standard error at 95% confidence limit (1.96)

p = local prevalence (89.7% = 0.897, Abiayi et al., 2015).

q = 1.0-p = 1.0-0.897 = 0.103

d =degree of accuracy (5%) = 0.05

Therefore,

$N = (1.96)^2 (0.897 * 0.103)/0.05^2$

$=3.8416*0.0924/0.0025$

$=0.3550/0.0025$

$N = 142$

Sample Collection and Technique

Consecutive convenience sampling was used to collect blood samples from a total of 143 individuals in a non-biased manner; the samples were collected as consenting individuals presented themselves. The samples collected were 90 from Jos South and 53 from Kanke LGAs, respectively. Five (5ml) of blood samples were collected using a sterile syringe and needle. The blood was dispensed into plain tube containers, tightly screwed, and transported to the microbiology unit of the Central Diagnostic Laboratory Division, NVRI Vom under cold conditions. The serum was separated from the whole blood by centrifugation at 2000rpm for 5 minutes; the serums were harvested with the aid of a pipette and dispensed into sterile cryovials (tubes) and kept at -20 °C until the time of used

Detection of Leptospira IgG Antibodies

The DAI ELISA USA cat # 8208-35 with 100/100 sensitivity/specificity (as reported by the manufacturer) was used to detect anti-Leptospira IgG antibodies from sera samples as previously described (Abiayi et al., 2015). Briefly, sera and reagents were allowed to reach 15-25 °C. Thereafter, 1 in 40 dilutions of the samples were prepared by adding 10 µL of sera to 390 µL of dilution buffer, for a total volume of 400 µL. Using a sterile pipette, 100 µL of each positive and negative control was dispensed into the first and second wells of the microtiter plate, respectively. To the remaining wells of the plate, 100 µL of the test sera were added, and the plate was incubated at room temperature for 10 minutes. The plate contents were discarded, and the wells were washed 3 times with wash buffer. Two drops of enzyme conjugate were added to each well, followed by 10 minutes of incubation at room temperature. The plate was rewashed 3 times and slapped against a paper towel to ensure complete removal of all liquid from the wells. Two drops of chromogen were added to all wells, and the plate was incubated for 5 minutes. Thereafter, 2 drops of stop solution were added to each well, and the contents were mixed by tapping the strip holder. The plate was read within one hour at 450 and 620-650 nm wavelengths. OD > 1.0 is considered a positive reaction for anti-Leptospira IgG antibodies; OD < 0.3 is considered negative.

RESULT

The study recruited a total of 143 subjects; 90 (62.9%) from Jos South and 53 (37.1%) from Kanke LGA. The population of males and females was 70 (40.6%) and 73 (59.4%), respectively. The distribution of dog handlers includes 22 (15.4%) Veterinary practitioners, 11 (7.7%) Dog breeders, 88 (61.5%) Dog sellers, and 22 (15.4%) Dog meat sellers. 15 (10.5%) of the participants had no formal education, 48 (33.6%) had primary education, 41 (28.7%) had Secondary education, and 39 (27.3%) had tertiary education. 126 (88.1%) of the population are married, with 17 (11.9%) single participants. A total of 72(50.3%) out of the 143 subjects were positive for Leptospira IgG antibodies.

None of the sociodemographic characteristics of the study subjects was significantly associated with Leptospira IgG antibodies (all $p > 0.05$) (Table 1). Across the LGAs, seropositivity was slightly higher in participants from Kanke (54.7%) than in those from Jos South (47.8%), though the difference was not statistically significant ($p = 0.423$). Highest prevalence was observed among individuals aged 40–49 years (63.4%), followed by those aged 50–59 years (52.4%) and 20–29 years (53.8%); however, the differences were not significant ($p = 0.251$). The gender distribution of seropositivity was nearly identical in males (50.0%) and females (50.7%), with no significant association ($p = 0.945$). The marital status of the participants showed no significant association with the prevalence of Leptospira IgG, with single (52.9%) and married (50.0%) demonstrating comparable rates ($p = 0.820$). Educational level of participants demonstrated a modestly varied prevalence; the least and highest positivity

was observed among those with secondary education (43.9%) and no formal education (60.0%), respectively, yet these differences were not statistically significant (p = 0.698).

Table 2 demonstrated the distribution of *Leptospira* IgG antibodies among the different categories of dog handlers with no significant association (p = 0.070). Positivity of Leptospira IgG antibodies, in descending order, includes veterinary practitioners (72.7%), dog breeders (63.6%), dog meat sellers (50.0%), and dog sellers (43.2%).

Table 3 presents a multivariable logistic regression model fitted to examine factors associated with Leptospira IgG ELISA positivity, adjusted for potential confounders (age, sex, occupation, and LGA). The overall model was not statistically significant (χ^2 (5) = 9.34, p = 0.096) and explained approximately 8.4% of the variance in Leptospira IgG status (Nagelkerke R^2 = 0.084). The Hosmer–Lemeshow goodness-of-fit test indicated adequate model fit (p = 0.851). After adjusting for age, sex, and LGA, occupation showed a significant overall effect (p = 0.021). Compared with participants engaged in business, civil servants had lower odds of being IgG ELISA positive (adjusted OR = 0.14; 95% CI = 0.01–1.32; p = 0.085), while those in other occupations (veterinary practitioners and students) were not significantly different (OR = 0.49; 95% CI = 0.05–5.21; p = 0.558). Age (OR = 1.00; 95% CI = 0.97–1.03; p = 0.906), gender (OR = 0.77; 95% CI = 0.35–1.68; p = 0.503), and LGA (OR = 0.53; 95% CI = 0.25–1.14; p = 0.104) were not significantly associated with IgG positivity.

Table 1: Prevalence of *Leptospira* IgG antibodies in relation to the sociodemographic characteristics of the study subjects.

Variable	Category	Positive (n/N)	Prevalence (%)	95% CI	p-value*
LGA	Jos South	43/90	47.8	37.5–58.1	**0.423**
	Kanke	29/53	54.7	41.4–68.0	
Age (years)	20–29	14/26	53.8	34.6–73.0	**0.251**
	30–39	19/49	38.8	25.3–52.3	
	40–49	26/41	63.4	48.7–78.1	
	50–59	11/21	52.4	31.0–73.8	
	60–69	1/4	25.0	0.6–80.6	
	≥70	1/2	50.0	1.3–98.7	
Gender	Male	35/70	50.0	38.0–62.0	**0.945**
	Female	37/73	50.7	38.7–62.7	
Marital Status	Single	9/17	52.9	28.5–77.3	**0.820**
	Married	63/126	50.0	41.4–58.6	
Education	None	9/15	60.0	35.0–85.0	**0.698**
	Primary	24/48	50.0	35.9–64.1	
	Secondary	18/41	43.9	28.7–59.1	
	Tertiary	21/39	53.8	37.2–70.4	

Table 2: Prevalence of *Leptospira* IgG antibodies in relation to the method of handling dogs

Method of handling dogs	Positive (n/N)	Prevalence (%)	95% CI	p-value*
Veterinary practitioners	16/22	72.7	53.0–92.0	0.070
Dog breeder	7/11	63.6	36.0–91.0	
Dog seller	38/88	43.2	32.0–54.0	
Dog meat seller	11/22	50.0	26.0–69.0	
Total / Overall	**72/143**	**50.3**	—	—

Table 3: Multivariable Logistic Regression Analysis of Factors Associated with IgG ELISA Positivity

Variable	β (Beta)	SE	Wald	df	p-value	Adjusted OR (Exp(β))	95% CI for OR
Age	0.002	0.016	0.014	1	0.906	1.002	0.971 – 1.033
Gender (Male vs Female)	−0.268	0.400	0.448	1	0.503	0.765	0.349 – 1.676
LGA (Jos South vs Kanke)	−0.637	0.392	2.638	1	0.104	0.529	0.245 – 1.141
Occupation (overall)	—	—	7.723	2	**0.021***	—	—
Civil Servant vs Others (Vet & Stud)	−2.003	1.162	2.971	1	0.085	0.135	0.014 – 1.316
Business vs Others (Vet & Stud)	−0.705	1.202	0.344	1	0.558	0.494	0.047 – 5.211
Constant	2.172	1.345	2.606	1	0.106	8.776	—

Model diagnostics:

- Omnibus test of model coefficients: χ^2 = 9.335, df = 5, p = *0.096*
- Hosmer–Lemeshow goodness-of-fit: χ^2 = 4.067, df = 8, p = *0.851*
- Cox & Snell R^2 = 0.063; Nagelkerke R^2 = 0.084
- Model classification accuracy: 60.1 %

*Overall (block) p-value for the variable Occupation (df = 2, Wald χ^2 = 7.723, p = 0.021).

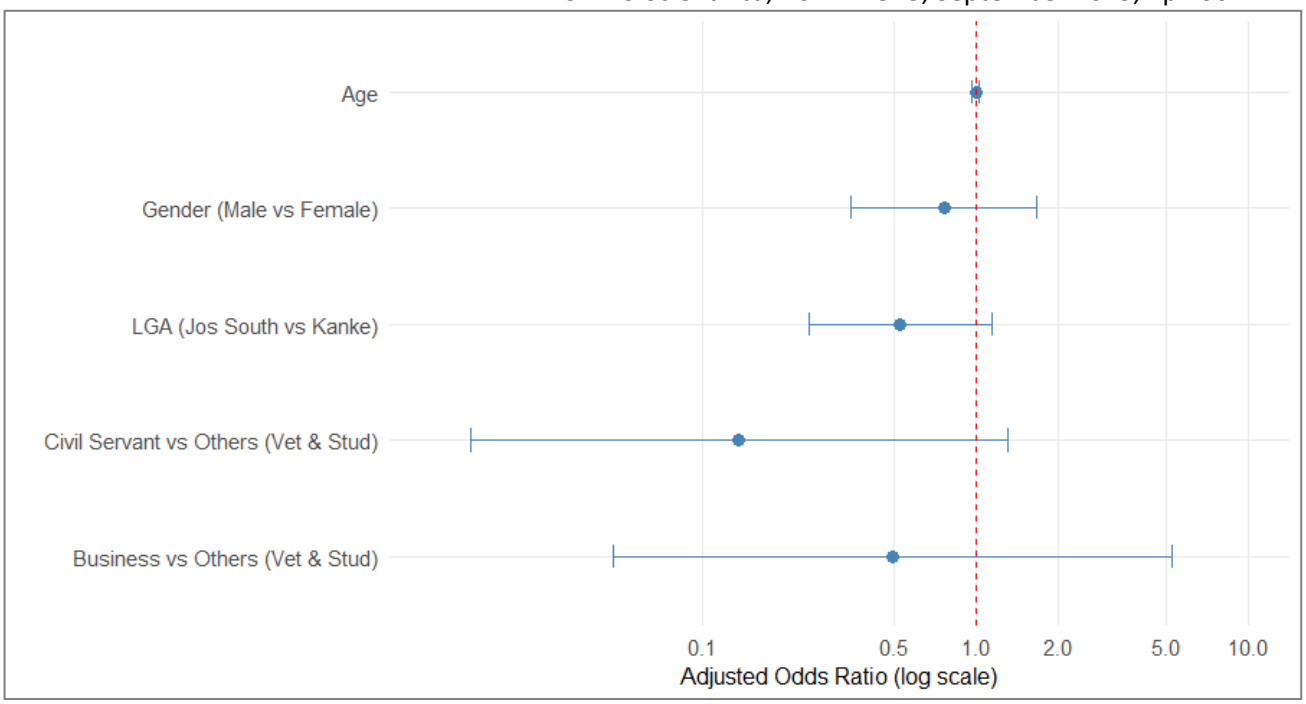

Figure 2: Forest plot displaying adjusted odds ratios (AORs) and 95% confidence intervals from the multivariable logistic regression model assessing factors associated with IgG ELISA positivity.

The forest plot visually presents the adjusted odds ratios (AORs) from the multivariable logistic regression model evaluating factors associated with Leptospira IgG ELISA positivity (Figure 2). After adjusting for age, sex, occupation, and LGA, occupation was the only factor associated with the outcome (overall p = 0.021). Civil servants had lower odds of being Leptospira IgG positive compared to other respondents (AOR = 0.14; 95% CI: 0.01–1.32), though the confidence interval included 1, indicating no statistical significance at $p < 0.05$. Age (AOR = 1.00; 95% CI: 0.97–1.03), gender (AOR = 0.77; 95% CI: 0.35–1.68), and LGA (AOR = 0.53; 95% CI: 0.25–1.14) were not significantly associated with IgG positivity. Confidence intervals crossing the reference line (OR = 1) indicate non-significant predictors.

DISCUSSION

Domestic dogs (Canis lupus familiaris) are usually considered a reservoir host for Leptospira (Ricardo et al., 2024), but specific serovars can establish infection (Ohore et al., 2024) associated with severe disease (Ricardo et al., 2024). Poor hygiene, accompanied by unrestricted movement of dogs scavenging for litter or sniffing and licking Leptospira-contaminated urine from other animals shedding the organism, increases the exposure of these companion animals (Ricardo et al., 2024), which serve as sources of human infection.

The prevalence (50.3%) established in the present study suggests that more than half of the population tested positive to anti-Leptospira IgG antibodies. This confirms that Leptospira is endemic among dog handlers, which could partly be explained by the close association of the population with dogs, as observed in Nigeria over the past decade (Ajayi et al., 2017). This prevalence is lower than earlier reports (Awosanya et al., 2013; Abiayi et al., 2015) from North-Central Nigeria, where work has been done among kennel and abattoir workers. On the other hand, patients presumed to have malaria in Oyo State, Nigeria (Besong et al., 2022) demonstrated a much lower prevalence (8.4%) of Leptospira antibodies than the present study. A possible explanation for the observed differences could be the exposure pattern of abattoir workers (high risk) and variation in the population, particularly in the study on kennel workers, which recruited symptomatic individuals, resulting in a higher prevalence than in the present study.

None of the sociodemographic factors (LGA, age, gender, marital status, or education) demonstrated a significant association with *Leptospira* IgG seropositivity on univariable analysis. This is in agreement with the separate reports of Awosanya et al. (2013) among kennel workers and Besong et al. (2022) among presumptive malaria patients in Abuja and Oyo state, respectively. There was no significant association between the method of handling dogs and Leptospira antibodies in this study (p=0.070). However, veterinary practitioners recorded a higher prevalence (72.7%) than other dog handlers; this may partly be attributed to their frequent contact with active Leptospira cases in dogs. The finding differs from the study on kennel workers in Abuja (Awosanya et al., 2013), in which dog handlers were reported to be more positive than veterinarians. It is difficult to ascertain the reason for the disparity because the composition of dog handlers in the later study was not defined and could have contributed to the observed difference.

The multivariate logistic regression suggests an association of occupation of the participants with Leptospira IgG antibodies after adjusting for confounders (age, sex, occupation, and LGA), agreeing with a previous report (Udechukwu et al., 2024) that leptospirosis is an occupational disease, placing certain occupations (farmers, veterinarians, and abattoir workers) at higher risk of

contracting leptospirosis. This explains why the veterinary practitioners showed the highest seropositivity (72.7%) to Leptospira antibodies among the dog handler categories, though the observed differences are not statistically significant (p = 0.070).

Several studies have made the effort to elucidate the relationship of Leptospira antibodies with education attainment; varying responses such as primary, secondary, and tertiary education (Awosanya et al., 2013), yes or no education (Mohd Hanapi et al., 2021), Secondary/Post-Secondary or primary and below (Besong et al., 2022) were investigated and have shown a positive correlation of leptospirosis with increasing educational attainment. This was not the case in the present study, as dog handlers with no formal education demonstrated a more positive reaction to Leptospira antibodies than those with primary, secondary, or tertiary education. Certain practices, such as poor hygiene, eating/drinking while handling animal tissues, and barefoot movement, are more common among the educationally disadvantaged population and may be a reason for the observed higher prevalence.

CONCLUSION

The prevalence of Leptospira IgG antibodies in the present study is high and alarming, demonstrating public health significance. While the univariate analysis of sociodemographic factors showed no significant association of Leptospira IgG antibodies with age, gender, education and marital status of the study participants, adjusting for potential confounders (age, sex, occupation and LGA) shows that occupation is significantly associated with Leptospira IgG antibodies in dog handlers using the logistic regression analysis. Veterinary practitioners demonstrated higher positivity for Leptospira antibodies than other categories of dog handlers. While this study is limited to reporting Leptospira IgG antibodies, additional methods, such as the microscopic agglutination test (MAT), an IgM ELISA for paired serum samples, and PCR, are needed to confirm active cases of Leptospirosis.

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