

Sokoto Journal of Veterinary Sciences

(P-ISSN 1595-093X; E-ISSN 2315-6201)



<http://dx.doi.org/10.4314/sokjvs.v24i1.1>



Inechi *et al.*/Sokoto Journal of Veterinary Sciences, 24(1): 1 - 10.

Seroprevalence and circulating serovars of *Leptospira* in dogs presented to the Veterinary Teaching Hospital, University of Jos, Nigeria

OI Inechi¹, DO Omoniwa^{1*}, E Abiayi², OM Akinsola³, C Uchendu⁴, TO Omobowale⁵, ES Idoga⁴, MT Ojeamiren⁵ & CA Meseko⁶

1. Department of Veterinary Medicine, Surgery and Radiology, Faculty of Veterinary Medicine, University of Jos, Plateau State, Nigeria
2. National Veterinary Research Institute, Vom, Plateau State, Nigeria
3. Department of Theriogenology and Production, Faculty of Veterinary Medicine, University of Jos, Plateau State, Nigeria
4. Department of Veterinary Physiology, Biochemistry and Pharmacology, Faculty of Veterinary Medicine, University of Jos, Plateau State, Nigeria
5. Department of Veterinary Medicine, Faculty of Veterinary Medicine, University of Ibadan, Oyo State, Nigeria
6. Agricultural Research Council of Nigeria
7. National Veterinary Research Institute, Vom, Plateau State, Nigeria

*Correspondence: Tel.: +234 8032765952; E-mail: dareomoniwa@gmail.com

Copyright: © 2026

Inechi *et al.* This is an open-access article published under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Publication History:

Received: 07-07-2025

Revised: 04-11-2025

Accepted: 10-11-2025

Abstract

Leptospirosis is a globally significant re-emerging zoonotic disease and a core concern of the One Health approach. It is an economically devastating disease causing huge losses to farmers, pet owners and degrading means of livelihood as well as infecting humans. It is caused by pathogenic spirochetes of the genus *Leptospira*, transmitted through contact with infected animals or contaminated environments. Despite its relevance, canine leptospirosis remains underreported in Nigeria. This study aimed to determine the seroprevalence, associated risk factors, and circulating serovars of leptospira in dogs presented at the Veterinary Teaching Hospital, University of Jos, Plateau State. Blood samples were collected from 216 apparently healthy dogs and screened using the Microscopic Agglutination Test (MAT). The overall seroprevalence was 50.9%, with *Leptospira* serovar Tarassovi being the most prevalent. Multiple serovar infections were observed. Statistically significant associations were found between Jos South LGA and serovars Icterohaemorrhagiae ($p = 0.0003$) and Bratislava ($p = 0.0319$). The study highlights the endemic nature of leptospirosis and the need for improved preventive strategies.

Keywords: Canine leptospirosis, Microscopic agglutination test, Nigeria, Seroprevalence, Tarassovi, Zoonosis

Introduction

Leptospirosis is a global zoonosis caused by pathogenic *Leptospira*, members of the order *Spirochaetales* and family *Leptospiraceae*, which are thin, spiral-shaped, Gram-negative bacteria, with transmission primarily through direct contact with infected animals or their fluids, or through environmental exposure (Cilia *et al.*, 2020). Domestic dogs and cats may serve as reservoirs or indicators of environmental leptospiral contamination, representing a public health concern (Mazzotta *et al.*, 2023). *Leptospira* species are highly diverse and are commonly classified into serogroups, which offer insights into their associations with specific host species (Chen, 2022). Leptospirosis has a complex transmission cycle at the ecosystem interface between animals, humans, and the environment (Pal *et al.*, 2021). Human infections occur through direct contact with urine from infected animals or indirectly by exposure to soil or water contaminated by the urine of infected animals (Sykes *et al.*, 2023). A systematic review, which included studies published between January 1930 and October 2014, reported that the prevalence of human leptospirosis in hospitalized patients in Africa ranged from 2.3% to 19.8% (Allan *et al.*, 2015). Globally, from 2010 to 2021, the reporting rate increased by 5.0% per year despite the COVID-19 pandemic and the related behavioural changes (Beauté *et al.*, 2024). Pathogenic *Leptospira* species are typically endemic to specific regions and are maintained within distinct mammalian host populations. However, they could infect a wide range of animal species across various ecosystems (Ellis, 2015; Schuller *et al.*, 2015). *Leptospira* infection in dogs is caused by various serovars belonging to different serogroups, including *L. canicola*, *L. icterohaemorrhagiae*, *L. grippityphosa*, *L. australis*, *L. pomona*, and *L. sejroe* (Schuller *et al.*, 2015). Reports on canine leptospirosis in Nigeria are few and scarce, with recent molecular and serological surveys confirming infection in domestic dogs across multiple regions. A cross-sectional study found an overall serological prevalence of 16.4% and a bacteriological prevalence of 11.7% in 342 dogs, indicating that about one in ten dogs may harbour active infection (Pilau *et al.*, 2022). Earlier work identified high prevalences in dogs in the southwestern region, and documented multiple pathogenic serovars including *icterohaemorrhagiae*, *pomona*, *bratislava* and *canicola* (Ajayi, 2013). A cluster investigation in a kennel in Abuja reported a canine attack rate of 65% and a case-fatality rate of 32% in 2009, underscoring the potential severity of

the disease (Awosanya *et al.*, 2013). Despite these findings, leptospirosis is rarely included in routine differential diagnosis in Nigerian veterinary practice, and vaccination coverage and strain-specific vaccine efficacy are poorly documented. Given Nigeria's climate (with flooding/standing water during rainy seasons) and rodent/wildlife reservoir pressures, there is concern that dogs may serve as a bridge for human exposure in a One Health context (Pilau *et al.*, 2022; Awosanya *et al.*, 2013). In summary, canine leptospirosis in Nigeria warrants greater surveillance, improved diagnostic capacity, and better understanding of vaccine strategy and local serovar distribution to protect both animal and human health. Although vaccination is the primary method for controlling leptospirosis in dogs, it has been noted that vaccinated dogs can still become infected, particularly when exposed to heterologous strains that differ from those included in the vaccine. This is because cross-protection between different strains is at best partial (Sant'Anna da Costa *et al.*, 2022). The microagglutination test (MAT) is the most used diagnostic method for leptospirosis in veterinary practice. However, it has certain limitations, particularly regarding its sensitivity and specificity (Esteves *et al.*, 2023). Domestic dogs are at heightened risk for infection with *Leptospira* spp. when they are exposed to contaminated water or moist soil, particularly in warm, humid climates or after flooding events, because the bacteria persist longer in such environments (Heydari *et al.*, 2025). Dogs that roam freely, hunt rodents or wildlife, live outdoors, or drink from puddles or untreated water sources face increased exposure to reservoir hosts and contaminated substrates (Vyn *et al.*, 2024). Urban and peri-urban dogs are also vulnerable, as higher rodent populations, dense housing, poor sanitation, and water-logging create conditions supportive of transmission (Burriel *et al.*, 2003). Additionally, male and adult dogs with street access or outdoor access, proximity to waste collection centres, presence of open sewers, low-income neighbourhoods, and absent or incomplete vaccinations are all considered to be risk factors of canine leptospirosis (Vyn *et al.*, 2024; Scahill *et al.*, 2022). This study aimed to identify the circulating *Leptospira* serovars affecting dogs presented at the Veterinary Teaching Hospital, University of Jos and was justified by the increasing cases of canine leptospirosis reported at the Hospital, as well as infections in dogs with a complete history of vaccination and the need to add to the body of

knowledge of leptospirosis in our immediate environment.

Materials and Methods

Study design

The study was conducted as a cross-sectional survey using a purposive sampling technique. Sex, age, breed, location and vaccination history were determined.

Study area

The study was conducted in Jos, Plateau State, Nigeria. Plateau State is in the Northern Guinea Savana Vegetation belt, covering 8,600km² with an average altitude of 1, 280m. It lies between Latitude 8°30' - 10°30'N, Longitude 7°30' - 13°37'E (Wuyep & Daloeng, 2020). The climate is a semi-temperate one with temperatures ranging from 18°C to 25°C. Rainfall received by Jos city is around 1,400mm (55.1 in) annually (Danbauchi, 2023).

Experimental animals

The study was conducted using 216 adult dogs both male and female of diverse breeds including Russian Shepherd (100), German Shepherd (25), Rottweiler (9), Neapolitan mastiff (12), Bull mastiff (11), Saint Bernard (8), Pitbull (1), Boerbell (3) and Nigerian Indigenous Breed of Dog (47), from July through September 2022. The inclusion criteria were apparently healthy dogs of either sex, above six months of age, with the informed consent of the client. The sample size was obtained using the formula:

$$N = \frac{Z^2 + P(1 - P)}{d^2}$$

Where;

N = sample size;

Z = 1.96, Standard normal value at 96% Confidence Interval.

d = allowable error of 5% and

P = Prevalence of 16.7% (Pilau *et al.*, 2022).

Thus:

$$N = \frac{1.96^2 \times 0.167(1-0.167)}{0.0025} = 214.$$

Blood collection and preservation

Blood was obtained from the cephalic vein of apparently healthy dogs as described by Jensen *et al.* (1994) using sterile latex examination hand gloves, sterile needles and syringes after disinfecting the collection site with a swab of sterile cotton wool soaked in 70% alcohol and information including age, sex, breed, vaccination status and address were

obtained and recorded. The blood was then centrifuged at 2,000 r.p.m and sera were harvested into cryovials and preserved at -20°C, at the National Veterinary Research Institute (NVRI).

Microscopic agglutination test

The Microscopic Agglutination Test was carried out as described by WHO (2003). The frozen sera were allowed to thaw. A 1:10 dilution of the serum sample and Sorensen's buffer (32: 288µl) to dilute out the complement was carried out in a U – bottom microtiter plate. The plate was gently shaken for 30 seconds using a microtiter plate shaker. About 25µl of the above was dispensed into a new microtiter plate, and 25µl of antigen in each of the wells containing the combination of sera and Sorensen's buffer was shaken. The combination was incubated for 2 hours at 37°C to allow the antibody-antigen reaction to take place. Using a micropipette, it was dispensed on a clean, grease-free slide and viewed under a dark field microscope to observe for agglutination, which is indicative of the presence of the antibodies to the specific antigen.

During the test, new Eppendorf tips were used for each serovar, each plate was numbered with care, and 50% and above agglutination observed is considered positive.

Statistical analysis

The data collected were subjected to descriptive statistics and Analysis of variance (ANOVA) using GraphPad Prism 7.0 for Windows (GraphPad software, San Diego, California, USA) and were expressed as percentages and tested using Chi-square at a significant level of P ≤ 0.05.

Results

The overall seroprevalence of canine leptospirosis from sampled animals that tested positive to at least one serovar was 50.9% (110/216) in this study (Figure 1). Serovar Tarrasovi 25.5% (55/216) was the most prevalent of the seven serovars tested in the study, followed by Pomona 23.6% (51/216), Bratislava 17.4% (32/216), Icterohaemorrhagica 15.7% (34/216), Canicola and Hardjo both 14.4% (31/216), and Grippotyphosa 9.7% (21/216) respectively (Table 1). The study also identified the presence of multiple serovar infections, ranging from a single serovar infection, which had the highest seroprevalence, 23.2% (50/216), to seven serovar infection 0.5% (1/216), which had the least seroprevalence (Table 2). Females had a higher seroprevalence than males across the seven serovars, but this was not

statistically significant (Table 3). The 1-5 year age group had consistently higher seroprevalences across the serovars than the >5 years, but this difference was not statistically significant (Table 4). The exotic breeds of dogs had higher seroprevalences than the indigenous breed of dogs, but this was not statistically significant (Table 5). Seroprevalences were varied across the two sample locations Jos south was statistically significant for serovars Icterohaemorrhagica and Bratislava (Table 6). The vaccination history, categorised as none, incomplete vaccination, and complete vaccination, showed no statistical significance across the seven serovars (Table 7).

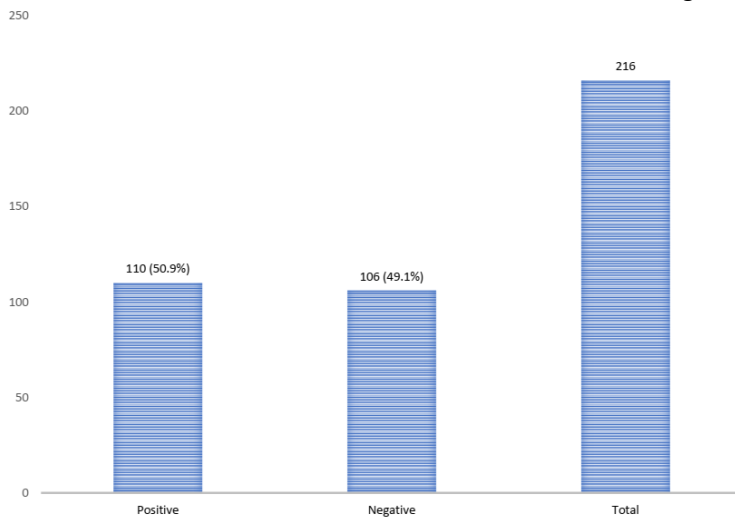


Figure 1: Seroprevalence of Leptospiriosis in dogs presented to the Veterinary Teaching Hospital, Jos, Plateau State

Table 1: Seroprevalence of serovars of Leptospiriosis in dogs presented to the Veterinary Teaching Hospital, Jos, in Plateau State

Serovar	IC	CA	HJ	TA	BR	PO	GR
Total No.	216	216	216	216	216	216	216
Positive	34	31	31	55	32	51	21
Percentage positive	15.7	14.4	14.4	25.5	17.4	23.6	9.7

Where: IC= Icterohaemorrhagica, CA= Canicola, HJ= Hardjo, TA= Tarassovi, BR= Bratislava, PO= Pomona, GR= Grippotyphosa

Table 2: Seroprevalence of single and multiple *Leptospira* serovar co- infections in dogs presented to the Veterinary Teaching Hospital, Jos, in Plateau State

No of Serovars	No Positive	N	Prevalence (%)
1	50	216	23.2
2	23	216	10.6
3	12	216	5.6
4	11	216	5.1
5	5	216	2.3
6	8	216	3.7
7	1	216	0.5

Discussion

This study revealed a high overall seroprevalence of canine leptospirosis among dogs presented at the Veterinary Teaching Hospital of the University of Jos, Plateau State, Nigeria. This prevalence is notably higher than that reported in several countries, such as Greece (11.4%) (Burriel *et al.*, 2003), New Zealand (14.9%) (O’Keefe *et al.*, 2002), Chile 25.1% (Lelu *et al.*, 2015), and this may be because some of the earlier-mentioned studies were conducted 20 years earlier and that leptospirosis is a re-emerging zoonosis and also that these countries are in temperate regions in which the cold environment is not so favourable for the propagation of leptospires. The results obtained align more closely with reports from tropical and

subtropical countries such as Iran (44.1% (Arzamani *et al.*, 2022), and India (71.1%) (Ambily *et al.*, 2013) and may be because these studies are relatively more recent, coupled with the fact that they are in the tropics like Nigeria, and the environment helps facilitate the spread of the leptospires. The relatively high seroprevalence observed in this study underscores the endemic nature of leptospirosis in Nigeria and the potential risk of zoonotic transmission, particularly in areas where human-animal-environment interfaces are common.

One of the key findings of this research is the predominance of Serovar Tarassovi in the sampled population,

Table 3: Seroprevalence of *Leptospira* serovars by sex in dogs presented to the Veterinary Teaching Hospital, Jos, in Plateau State (n = 216)

Serovars	Sex	No Positive	N	Prevalence within Serovars (%)	Total Prevalence (%)	X ²	p-value	RR	OR
<i>Icterohaemorrhagica</i>	Female	28	153	18.3	13	2.592	0.1074	1.199	2.128
	Male	6	63	9.5	2.8				
<i>Tarrasovi</i>	Female	38	153	24.8	17.6	1.084	0.7419	0.9673	0.8941
	Male	17	63	27.0	7.9				
<i>Pomona</i>	Female	40	153	26.1	18.5	1.866	0.1720	1.145	1.673
	Male	11	63	17.5	5.1				
<i>Grippotyphosa</i>	Female	15	153	9.8	6.9	1.852	0.6669	1.665	1.261
	Male	5	63	7.9	2.3				
<i>Bratislava</i>	Female	24	153	15.7	11.1	0.556	0.4558	1.0697	1.387
	Male	8	63	12.7	3.7				
<i>Canicola</i>	Female	21	153	13.7	9.7	0.167	0.6824	0.9494	0.8432
	Male	10	63	15.9	4.6				
<i>Hardjo</i>	Female	21	153	13.7	9.7	0.167	0.6824	0.9494	0.8432
	Male	10	63	15.9	4.6				

Table 4: Seroprevalence of *Leptospira* serovars by age in dogs presented to the Veterinary Teaching Hospital, Jos, in Plateau State (n = 216)

Serovars	Age (years)	No Positive	N	Prevalence within Serovars (%)	Total Prevalence (%)	X ²	p-value	OR
<i>Icterohaemorrhagica</i>	1 – 5	31	193	16.1	14.4	2.235	0.1349	4.210
	>5	1	23	4.3	0.4			
<i>Tarrasovi</i>	1 – 5	51	193	26.4	23.6	0.8836	0.3472	1.706
	>5	4	23	17.4	1.9			
<i>Pomona</i>	1 – 5	46	193	23.8	21.3	0.5001	0.8260	0.1270
	>5	5	23	21.7	2.3			
<i>Grippotyphosa</i>	1 – 5	20	193	10.4	9.3	0.8741	0.3574	2.543
	>5	1	23	4.3	0.5			
<i>Bratislava</i>	1 – 5	28	193	14.5	13	0.1354	0.7129	0.8061
	>5	4	23	17.4	1.9			
<i>Canicola</i>	1 – 5	28	193	14.5	13	0.0359	0.8498	1.1310
	>5	3	23	13	1.4			
<i>Hardjo</i>	1 – 5	26	193	13.5	12	1.141	0.2851	0.5605
	>5	5	23	21.7	2.3			

this was followed by Serovars Pomona, Bratislava, Icterohaemorrhagiae, Canicola, Hardjo, and Grippotyphosa. The dominance of Tarassovi is particularly noteworthy, as this serovar is not typically included in standard commercial canine *Leptospira* vaccines, which commonly incorporate Icterohaemorrhagiae and Canicola. This mismatch may explain the lack of significant association between vaccination status and seropositivity in the current study. Given the lack of cross-protection among different *Leptospira* serovars, the presence of antibodies against non-vaccine serovars, such as Tarassovi and Pomona, highlights the limitations of

current vaccination strategies and the potential vulnerability of vaccinated dogs to infection by locally circulating strains.

Importantly, the study found evidence of multiple serovar infections. A substantial proportion of dogs were seropositive for a single serovar, while others showed antibodies to two to seven serovars. These findings suggest that dogs in this region are exposed to a diverse range of *Leptospira* serovars and may act as both sentinel species and reservoirs of infection. The presence of multiple serovar infections also supports the hypothesis of environmental contamination and frequent contact with multiple

Table 5: Seroprevalence of *Leptospira* serovars by breed in dogs presenting to the Veterinary Teaching Hospital, Jos, in Plateau State (n = 216)

Serovars	Breeds	No Positive	N	Prevalence within Serovars (%)	Total Prevalence (%)	X ²	p-value	OR
<i>Icterohaemorrhagica</i>	Indigenous	4	47	8.5	1.9	1.892	0.169	0.468
	Exotic	28	169	16.6	13.0			
<i>Tarrasovi</i>	Indigenous	10	47	21.3	4.6	0.555	0.456	0.745
	Exotic	45	169	26.6	20.8			
<i>Pomona</i>	Indigenous	9	47	19.2	4.2	0.763	0.402	0.708
	Exotic	42	169	24.9	19.4			
<i>Grippotyphosa</i>	Indigenous	3	47	6.4	1.4	0.966	0.326	0.534
	Exotic	18	169	10.7	8.3			
<i>Bratislava</i>	Indigenous	5	47	10.6	2.3	0.830	0.362	0.626
	Exotic	27	169	16.0	12.5			
<i>Canicola</i>	Indigenous	4	47	8.5	1.9	1.667	0.197	0.489
	Exotic	27	169	16.0	12.5			
<i>Hardjo</i>	Indigenous	8	47	17.0	3.7	0.348	0.555	1.302
	Exotic	23	169	13.6	10.6			

Table 6: Seroprevalence of *Leptospira* serovars by location in dogs presenting to the Veterinary Teaching Hospital, Jos in Plateau State (n = 216)

Serovar	Location	No Positive	N	Prevalence within Serovars (%)	Total Prevalence (%)	X ²	p-value	OR
<i>Icterohaemorrhagica</i>	Jos North	14	153	9.2	6.5	13.34	0.0003*	0.2518
	Jos South	18	63	28.6	8.3			
<i>Tarrasovi</i>	Jos North	40	153	26.1	18.5	0.128	0.720	1.133
	Jos South	15	63	23.8	6.9			
<i>Pomona</i>	Jos North	35	153	22.9	16.2	0.157	0.692	0.8713
	Jos South	16	63	25.4	7.4			
<i>Grippotyphosa</i>	Jos North	11	153	7.2	5.1	3.834	0.502	0.4106
	Jos South	10	63	15.9	4.6			
<i>Bratislava</i>	Jos North	16	153	10.5	7.4	4.604	0.0319*	0.4222
	Jos South	16	63	25.4	7.4			
<i>Canicola</i>	Jos North	22	153	14.4	10.2	0.0003	0.986	1.008
	Jos South	9	63	14.3	4.2			
<i>Hardjo</i>	Jos North	22	153	14.4	10.2	0.0003	0.986	1.008
	Jos South	9	63	14.3	4.2			

*(≤ 0.05)

sources of infection, especially in urban or peri-urban settings where dogs roam freely or are exposed to contaminated water sources.

Contrary to expectations, sex, age, breed, location and vaccination status were not significantly associated with *Leptospira* seropositivity. While previous studies (Filipe *et al.*, 2024) have suggested that male dogs or unvaccinated dogs may be at higher risk, the findings indicate a uniform distribution of infection across demographic groups. The lack of significant association with vaccination status may be

due to several factors, including the administration of incomplete or outdated vaccines, exposure to heterologous strains not covered by the vaccine, or waning immunity over time (Bashiru & Bahaman, 2018). These limitations highlight the need for locally customized vaccines that incorporate prevalent serovars in Nigeria to enhance protection.

The geographic distribution of serovars between Jos North and Jos South Local Government Areas (LGAs) revealed statistically significant differences for Serovars *Icterohaemorrhagiae* and *Bratislava*. The

Table 7: Seroprevalence of *Leptospira* serovars by vaccination status in dogs presenting to the Veterinary Teaching Hospital, Jos in Plateau State (n = 216)

Serovars	Vaccination Status	No Positive	N	Prevalence within Serovars (%)	Total Prevalence (%)	X ²	p-value
<i>Icterohaemorrhagica</i>	None	5	54	9.3	2.3	2.846	0.2410
	Incomplete	14	70	20.0	6.5		
	Complete	13	92	14.1	6.0		
<i>Tarrasovi</i>	None	10	54	18.5	4.6	1.722	0.4228
	Incomplete	12	70	17.1	5.6		
	Complete	23	92	25.0	10.6		
<i>Pomona</i>	None	11	54	20.4	5.1	2.345	0.3096
	Incomplete	21	70	30.0	9.7		
	Complete	19	92	20.7	8.8		
<i>Grippotyphosa</i>	None	3	54	5.6	1.4	1.598	0.4499
	Incomplete	7	70	10.0	3.2		
	Complete	11	92	12	5.1		
<i>Bratislava</i>	None	7	54	13	3.2	0.4815	0.7860
	Incomplete	12	70	17.1	5.6		
	Complete	13	92	14.1	6.0		
<i>Canicola</i>	None	8	54	14.8	3.7	0.0133	0.4934
	Incomplete	10	70	14.3	4.6		
	Complete	13	92	14.1	6.0		
<i>Hardjo</i>	None	9	54	16.7	4.2	0.7705	0.6803
	Incomplete	11	70	15.7	5.1		
	Complete	11	92	12.0	5.1		

higher prevalence observed in Jos South may be linked to specific ecological and anthropogenic factors. For instance, Jos South contains major abattoirs and a prominent dog market. These settings likely contribute to the congregation of dogs from various regions, increasing their exposure to contaminated environments and facilitating the spread of multiple *Leptospira* serovars. Additionally, poor waste management, stagnant water bodies, and rodent infestation in such locations may serve as environmental reservoirs for *Leptospira*, thereby amplifying transmission risks (Bradley & Lockaby, 2023).

The findings of this study may support the growing consensus that climate and environmental factors, including increased rainfall, flooding, poor sanitation, and changing land use patterns, contribute significantly to the burden of leptospirosis (Bradley & Lockaby, 2023). Plateau State's semi-temperate climate, coupled with a rainy season and urban infrastructure challenges, may create conditions favorable to the persistence of *Leptospira* in the environment. Dogs that frequent such areas, particularly those with unrestricted movement, are at greater risk of exposure, as the bacteria can survive

for extended periods in moist soil and stagnant water contaminated with the urine of infected animals.

The high seroprevalence of serovars not included in current vaccines calls for an urgent review of vaccination strategies in Nigeria. The use of imported vaccines that are not matched to local serovar profiles may be inadequate in preventing infection. Developing polyvalent vaccines using locally isolated strains may improve vaccine efficacy and offer better protection against canine leptospirosis in endemic regions (Bashiru & Bahaman, 2018; Bradley & Lockaby, 2023). Moreover, awareness campaigns among dog owners and veterinarians on the limitations of existing vaccines and the need for booster doses may help mitigate the disease burden (Esteves *et al.*, 2022)

Furthermore, the study has important public health implications. Leptospirosis is a zoonotic disease that can be transmitted from dogs to humans, particularly through exposure to contaminated urine or environments. Individuals at high risk include pet owners, veterinary staff, abattoir workers, and children who play in areas frequented by dogs (Cilia *et al.*, 2020). The high seroprevalence observed suggests that many dogs may serve as asymptomatic

carriers, continuously shedding *Leptospira* in the environment and posing a persistent zoonotic risk. This highlights the need for integrated One Health approaches that combine veterinary and human public health strategies to reduce transmission risks (Pilau *et al.*, 2022).

This study also underscores the diagnostic value and limitations of the Microscopic Agglutination Test (MAT). While MAT remains the gold standard for *Leptospira* diagnosis due to its serovar-specificity, it has known limitations in sensitivity, particularly during early infection stages or in chronic cases. Cross-reactions among serovars and the subjective interpretation of agglutination endpoints can also affect diagnostic accuracy. Future studies should consider combining MAT with molecular techniques such as PCR or sequencing to confirm active infections and better characterize circulating *Leptospira* strains. One of the limitations of this study is its cross-sectional nature, which does not allow for causal inferences. Additionally, the use of purposive sampling and a single veterinary hospital may limit the generalizability of findings to the broader dog population in Plateau State. Moreover, the lack of molecular confirmation and environmental sampling limits the understanding of infection dynamics and sources of exposure. Despite these limitations, this study provides valuable baseline data on the epidemiology of canine leptospirosis in Nigeria and highlights critical areas for public health intervention. In conclusion, this study reveals a high seroprevalence of canine leptospirosis in Plateau State, with multiple serovar exposures and a mismatch between vaccine components and circulating strains. The findings call for improved surveillance, the development of locally relevant vaccines, and the implementation of One Health strategies to address this neglected zoonosis. Future research should focus on isolating local strains, assessing environmental reservoirs, and conducting longitudinal studies to understand the dynamics of infection and reinfection in dogs.

Acknowledgements

We wish to acknowledge the staff of the Small Animal Clinic of the Veterinary Teaching Hospital of the University of Jos for their cooperation and help.

Funding

No funding was received.

Conflict of Interest

The authors declare no conflict of interest.

References

- Ajayi OL (2013). Serovars and Renal Pathology of Leptospirosis in Dogs, Cattle and Wild Rats, and its Pathogenesis in a Guinea Pig Model. PhD Thesis, Department of Veterinary Pathology, Faculty of Veterinary Medicine, University of Ibadan. Pp 228-253.
- Allan KJ, Biggs HM, Halliday JE, Kazwala RR, Maro VP, Cleaveland S & Crump JA (2015). Epidemiology of leptospirosis in Africa: A systematic review of a neglected zoonosis and a paradigm for "One Health" in Africa. *PLOS Neglected Tropical Diseases*, 10.1371/journal.pntd.0003899.
- Ambily R, Mini M, Joseph S, Krishna SV & Abhinay G (2013). Canine leptospirosis – a seroprevalence study from Kerala, India. *Vet World*, 6(1): 42-44.
- Arzamani K, Abdollahpour G, Azimian A, van Belkum A & Ghasemzadeh-Moghaddam H (2022). High-level seroprevalence against *Leptospira interrogans* serovars among wild foxes, jackals and stray dogs in the North Khorasan Province, Iran. *Veterinary Medicine and Science*, 8(5): 1915–1921.
- Awosanya EJ, Nguku P, Oyemakinde A & Omobowale O (2013). Factors associated with probable cluster of leptospirosis among kennel workers in Abuja, Nigeria. *The Pan African Medical Journal*, doi.10.11604/pamj.2013.16.144.3529.
- Bashiru G & Bahaman AR (2018). Advances & challenges in Leptospiral vaccine development. *The Indian Journal of Medical Research*, 147(1): 15–22.
- Beauté J, Innocenti F, Aristodimou A, Špačková M, Eves C, Kerbo N, Rimhanen-Finne R, Picardeau M, Faber M, Douglas G, Halldórsdóttir AM, Jackson S, Leitēna V, Vergison A, Borg ML, Pijnacker R, Sadkowska-Todys M, Martins JV, Rusu LC, Grilc E & Westrell T (2024). Epidemiology of reported cases of leptospirosis in the EU/EEA, 2010 to 2021. *Eurosurveillance: bulletin Europeen sur les maladies transmissibles = European Communicable Disease Bulletin*, doi.10.2807/1560-7917.ES.2024.29.7.2300266.
- Bradley EA & Lockaby G (2023). Leptospirosis and the Environment: A review and future directions. *Pathogens (Basel, Switzerland)*, doi.10.3390/pathogens12091167.

- Burriel AR, Dalley C & Woodward MJ (2003). Prevalence of *Leptospira* species among farmed and domestic animals in Greece. *The Veterinary Record*, **153**(5): 146–148.
- Chen KT (2022). Emerging infectious diseases and one health: Implication for public health. *International Journal of Environmental Research and Public Health*, doi.10.3390/ijerph19159081.
- Cilia G, Bertelloni F, Piredda I, Ponti MN, Turchi B, Cantile C, Parisi F, Pinzauti P, Armani A & Palmas B (2020). Presence of pathogenic *Leptospira* spp. in the reproductive system and fetuses of wild boars (*Sus scrofa*) in Italy. *PLOS Neglected Tropical Diseases*, doi.10.1371/journal.pntd.0008982.
- Danbauchi ES (2023). Climate is changing; Temperature and rainfall pattern (Variability) in Jos-Metropolis, Plateau state, Nigeria. *International Journal of Geography & Environmental Management*. **9**(2): 10-24.
- Ellis WA (2015). Animal leptospirosis. In: *Current Topics in Microbiology and Immunology* (B Adler, editor), Springer. Pp 99–137.
- Esteves SB, Santos CM, Salgado FF, Gonçalves AP, Guilloux AGA, Martins CM, Hagiwara MK & Miotto BA (2022). Efficacy of commercially available vaccines against canine leptospirosis: A systematic review and meta-analysis. *Vaccine*, **40**(12): 1722–1740.
- Esteves SB, Santos CM, Silva BCS, Salgado FF, Guilloux AGA & Cortez A (2023). Time for change? A systematic review with meta-analysis of leptospire infecting dogs to assess vaccine compatibility in Brazil. *Preventive Veterinary Medicine*, **213**: 105869. doi.10.1016/j.prevetmed.2023.105869
- Filipe J, Lauzi S, Bullo F, D'Incau M, Meroni G, Martino PA, Magistrelli S, Restelli M & Dall'Ara P (2024). *Leptospira* spp. antibody seroprevalence in stray dogs and cats: A study in Milan, northern Italy. *Veterinary Science*, doi.10.3390/vetsci11100478.
- Furlanello T & Reale I (2020). First description of reactive arthritis secondary to leptospirosis in a dog. *Iranian Journal of Veterinary Research*, **21**(2): 146-149.
- Heydari P, Tirbandpay M & Ghasemishayan R (2025). Systematic review of the prevalence of environmental and host-related risk factors and the zoonotic potential of leptospirosis in domestic dogs in regions impacted by environmental changes. *BMC Veterinary Research*, doi.10.1186/s12917-025-05023-0.
- Jensen AL, Wenck A, Koch J & Poulsen JS (1994). Comparison of results of haematological and clinical chemical analyses of blood samples obtained from the cephalic and external jugular veins in dogs. *Research in Veterinary Science*, **56**(1): 24–29.
- Lelu M, Muñoz-Zanzi C, Higgins B & Galloway R (2015). Seroepidemiology of leptospirosis in dogs from rural and slum communities of Los Rios Region, Chile. *BMC Veterinary Research*, doi.10.1186/s12917-015-0341-9.
- Mazzotta E, De Zan G, Cocchi M, Boniotti MB, Bertasio C, Furlanell, T, Lucchese L, Ceglie L, Bellinati L & Natale A (2023). Feline susceptibility to leptospirosis and presence of immunosuppressive co-morbidities: First European report of *L. interrogans* Serogroup Australis Sequence Type 24 in a cat and Survey of *Leptospira* Exposure in Outdoor Cats. *Tropical Medicine and Infectious Disease*, doi.10.3390/tropicalmed8010054.
- O'Keefe JS, Jenner JA, Sandifer NC, Antony A & Williamson NB (2002). A serosurvey for antibodies to leptospira in dogs in the lower North Island of New Zealand. *New Zealand Veterinary Journal*, **50**(1): 23–25.
- Pal M, Bulcha MR & Bune MW (2021). Leptospirosis and one health perspective. *American Journal of Public Health Research*, **9**(4): 180–183.
- Pilau NN, Lubar AA, Daneji AI, Mera UM, Magaji AA, Abiayi EA, Chaiboonma KL, Busayo EI, Vinetz JM & Matthias MA (2022). Serological and molecular epidemiology of leptospirosis and the role of dogs as sentinels for human infection in Nigeria. *Heliyon*, doi.10.1016/j.heliyon.2022.e09484.
- Sant'Anna da Costa R, Di Azevedo MI, dos Santos Baptista Borges AL, Aymée L, Martins G & Lilenbaum W (2022). Effect of vaccination against *Leptospira* on shelter asymptomatic dogs following a long-term study. *Animals (Basel)*, doi.10.3390/ani12141788.
- Scahill K, Windahl U, Boqvist S & Pelander L (2022). *Leptospira* seroprevalence and associated risk factors in healthy Swedish dogs. *BMC Veterinary Research*, doi.10.1186/s12917-022-03472-5.
- Schuller S, Francey T, Hartmann K, Hugonnard M, Kohn B, Nally JE & Sykes J (2015). European consensus statement on leptospirosis in

- dogs and cats. *The Journal of Small Animal Practice*, **56**(3): 159–179.
- Sykes JE, Francey T, Schuller S, Stoddard RA, Cowgill LD & Moore GE (2023). Updated ACVIM consensus statement on leptospirosis in dogs. *Journal of Veterinary Internal Medicine*. doi.10.1111/jvim.16903.
- Vyn CM, Libera KC, Weese JS, Jardine CM, Berke O & Grant LE (2024). Social and environmental risk factors for canine leptospirosis: A scoping review. *The Veterinary Record*, doi.10.1002/vetr.4437.
- WHO (2003). *Human Leptospirosis: Guidance for Diagnosis, Surveillance and Control*. World Health Organization, Geneva, Switzerland. Pp 109.
- Wuyep SZ & Daloeng HM (2020). Climate change, rainfall trends and variability in Jos Plateau. *Journal of Applied Sciences*, doi.10.3923/jas.2020.76.82.