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Assessing Rabies Risk from Under-Vaccinated Owned Indigenous Dogs: Insights from Bite Incidents in a Veterinary Facility

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Abstract

Background: Dog bites pose a significant public health challenge globally, with developing countries bearing a disproportionate share of morbidity and mortality. In Plateau State, Nigeria, increasing bite incidents have raised concerns over rabies transmission, prompting an investigation into incidence and associated risk factors. **Methods:** From January to December 2024, data were prospectively collected on dog bite victims presenting at the Veterinary Hospital, Federal College of Animal Health and Production Technology, Vom, Nigeria. Victim demographics, exposure characteristics, and offending dog profiles, including age, sex, and rabies vaccination status, were recorded. Brain tissue from deceased or euthanized dogs was tested using Direct Fluorescent Antibody Test (DFAT). **Results:** The estimated incidence of dog bites was 46.6 per 100,000 population. Most victims (64.3%, 95% CI=0.56–0.72) reported bites within 0–3 days, with children and adolescents under 20 years comprising 62.2% (95% CI=0.54–0.70) and a slight male predominance (53.1%, 95% CI=0.45–0.62). Offending dogs were predominantly male, local breeds aged ≥1 year. Although 77.6% (95% CI=0.70–0.84) were owned, 92.3% (95% CI=0.87–0.96) had absent or expired anti-rabies vaccination. Among 36 brain samples tested, 28 (77.8%, 95% CI=0.61–0.90) were rabies-positive. **Conclusion:** High rates of bites from under-vaccinated indigenous dogs underscore the urgent need for strengthened rabies vaccination campaigns and promotion of responsible dog ownership.

Keywords: Dog bite, Incidence rate, Public Health, Rabies, Risk

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Introduction

Rabies is a neglected zoonotic disease that affects almost all warm-blooded animals Sivagurunathan et al., 2021. The aetiological agent is a single-stranded RNA virus belonging to genotype 1 of the genus *Lyssavirus* in the family *Rhabdoviridae* Hambolu et al., 2014. The disease is most prevalent in tropical and subtropical regions, with Africa, Asia, and Latin America identified as high-risk areas, particularly among impoverished populations with limited access to healthcare and preventive measures Sivagurunathan et al., 2021. Although rabies is entirely preventable, it is almost always fatal once clinical symptoms appear Aguèmon et al., 2016; Ikye-Tor et al., 2020. The causative agent is maintained and transmitted through various host species, with domestic dogs serving as the primary reservoir for human infections Ikye-Tor et al., 2020.

Dog bites in humans represent a major public health concern, affecting millions annually and accounting for approximately 85–95% of human rabies cases worldwide

Dhand et al., 2011; Hambolu et al., 2014; World Health Organization (WHO), 2018. Dog bites can result in serious health outcomes such as physical injuries, psychological trauma, and life-threatening diseases such as rabies Apanga et al., 2016.

The economic burden of managing dog bite cases, including post-exposure prophylaxis (PEP), wound care, antibiotics, and tetanus prophylaxis, is substantial, particularly in rabies-endemic regions American Veterinary Medical Association (AVMA), 2001; Hasoon et al., 2020; Bashar & Duggal, 2019. In many low- and middle-income countries where access to rabies vaccines and immunoglobulins is limited or costly, this burden is even more pronounced Bashar & Duggal, 2019. The true burden of dog bites and rabies transmission remains poorly understood due to underreporting Mshelbwala et al., 2013.

In many parts of Nigeria, including Jos, Plateau State, Nigeria, where human-animal interactions are frequent, there is a pressing need for continuous assessment of dog bite incidence, distribution, and associated risks of rabies exposure. Such investigations are vital for evidence-based control strategies, improved access to PEP, and targeted public health interventions to reduce dog bite–related morbidity and mortality. This study therefore aimed to determine the incidence, distribution, and characteristics of dog bites, and to assess rabies risk among victims attending a veterinary facility in Jos, Plateau State, Nigeria.

Methods

Study Location

The study was conducted at the Veterinary Hospital, Federal College of Animal Health and Production Technology (FCAH&PT), located within the National Veterinary Research Institute (NVRI), Vom, Plateau State, Nigeria. Plateau State, situated in Nigeria's Middle Belt, encompasses the Jos Plateau, characterized by elevations ranging from approximately 1,200 m to 1,829 m above sea level Karshima et al., 2020. The state lies between latitudes 8 °24′–10°30′N and longitudes 8°32′–10°38′E Iloeje, 2001. The Veterinary Hospital Authorities provides essential veterinary services to local residents and surrounding communities. Its strategic location within NVRI, which houses the Rabies Diagnostic Laboratory, makes it a key referral and reporting center for dog bite incidents in the region.

Study Design

This was a prospective descriptive study conducted between January and December 2024 at the Veterinary Hospital, FCAH&PT, Vom, to assess the incidence of dog bites and associated rabies exposure risks in Jos, Plateau State. Permission was obtained from the Veterinary Hospital prior to commencement. Data were prospectively collected from dog bite victims who presented to the hospital. Information was recorded on both victims and offending dogs, including demographic characteristics, ownership status, vaccination history, provocation circumstances, and time interval between exposure and presentation. In cases where the offending dog was euthanized or died, the head was submitted to the Rabies Diagnostic Unit, NVRI, for laboratory confirmation.

Laboratory Confirmation of Rabies

Brain tissues from offending dogs that died or were euthanized were tested for rabies antigen using the Direct Fluorescent Antibody (DFA) test following the standard protocol of the Centers for Disease Control and Prevention (CDC) Centers for Disease Control and Prevention, 2011. Briefly, brain impression smears were prepared, fixed, and stained with fluorescein isothiocyanate (FITC)-labelled anti-rabies monoclonal globulin (Fujirebio Diagnostic Inc., USA). Slides were examined under a fluorescent microscope (Meiji Techno Company Ltd., USA; Model MT6000 series) for characteristic apple-green fluorescence indicative of rabies virus antigen.

Data Analysis

Descriptive statistics, including frequencies and percentages, were computed using the Statistical Package for the Social Sciences (SPSS) version 26 (IBM Corp., USA). The incidence rate of dog bites was calculated using the method described by Martin et al., 1987:

$$\text{Incidence rate (per 100,000)} = \frac{\text{Number of dog bite cases}}{\text{Estimated population}} \times 100,000 \quad (1)$$

where the estimated population of Jos South Local Government Area was 306,716 and total dog bite cases were 143. Results were presented in tables and charts. The 95% confidence intervals (CIs) for proportions were calculated using an exact CI estimation tool available online at https://statpages.info/confint.html.

Results

Over the one-year study period, a total of 143 dog bite cases were received and evaluated at the Veterinary Hospital, FCAH&PT, Vom. The majority (64.3%) of victims reported within 0–3 days of exposure, while 24.5% reported to the hospital 7 days after the incident (Table 1). Bite victims were drawn from twelve LGAs, with half (50.0%) residing in Jos South LGA. The remaining cases primarily originated from neighbouring communities in adjacent LGAs, including a few from Kaduna State (Figure 1).

Analysis of the bite incidents, including characteristics of both the canines and victims, showed that the majority, 111 out of 143 (77.6%), involved owned dogs that were not confined or properly restricted by their owners (Table 2).

Stray dogs accounted for 32 cases, representing 22.4%. Of the total incidents, 58 cases (40.6%) involved male dogs, 52 (36.4%) involved female dogs, while the sex of the dog was unknown in 33 cases (23.0%) (Table 2). The majority (47.7%) of the offending dogs were aged one year and above (Table 2).

Table 1: Time interval between dog bite incident and seeking medical/professional advice (n = 143)

Time (days)	Freq (n)	Percent (%)	95% CI
0–3	92	64.3	0.56–0.72
4–7	16	11.2	0.07–0.18
>7	35	24.5	0.18–0.32

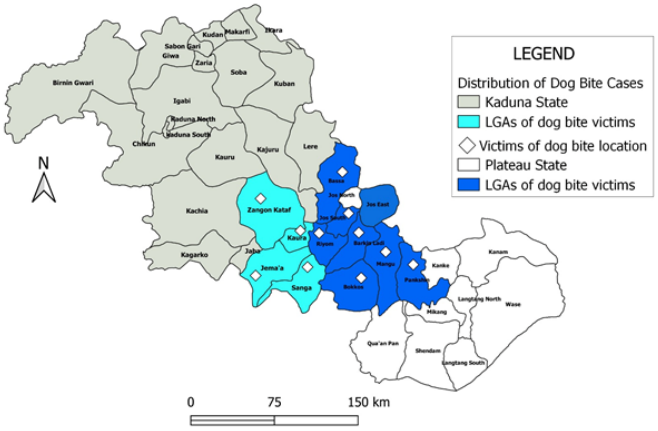

Figure 1: Map showing Jos South LGA and surrounding Areas indicating the origins of dog bite victims

Table 2: Profile of Indigenous dog breeds involved in a bite and their ARVS[a] status

Characteristics	Freq (n)	Percent (%)	95% CI
Ownership			
Known owner	111	77.6	0.70–0.84
Stray	32	22.4	0.16–0.30
Sex			
Male	58	40.6	0.32–0.50
Female	52	36.4	0.28–0.45
Unknown	33	23.0	0.16–0.31
Age			
0–6 mth	23	16.1	0.10–0.23
>6<1 yr	12	8.8	0.04–0.14
≥ 1 yr	71	47.7	0.41–0.58
Unknown	37	25.9	0.19–0.34
ARVS			
No/unknown/expired	132	92.3	0.87–0.96
Yes/current	11	7.7	0.04–0.13

ARVS: Anti-rabies vaccine status

A total of 132 out of 143 (92.3%) of the dogs had no history of rabies vaccination, had expired vaccination, or their vaccination status was unknown. Most of the bite incidents (66.6%; 95 cases) were classified as unprovoked, with all involving indigenous breeds (Table 3).

Additionally, the majority of the victims, 62.2% (89 of 143), were children and adolescents under 20 years of age (Table 4). Males accounted for 53.1% (76 of 143) of the victims (Table 4). The incidence rate of dog bites in this study was calculated at 46.6 bites per 100,000 population (Figure 2).

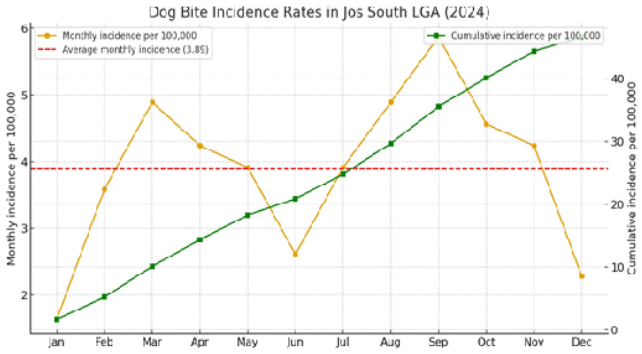

Figure 2: Incidence rates of 46.6 dog bites per 100,000 in Jos South LGA over a period of 12 months in 2024 as reported at the Veterinary Hospital FCAHPT, Vom

The number of reported cases was lowest in January, followed by a peak in March. A slight decline was observed in June, with another increase in July and a subsequent peak in September, before declining again in December (Figure 2).

Out of the 36 dog brain samples of offending dogs that died or were killed and analyzed at the NVRI rabies diagnostic laboratory, 28 (77.8%) were positive for rabies using the direct fluorescent antibody test (DFAT).

Table 3: Bite Circumstances/Dog breed

Variables	Freq (n)	Percent (%)	95% CI
CoB[a]			
Provoked	48	33.6	0.26–0.42
Unprovoked	95	66.4	0.58–0.74
Breed			
Local	143	100.0	0.98–1.00
Exotic	0	0.0	0.00–0.03

CoB: Circumstances of Bite

Table 4: Sex and Age of victims of dog bites presented at a Veterinary Hospital in Plateau State

Characteristics	Freq (n)	Percent (%)	95% CI
Sex			
Male	76	53.1	0.45–0.62
Female	67	46.9	0.38–0.55
Age (years)			
0–5	9	6.3	0.03–0.12
6–20	80	55.9	0.47–0.64
>20	54	37.8	0.30–0.46

Discussion

A total of 143 dog bite cases were recorded in this study, representing an incidence rate of 46.6 per 100,000 population, indicating an upward trend in dog bite frequency in Jos South. Globally, an estimated 59,000 human deaths occur annually due to rabies, with the majority of cases linked to bites from infected dogs Hampson et al., 2015; Ikye-Tor et al., 2020; World Health Organization (WHO), 2018. The incidence of dog bites, the primary route of rabies transmission, varies across regions and time periods. For example, Iyalomhe & Iyalomhe, 2015 documented 47 dog bite cases over a 20-year period (1994–2014) in Auchi, Nigeria, while Ikye-Tor et al., 2020 reported 139 cases over 15 years in Makurdi, Benue State. More recently, Obialigwe et al., 2024 reported 533 cases over 11 years in Jalingo, Taraba State. The comparably high frequency of dog bite incidents in this present study highlights a serious public health concern, including risks of human rabies and post-traumatic stress disorder among bite victims.

Jos South and neighbouring LGAs are characterized by extensive human-animal interaction, partly due to the presence of two major dog markets in Jos South and Kanke LGAs Konzing et al., 2019. Dog breeding for companionship, security, and even human consumption is widely practiced. These cultural and economic factors, coupled with low public awareness and weak enforcement of dog ownership regulations, likely contribute to the rising incidence of dog bites. There is an urgent need to strengthen rabies prevention through comprehensive public education, stricter enforcement of vaccination and licensing laws, and the establishment of robust surveillance systems.

Evidence shows that timely administration of post-exposure prophylaxis (PEP) is highly effective in preventing rabies infection World Health Organization, 2022. In this study, most victims reported their bite incident early (within 0–3 days), suggesting a positive health-seeking behaviour. However, nearly one quarter of victims presented more than seven days post-exposure, indicating a significant delay in timely medical intervention.

In Nigeria, as in many developing countries, a large proportion of dogs roam freely, increasing attack risks and rabies transmission potential Obialigwe et al., 2024. In this study, 77.6% of bites involved owned dogs that were neither confined nor properly restrained at the time of the attack. This finding aligns with previous studies Alabi et al., 2014; Ogundare et al., 2017, which reported 74–78.6% of dog bite cases involving unrestrained owned dogs. The lack of control reflects weak enforcement of animal regulations and underscores the need for sustained awareness campaigns promoting responsible dog ownership.

Indigenous dog breeds are generally managed under extensive systems with minimal restriction, unlike exotic breeds, which are more confined and vaccinated Otolorin et al., 2014. The low vaccination rates among indigenous dogs, often due to their perceived lower economic and social value, likely contribute to their major role in sustaining rabies transmission.

Most of the offending dogs (47.7%) were at least one year old. Adult dogs tend to be more territorial or aggressive, increasing their likelihood of biting humans. Furthermore, 92.3% of biting dogs in this study were unvaccinated or had unknown vaccination histories, reflecting persistently low vaccination coverage similar to trends observed elsewhere in Nigeria Bata et al., 2011; Ehimiyein et al., 2014; Otolorin et al., 2014. These findings highlight the need for mass rabies vaccination campaigns and stricter enforcement of existing regulations.

Children and adolescents under 20 years constituted the majority of bite victims, consistent with numerous studies Alabi et al., 2014; Andrade et al., 2019; Bata et al., 2011; De Keuster et al., 2006; Evangelio et al., 2020; Hasoon et al., 2020; Ogundare et al., 2017; Salomão et al., 2017. Their increased vulnerability may result from limited ability to interpret canine behaviour, playful tendencies that provoke dogs, and reduced defensive capacity Abubakar & Bakari, 2012; Omoke & Chukwueloka, 2018. However, other studies have reported a higher prevalence among adults Apeh et al., 2021; Hambolu et al., 2014; Isek et al., 2019; Obialigwe et al., 2024; Otolorin et al., 2014, suggesting that demographic variations may be shaped by socio-cultural and ownership patterns.

Globally and locally, males are more frequently affected by dog bites Obialigwe et al., 2024, a pattern corroborated by the current study and many others Konzing et al., 2019, Abubakar & Bakari, 2012; Alabi et al., 2014; Apeh et al., 2021; Hambolu et al., 2014; Iwuozo et al., 2022; N. S. Karshima et al., 2013; Ogundare et al., 2017; Otolorin et al., 2014; Yibrah & Damtie, 2015. Males' greater involvement in outdoor activities and risk-prone behaviours, such as rough play and approaching unfamiliar dogs, likely increases their vulnerability.

Dog bite incidents occurred year-round with modest monthly variations, similar to findings by Ehimiyein et al., 2014. Fewer cases were observed in January and December, with peaks in March, July, and September. Seasonal variations appear to align with transitions between dry (November–March) and rainy (April–October) seasons. In-

creased outdoor activity and dog breeding during festive periods may also contribute to these peaks Garba et al., 2005, Hasoon et al., 2020. Further studies are needed to clarify these seasonal dynamics.

Out of 36 dog heads submitted to the rabies diagnostic laboratory, 28 (77.8%) were DFAT-positive, indicating that rabies remains endemic in the dog population. This detection rate is markedly higher than the 1.58% reported in Lagos by Hambolu et al., 2014. This study, however, was limited to a single veterinary facility and may not fully represent all dog bite incidents in Plateau State. Additionally, only dogs that died or were killed were tested, which may underestimate true rabies prevalence.

Conclusion

This study examined the incidence of dog bites, the distribution of cases, and the associated risk of human rabies exposure. Findings revealed low rabies vaccination coverage among indigenous dog breeds, with children and adolescents under 20 years being the most affected group. This underscores the need for targeted interventions for this vulnerable population. The high number of laboratory-confirmed rabies cases indicates that the disease remains endemic in the study area. Strengthening enforcement of rabies vaccination laws, implementing large-scale vaccination campaigns, promoting responsible dog ownership, and expanding community awareness programs are essential strategies for reducing the public health burden of rabies in Nigeria.

Authors' Contributions

The research was carried out in collaboration with all the authors. Ishaku Bata Shalangwa, Asabe Dzikwi, and David Ehizibolo conceived and designed the study. Habiba Momoh Abdullateef, Sini Tekki, Levitcus Konzing, Kenneth Ogbu Ikejiofor, Eunice Agwuyo Alade, and Ishaku Bata Shalangwa drafted and designed the data collection tools. Abdullahi Maimadu, Sabo Jibril, Maikasuwa Hassan, Pam Amallam, Abbas Salihu Obalisa, Adebowale Nehemiah Poman, and Benedict Datong participated in data collection. Ishaku Bata Shalangwa, Rebecca Weka, Rhoda Yamatiya Bwala, Gushe Dan Fom, Johnson Lawrence, Olabode Mayowa, Oguche Moses, and Sati Molwat Michal sorted, analyzed, and interpreted the data. Ishaku Bata Shalangwa, Asabe Dzikwi, David Ehizibolo, Ayo Aladeshuyi, and Sini Tekki wrote the first draft of the article. David Ehizibolo, Asabe Dzikwi, and Ayo Aladeshuyi carried out the critical review. All authors have read and approved the final version of the manuscript.

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No funding was obtained for this study.

Conflict of Interest

The authors declare that no conflict of interest exists regarding the publication of this paper.

References

Abubakar, S. A., & Bakari, A. G. (2012). Incidence of dog bite injuries and clinical rabies in a tertiary health care institution: A 10-year retrospective study. *Annals of African Medicine*, *11*, 108–111. https://doi.org/10.4103/1596-3519.93534

Aguèmon, C. T., Tarantula, A., Zoumènou, E., Goyet, S., Assouto, P., Ly, S., Mewanau, S., Bourhy, H., Dodet, B., & Aguèmon, A. R. (2016). Rabies transmission risk during peripartum—two cases and a review of literature. *Vaccine*, *34*(15), 1752–1757.

Alabi, O., Nguku, P., Chukwukere, S., Gaddo, A., Nsubuga, P., & Umoh, J. (2014). Profile of dog bite victims in jos plateau state, nigeria: A review of dog bite records (2006–2008). *Pan African Medical Journal*, *18*(Suppl 1), 12.

American Veterinary Medical Association (AVMA). (2001). A community approach to dog bite prevention. *Journal of the American Veterinary Medical Association*, *218*(11), 1732–1749.

Andrade, B. F. M. D., Andrade, T. S. M., & Queiroz, I. H. (2019). Human rabies post-exposure prophylaxis relative to the disease epidemiological status. *Ciência & Saúde Coletiva*, *24*, 315–322.

Apanga, P. A., Awoonor-Williams, J. K., Acheampong, M., & Adam, M. A. (2016). A presumptive case of human rabies: A rare survived case in rural ghana. *Frontiers in Public Health*. https://doi.org/10.3389/fpubh.2016.00256

Apeh, D., Nwagbo, P. O., Ifende, V. I., Oguche, M. O., & Simon, E. (2021). Appraisal of dog bite cases in federal medical centre, umuahia abia state – nigeria. *Sokoto Journal of Veterinary Sciences*, *19*(1), 14–20.

Bashar, M., & Duggal, M. (2019). Seasonal variation in incidence and severity of dog bites in a union territory of northern india. *Journal of Clinical and Diagnostic Research*, *13*(9), LM01–LM04.

Bata, S. I., Dzikwi, A. A., & Ayika, D. G. (2011). Retrospective study of dog bite cases reported to ecwa veterinary clinic, bukuru, plateau state, nigeria. *Science World Journal*, *6*, 17–19.

Centers for Disease Control and Prevention. (2011). *Rabies guidance document*. Retrieved November 20, 2025, from https://www.cdc.gov/rabies/mediapdfs/2024/11/rabiesdfaspv2.pdf

De Keuster, T., Lamoureux, J., & Kahn, A. (2006). Epidemiology of dog bites: A belgian experience of canine behaviour and public health concerns. *Veterinary Journal*, *172*(3), 482–487.

Dhand, N. K., Gyeltshen, T., Firestone, S., Zangmo, C., Dema, C., Gyelshen, R., & Ward, M. P. (2011). Dog bites in humans and estimating human rabies mortality in rabies endemic areas of bhutan. *PLoS Neglected Tropical Diseases*.

Ehimiyein, A. M., Nanfa, F., Ehimiyein, I. O., & Jahun, B. M. (2014). Retrospective study of dog bite cases at ahmadu bello university, zaria, nigeria and its environment. *Veterinary World*, *7*(8), 617–621.

Evangelio, S. A., Satur, D. A., Lachica, Z. P. T., Mata, M. A. E., & Alviola, P. A. (2020). Risk factor analysis for dog bite victims

in davao city, southern philippines. *Philippine Journal of Science*, *149*(2), 225–233.

Garba, A., Oyetunde, I. L., Kumbish, P. R., Clement, A. M., Chiko, K. L., Ahmed, J. S., Lapang, H., Dashe, Y., Tunde, O., & Banyigyi, S. A. (2005). A retrospective study of biting dogs and rabies in vom, plateau state. *Vom Journal of Veterinary Sciences*, *1*(2), 57–63.

Hambolu, S. E., Dzikwi, A. A., Kwaga, J. K. P., Kazeem, H. M., Umoh, J. U., & Hambolu, D. A. (2014). Rabies and dog bites cases in lagos state, nigeria: A prevalence and retrospective studies (2006–2011). *Global Journal of Health Science*, *6*(1).

Hampson, K., Coudeville, L., Lembo, T., Sambo, M., Kiefer, A., Attlan, M., & Costa, P. (2015). Estimating the global burden of endemic canine rabies. *PLoS Neglected Tropical Diseases*, *9*, e0003709. https://doi.org/10.1371/journal.pntd.0003709

Hasoon, B. C., Shipp, A. E., & Hasoon, J. (2020). A look at the incidence and risk factors for dog bites in unincorporated harris county, texas, usa. *Veterinary World*, *13*(3), 419–425.

Ikye-Tor, P. M., Kwaga, J. K., Kia, G. S. N., Umoh, J. U., & Ikye-Tor, T. J. I. (2020). Retrospective study of dog bites and cases of rabies virus infected dogs in slaughter houses in makurdi, nigeria. *Sokoto Journal of Veterinary Sciences*, *18*(1), 18–26.

Iloeje, N. P. (2001). *A new geography of nigeria* (New revised ed.). Longman.

Isek, I., Umoh, U., & Dzikwi, A. (2019). A retrospective study of dog bite occurrence and anti-rabies vaccination of dogs in a state hospital in ogoja, cross river state, nigeria. *Veterinaria Italiana*, *55*(2), 163–168. https://doi.org/10.12834/VetIt.150.4315

Iwuozo, E. U., Kohol, E. S., Okeke, A. U., Bitto, T. T., Mbaave, T. P., & Ogiator, M. O. (2022). An eight-year review of the frequency and outcome of dog bite and clinical rabies in a teaching hospital in north central nigeria. *World Journal of Neuroscience*, *12*, 203–215. https://doi.org/10.4236/wjns.2022.124021

Iyalomhe, B. S., & Iyalomhe, S. I. (2015). Dog bite and clinical rabies in a suburban hospital in nigeria: A 20-year retrospective study of prevalence and treatment with anti-rabies vaccine. *World Journal of Pharmaceutical Research*, *4*(1), 113–121.

Karshima, N. S., Kujul, N. B., Ogbu, K. I., Abdullateef, M. H., Dung, P. A., & Salihu, A. A. (2013). Incidence and risk factors associated with rabies and dog bites among dogs involved in bites in plateau state, nigeria between 2011 and 2012. *Journal on Animal Science Advances*, *3*(3), 114–120.

Karshima, S. N., Bata, S. I., Bot, C., Kujul, B. N., Paman, N. D., Obalisa, A., Karshima, M. N., Dunka, H. I., & Oziegbe, S. D. (2020). Prevalence, seasonal and geographical distribution of parasitic diseases in dogs in Plateau state, nigeria: A 30-year retrospective study (1986–2015). *Journal of Parasitic Diseases*, *44*, 511–520. https://doi.org/10.1007/s12639-020-01219-3

Konzing, L., Kwaga, J. K. P., Kia, G. S. N., & Kazeem, H. M. (2019). A retrospective study of dog bite cases reported to some hospitals in plateau state, nigeria. *Sokoto Journal of Veterinary Sciences*, *17*(1), 56–61.

Martin, W., Alan, M., & Preben, W. (1987). *Veterinary epidemiology: Principles and methods*. Iowa State University Press.

Mshelbwala, P. P., Ogunkoya, A. B., & Maikai, B. V. (2013). Detection of rabies antigen in the saliva and brains of apparently healthy dogs slaughtered for human consumption and its public health implications in abia state, nigeria [5 pages]. *Veterinary Science*, Article ID 468043.

Obialigwe, T. F., Garba, L., Nyifi, S., Uko, I. B., Bilbonga, G., Ekechukwu, K. C., & Tanimu, E. (2024). Retrospective study of dog bite cases in federal medical centre jalingo, taraba state, nigeria. *Science World Journal*, *19*(3).

Ogundare, E. O., Olatunya, O. S., Oluwayemi, I. O., Inubile, A. J., Taiwo, A. B., Agaja, O. T., Airemionkhale, A., & Fabunmi, A. (2017). Pattern and outcome of dog bite injuries among children in ado-ekiti, southwest nigeria. *The Pan African Medical Journal*. https://doi.org/10.11604/pamj.27.81.7360

Omoke, N. I., & Chukwueloka, O. N. O. (2018). Incidence and pattern of dog bite injuries treated in the emergency room of a teaching hospital, south east nigeria. *African Journal of Medical and Health Sciences*, *17*, 35–40.

Organization, W. H. (2018). Animal bites: Dog bites [Retrieved from WHO website].

Otolorin, G. R., Umoh, J. U., & Dzikwi, A. A. (2014). Cases of dog bite in aba, abia state nigeria and its public health significance. *International Journal of Tropical Disease and Health*, *4*(10), 1097–1103.

Salomão, C., Nacima, A., Cuamba, L., Gujral, L., Amiel, O., Baltazar, C., Cliff, J., & Gudo, E. S. (2017). Epidemiology, clinical features, and risk factors for human rabies and animal bites during an outbreak of rabies in maputo and matola cities, mozambique, 2014. *PLoS Neglected Tropical Diseases*, *11*(7), e0005787. https://doi.org/10.1371/journal.pntd.0005787

Sivagurunathan, C., Umadevi, R., Balaji, A., Rama, R., & Gopalakrishnan, S. (2021). Knowledge, attitude, and practice study on animal bite, rabies, and its prevention in an urban community. *Journal of Family Medicine and Primary Care*, *10*(2), 850–858.

World Health Organization. (2022). *Rabies: Key facts*. Retrieved November 11, 2025, from https://www.who.int/news-room/fact-sheets/detail/rabies

World Health Organization (WHO). (2018). *Who expert consultation on rabies: Third report* (Technical Report No. 1012). World Health Organization. Geneva, Switzerland.

Yibrah, M., & Damtie, D. (2015). Incidence of human rabies exposure and associated factors at the gondar health centre, ethiopia: A three-year retrospective study. *Infectious Diseases of Poverty*, *4*(3), 1–6.