



PREVALENCE AND SPECIES DIVERSITY OF GASTROINTESTINAL PARASITES IN DOGS IN SELECTED PARTS OF SABON GARI, ZARIA, NIGERIA: A COMBINED RETROSPECTIVE AND PROSPECTIVE STUDY

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ABSTRACT

Gastrointestinal (GI) parasites in dogs pose significant veterinary and public health risks in developing regions due to poor sanitation and close human-animal contact. This study investigated the prevalence and diversity of GI parasites in Sabon Gari, Zaria, Nigeria. A retrospective review of laboratory records (2012–2016, n=376) and a prospective cross-sectional survey (January–March 2017, n=89) were conducted. Prospective faecal samples were examined using the zinc sulphate–sucrose flotation technique. Retrospective data revealed an overall prevalence of 44.7% (168/376), with the highest prevalence recorded in 2012 (57.5%; p=0.027). While females (48.4%) and the wet season (45.5%) showed higher rates than males (41.9%) and the dry season (44.0%), these differences were not statistically significant (p>0.05). In the prospective study, overall prevalence was 47.2%, with female dogs (61.8%) having a significantly higher prevalence than males (38.2%; p=0.03). Identified parasites included *Taenia* spp. (12.4%), *Isospora* spp. (9.0%), *Toxocara canis* (6.7%), and *Ancylostoma caninum* (6.7%), alongside species such as *Trichuris vulpis* and *Dipylidium caninum*. GI parasites are endemic in Sabon Gari dogs, presenting notable zoonotic risks. Enhanced public awareness, routine deworming, and improved management of dogs are essential to limit environmental contamination and transmission.

Keywords: Dogs; Gastrointestinal parasites; Prevalence; Sabon Gari; Zoonosis

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INTRODUCTION

Dogs have maintained a close association with humans for thousands of years, where they serve different roles that range from companionship and security to hunting, transportation, and food sources. Their integration into human societies, particularly in urban and peri-urban environments, has increased their relevance in both socio-economic and public health contexts [1, 2]. In regions like northern Nigeria, dogs are commonly kept for guarding homes, hunting, and occasionally for consumption, thereby increasing the intensity of human–animal interactions [3]. This close relationship, while beneficial, also creates opportunities for the transmission of infectious diseases, especially zoonotic parasites [4].

Gastrointestinal (GIN) parasites remain one of the most significant health challenges affecting canine populations worldwide. These parasites, including helminths and protozoans, frequently establish subclinical infections which allow infected dogs to act as reservoirs of infection without obvious clinical signs [5, 6, 7]. Their impact extends beyond animal health, as many of these parasites possess zoonotic potential, thereby posing serious risks to human populations [8]. In densely populated areas where sanitation is poor and veterinary care is limited,

environmental contamination with infective stages of parasites becomes a critical factor in disease transmission [9].

Previous studies across different regions of the world, including Africa, Europe, and Asia, have consistently reported varying prevalence rates of canine GIN parasites, influenced by climatic conditions, management practices, and access to veterinary services [5, 7]. In Nigeria, several investigations have documented high infection rates among dogs, particularly in areas with large populations of stray or semi-confined animals [10 - 14]. Despite these reports, there remains a gap in localised epidemiological data and temporal patterns of infection in specific communities such as Sabon Gari, Zaria.

Given the public health implications and the limited availability of comprehensive local data, this study was designed to determine the prevalence, distribution, and types of GIN parasites affecting dogs in Sabon Gari, Zaria. Through a combination of retrospective and prospective analyses, the study provides a comprehensive epidemiological assessment. The findings are expected to contribute baseline data necessary for the development of effective parasite control strategies and to inform

public health interventions aimed at reducing zoonotic risks associated with canine populations.

MATERIALS AND METHODS

Study area

The study was conducted in Sabon Gari, Zaria, Kaduna State, Nigeria, an urban centre located in the northern savannah region. The area lies at latitude 11.03818°N and longitude 7.70454°E, with an average annual temperature of 25.6°C. Sabon Gari experiences a tropical wet and dry climate, characterised by a rainy season from April to September and a dry season from October to March [15].

Study design

This study employed both retrospective observational and prospective cross-sectional designs. The retrospective component involved the analysis of laboratory records of canine faecal samples examined between 2012 and 2016 at the Helminthology Laboratory of the Department of Veterinary Parasitology and Entomology, Ahmadu Bello University, Zaria. Data extracted included number of samples examined, infection status, sex of animals, seasonal distribution, and identified parasite species. The prospective study involved active collection and laboratory examination of faecal samples from dogs between January and March 2017 using standard flotation techniques.

Sample size determination

The sample size was determined using the formula described by Thrusfield [16] at a 95% confidence level and 5% precision. An expected prevalence was selected based on previous studies of gastrointestinal parasites in dogs in Nigeria [8]. A total of 376 samples were available for the retrospective review and 89 samples in the prospective survey.

Study animals

A total of 89 household dogs of varying ages and sexes were prospectively and purposively sampled from four selected communities in Sabon Gari Local Government Area, namely Unguwar Mai Godo, Unguwar Kanawa, Unguwar Jaba, and Cemetery Road.

Sample collection

Dogs were physically restrained, and approximately 5 g of faecal material was collected directly from the rectum using sterile gloves. Samples were placed in labelled polythene bags indicating the date, sex and identification of each animal and transported in a cool box to the Helminthology laboratory at the

Department of Veterinary Parasitology and Entomology, Ahmadu Bello University. Samples were stored at 4°C prior to analysis.

Sample processing

A zinc sulphate–sucrose flotation solution (specific gravity 1.27) was prepared by dissolving zinc sulphate and sucrose in boiling distilled water, after which thymol was added as a preservative following standard parasitological procedures [17]. Faecal samples (2–3 g) were processed using the simple flotation technique as previously described [18]. Samples were homogenised, filtered, and allowed to stand for 5–10 minutes to permit flotation of helminth eggs. Cover slips were then carefully removed and examined under a microscope at $\times 10$ and $\times 40$ magnifications for identification of helminth eggs protozoa oocysts.

Statistical analysis

Data were analysed using GraphPad Prism version 5.0. Chi-square tests were used to assess associations between variables such as sex, season, and infection status. Statistical significance was set at $p < 0.05$.

RESULTS

Retrospective study (2012–2016)

The retrospective analysis covering 2012–2016 revealed a substantial burden of GIN parasites among dogs in Sabon Gari, with an overall prevalence of 44.7% (Table 1). Annual variation showed that infection rates fluctuated significantly across the five year ($\chi^2 = 12.637$; $p = 0.027$). The highest prevalence was recorded in 2012 (57.5%), followed by a gradual decline in 2014 and 2015, with the lowest value observed in 2015 (34.1%), before rising again in 2016 (49.2%) (Table 1).

Sex-based analysis indicated a slightly higher prevalence in females (48.4%) compared to males (41.9%), although the difference was not statistically significant ($\chi^2 = 1.565$; $p = 0.211$) (Table 2).

Seasonal analysis showed slightly higher prevalence during the wet season (45.5%) compared to the dry season (44.0%), but the difference was not statistically significant ($\chi^2 = 0.080$; $p = 0.777$) (Table 3).

Parasite species distribution (Table 4) showed that *Isospora* (12.5%) was the most frequently detected parasite over the study period, followed by *Ancylostoma* (10.1%) and *Taenia* spp. (9.6%). Other parasites such as *Toxocara* (6.7%) and *Dipylidium* (4.3%) were also commonly observed, while *Trichuris*, *Capillaria*, *Physaloptera*, and *Spirocerca* occurred at very low frequencies ($\leq 0.5\%$).

Table 1: Annual distribution and prevalence of gastrointestinal parasites in dogs presented to the Veterinary

Teaching Hospital of Ahmadu Bello University, Zaria in Sabon Gari Area, Kaduna State, Nigeria (2012–2016)

Year	Number of dogs screened	Number of dogs positive	Percentage positive (%)	χ^2	p-value
2012	87	50	57.5	12.637	0.027
2013	73	34	46.6		
2014	70	25	35.7		
2015	85	29	34.1		
2016	61	30	49.2		
Total	376	168	44.7		

Table 2: Sex-related prevalence of gastrointestinal parasites among dogs presented to the Veterinary Teaching Hospital of Ahmadu Bello University, Zaria in Sabon Gari Area, Kaduna State, Nigeria (2012–2016)

Sex	Number of dogs screened	No. of dogs positive (%)	Chi-square	p-value
Male	217	91 (41.9)	1.565	0.2110
Female	159	77 (48.4)		
Total	376	168 (44.7)		

Table 3: Seasonal variation in the prevalence of gastrointestinal parasites among dogs presented to the Veterinary Teaching Hospital of Ahmadu Bello University, Zaria in Sabon Gari Area, Kaduna State, Nigeria (2012–2016)

Season	Number of dogs screened	No. of dogs positive (%)	Chi-square	p-value
Dry	200	88 (44.0)	0.080	0.777
Wet	176	80 (45.5)		
Total	376	168 (44.7)		

Table 4: Year-wise distribution of the identified gastrointestinal parasite species among dogs presented to the Veterinary Teaching Hospital of Ahmadu Bello University, Zaria in Sabon Gari Area, Kaduna State, Nigeria (2012–2016)

	Year					
Gastrointestinal parasite taxa	2012	2013	2014	2015	2016	Total
<i>Isospora</i>	18 (20.7)	7 (9.6)	4 (5.8)	10 (11.8)	8 (13.1)	47 (12.5)
<i>Toxocara</i>	9 (10.3)	3 (4.1)	4 (5.8)	4 (4.7)	5 (8.2)	25 (6.7)
<i>Ancylostoma</i>	14 (16.1)	8 (11.0)	6 (8.7)	4 (4.7)	6 (9.8)	38 (10.1)
<i>Taenia</i>	7 (8.0)	10 (13.7)	9 (13.0)	6 (7.1)	4 (6.6)	36 (9.6)
<i>Dipylidium</i>	1 (1.1)	4 (5.5)	2 (2.9)	4 (4.7)	6 (9.8)	16 (4.3)
<i>Trichuris</i>	0 (0.0)	2 (2.7)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.5)
<i>Capillaria</i>	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.2)	0 (0.0)	1 (0.3)
<i>Physaloptera</i>	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.6)	1 (0.3)
<i>Spirocerca</i>	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.6)	1 (0.3)

Prospective study (2017)

Out of 89 samples analyzed, 42 were positive, giving an overall prevalence of 47.2% (Table 5). Sex-associated distribution showed that gastrointestinal parasite infection occurred in both sexes, with a higher proportion recorded in females (61.8%) compared with males (38.2%). The association between sex and infection status was statistically significant ($\chi^2 = 4.689$, $p = 0.03$) (Table 5).

Across all dogs examined, nine gastrointestinal parasite genera were identified. *Taenia* had the highest occurrence (12.4%), followed by *Isospora* (9.0%). *Toxocara* and *Ancylostoma* each recorded equal proportions (6.7%), while *Dipylidium* accounted for 4.5%. *Capillaria* and *Spirocerca* each contributed 2.2%, with *Trichuris* and *Physaloptera* both recording the lowest individual proportions (1.1% each). More than half of the examined dogs

showed no detectable ova or oocysts (53.9%) (Table 6).

Monthly distribution of infection varied across the study period. January recorded the highest proportion of positive cases (62.5%), followed by February (46.4%), while March recorded the lowest (31.0%). The variation across months was statistically significant ($\chi^2 = 6.053$, $p = 0.048$), reflecting differences in infection levels over the study period (Table 7).

Species distribution by sex showed variation in the occurrence of individual parasites between male and female dogs. Male dogs accounted for higher proportions of *Isospora* (12.7%) and *Trichuris* (1.8%), while females recorded higher proportions of *Taenia* (20.6%), *Ancylostoma* (14.7%), *Dipylidium* (11.8%), and *Spirocerca* (5.9%). *Capillaria* was detected only in males (3.6%), while *Physaloptera* was recorded in a single sex group. No ova or oocysts were observed in 63.6% of males and 38.2% of females (Table 8).

Table 5: Sex-associated prevalence of gastrointestinal parasites in dogs examined during the prospective study in selected areas of Sabon Gari LGA, Kaduna State, Nigeria (January–March 2017)

Sex	Number of dogs sampled	Number of dogs Positive (%)	χ^2	P-value
Male	55	21 (38.2)	4.689	0.03
Female	34	21 (61.8)		
Total	89	42 (47.2)		

Table 6: Frequency distribution and prevalence of gastrointestinal parasite species identified in dogs during the prospective study in selected areas of Sabon Gari LGA, Kaduna State, Nigeria (January–March 2017)

Gastrointestinal parasite taxa	Frequency	Prevalence (%)
<i>Trichuris</i>	1	1.1
<i>Physaloptera</i>	1	1.1
<i>Capillaria</i>	2	2.2
<i>Spirocerca</i>	2	2.2
<i>Dipylidium</i>	4	4.5
<i>Toxocara</i>	6	6.7
<i>Ancylostoma</i>	6	6.7
<i>Isospora</i>	8	9.0
<i>Taenia</i>	11	12.4
No ova or oocysts seen	48	53.9
Total	89	100.0

Table 7: Monthly distribution and prevalence of gastrointestinal parasites among dogs examined in selected areas of Sabon Gari LGA, Kaduna State, Nigeria (January–March 2017)

Month	Total	No ova or oocysts seen (%)	Positive (%)	χ^2	p-value
January	32	12 (37.5%)	20 (62.5%)	6.053	0.048
February	28	15 (53.6%)	13 (46.4%)		
March	29	20 (69.00%)	9 (31.0%)		
Total	89	47 (52.8%)	42 (47.2%)		

Table 8: Sex-based distribution of gastrointestinal parasite species among dogs examined during the prospective study in selected areas of Sabon Gari LGA, Kaduna State, Nigeria (January–March 2017)

Sex	Male	Female	Total
No ova or oocyst seen	35 (63.6%)	13 (38.2%)	48 (53.9%)
<i>Isospora</i>	7 (12.7%)	1 (2.9%)	8 (9.0%)
<i>Toxocara</i>	4 (7.3%)	2 (5.9%)	6 (6.7%)
<i>Ancylostoma</i>	1 (1.8%)	5 (14.7%)	6 (6.7%)
<i>Taenia</i>	4 (7.3%)	7 (20.6%)	11 (12.4%)
<i>Dipylidium</i>	0 (0.0%)	4 (11.8%)	4 (4.5%)
<i>Trichuris</i>	1 (1.8%)	0 (0.0%)	1 (1.1%)
<i>Capillaria</i>	2 (3.6%)	0 (0.0%)	2 (2.2%)
<i>Physaloptera</i>	1 (1.8%)	0 (0.0%)	1 (1.1%)
<i>Spirocerca</i>	0 (0.0%)	2 (5.9%)	2 (2.2%)

DISCUSSION

The findings of this study support the persistent burden of canine GIN parasites in urban and peri-urban settings in Nigeria, and these findings showed a pattern that aligns with reports from several parts of the country and other developing regions. Comparable prevalence levels have been documented in studies conducted in southeastern and southwestern Nigeria [8, 11], as well as in other African countries such as Ethiopia [5]. These similarities may suggest that despite geographical differences, common underlying factors, such as inadequate veterinary care, poor environmental sanitation, and high numbers of free-roaming dogs, continue to sustain parasite transmission cycles. The persistence of these infections might reflect systemic gaps in preventive veterinary services and public health awareness.

The temporal variation observed across the study period may be attributed to fluctuations in environmental conditions, changes in dog population dynamics, and varying levels of veterinary intervention over time. The observed decline in some years followed by a resurgence could be linked to inconsistent deworming practices and lack of sustained control programmes. Similar temporal trends were reported in longitudinal parasitological studies, where infection dynamics are influenced by intermittent interventions and ecological variability [8]. In areas like Sabon Gari, Zaria, where climatic conditions alternate between wet and dry seasons, the survival and development of infective stages in the environment may vary annually, thus, contributing to these fluctuations.

The absence of a statistically significant difference in infection between sexes in the retrospective data is in contrast with a significant association in the prospective component, and this suggests that sex-related susceptibility may be context-dependent. Female dogs often experience physiological stress during pregnancy and lactation, which could suppress immunity and increase susceptibility to parasitic infections [19]. This observation is consistent with findings from other studies that report higher parasite burdens in female animals under reproductive stress [20]. However, the inconsistency between study components indicates that sex alone may not be a strong independent risk factor, and its influence is likely modulated by management practices and nutritional status.

The lack of marked seasonal variation in infection prevalence is noteworthy, particularly in a region with distinct wet and dry seasons. While many studies have reported higher parasite prevalence during the rainy season due to favourable conditions for larval development and survival [7, 14, 21], the relatively stable prevalence observed in the present study might indicate continuous environmental contamination throughout the year. This could be driven by poor waste disposal practices and the presence of stray dogs, which maintain a constant source of infection regardless of

season. It may also suggest that in such endemic settings, transmission is less dependent on seasonal factors and more on sustained exposure.

The diversity of parasite species identified, in this study, might reflect a complex epidemiological landscape with both helminthic and protozoan infections co-circulating within the dog population. The predominance of parasites such as *Taenia*, *Isospora*, *Toxocara*, and *Ancylostoma* is consistent with previous reports in Nigeria and globally [7, 13]. The presence of these parasites is particularly significant due to their zoonotic potential. For instance, *Toxocara canis* is a well-known cause of visceral and ocular larva migrans in humans [22], while *Ancylostoma* species are associated with cutaneous larva migrans [23]. Their detection emphasises the public health relevance of canine parasitism, especially in communities where close human–dog interactions are common.

The relatively high occurrence of cestodes such as *Taenia* and *Dipylidium* may be linked to feeding habits and intermediate host availability. Dogs in the study area are often fed raw offal or allowed to scavenge, increasing their exposure to infective stages. Furthermore, the life cycle of *Dipylidium caninum* involves fleas as intermediate hosts, suggesting that inadequate ectoparasite control may also contribute to the high prevalence of infection [24]. This aligns with findings from other studies where inadequate control of intermediate hosts was identified as a key driver of cestode infections [10, 25].

Monthly variation observed in the prospective study provides further insight into short-term dynamics of infection. The higher infection rates earlier in the sampling period may be associated with residual environmental contamination from preceding months or increased susceptibility following seasonal transitions. Such short-term fluctuations were indicated in similar studies and are often influenced by micro-environmental factors, including humidity and temperature, which affect egg and larval viability [21, 26, 27, 28].

The detection of multiple parasite species with varying distributions between sexes may suggest differences in exposure patterns and behaviour. Female dogs showing higher proportions of certain parasites may reflect differences in roaming behaviour, feeding patterns, or physiological status [5]. However, the presence of less common parasites such as *Spirocerca* and *Physaloptera* might indicate exposure to specific intermediate hosts like beetles, thus, suggesting that some dogs engage in scavenging or hunting behaviours. This ecological dimension of parasite transmission is often overlooked but is critical for understanding infection risk in free-roaming dog populations.

From a public health perspective, the endemicity of zoonotic parasites in dogs within a densely populated area raises concerns about environmental contamination and human exposure, particularly among children who are more likely to

come into contact with contaminated soil. The results support previous assertions that dogs serve as important reservoirs for zoonotic infections in Nigeria [4, 9]. Without effective control measures, the risk of transmission to humans remains substantial and this supports the need for a One Health approach that integrates veterinary and human health interventions.

In practical terms, the study shows the urgent need for structured parasite control programmes, including routine deworming, improved dog management practices, and public education on zoonotic risks. Control of stray dog populations and enforcement of responsible pet ownership are also important. Environmental sanitation, particularly proper disposal of dog faeces, is critical in breaking the transmission cycles [5]. Therefore, these measures would not only improve canine health but also reduce the burden of zoonotic infections in the human population.

CONCLUSION

Canine gastrointestinal parasites are prevalent in Sabon Gari, Zaria, with diverse species of notable zoonotic importance circulating among dogs. The findings indicate sustained transmission driven by environmental contamination and suboptimal management practices. Regular deworming programmes, improved sanitation, and control of stray dog populations are necessary to reduce infection pressure. Hence, there is need to strengthen public awareness of zoonotic risks, while integrated One Health strategies involving veterinarians and public health authorities are recommended to effectively limit transmission and safeguard both animal and human health.

REFERENCES

1. BHATTACHARYYA, H.K. (2025). The intricate relationship between dogs and humans: Historical, cultural, and societal perspectives. *Pharma Innovation*, **14**(8): 01-06.
<https://doi.org/10.22271/tpi.2025.v14.i8a.26214>
2. FALLAHI, M., MASOUDI, A.A., VAEZ TORSHIZI, R. & MAGHSOUDI, A. (2024). Socio-economic evaluation of human-dog coexistence: A 40,000-year history. *Veterinary Medicine & Science*, **10**(6): e70012. <https://doi.org/10.1002/vms3.70012>
3. AIYEDUN, J.O. & OLUGASA, B.O. (2012). Identification and analysis of dog use, management practices and implications for rabies control in Ilorin, Nigeria. *Sokoto Journal of Veterinary Sciences*, **10**(2): 1-6.
<https://doi.org/10.4314/sokjvs.v10i2.1>
4. GADO, D.A., EHIZIBOLO, D.O., MESEKO, C.A., ANDERSON, N.E. & LURZ, P. W.W. (2023). Review of Emerging and Re-Emerging Zoonotic Pathogens of Dogs in Nigeria: Missing Link in One Health Approach. *Zoonotic Diseases*, **3**(2), 134-161.
5. BAYOU, K., TEREFE, G. & KUMSA, B. (2025). Epidemiology of gastrointestinal parasites of dogs in four districts of central Ethiopia: Prevalence and risk factors. *PloS One*, **20**(1), e0316539.
<https://doi.org/10.1371/journal.pone.0316539>
6. IDIKA, I.K., ONUORAH, E.C., OBI, C.F., UMEAKUANA, P.U., NWOSU, C.O., ONAH, D.N. & CHIEJINA, S.N. (2017). Prevalence of gastrointestinal helminth infections of dog in Enugu State, South Eastern Nigeria. *Parasite Epidemiology & Control*, **2**(3), 97-104.
<https://doi.org/10.1016/j.parepi.2017.05.004>
7. KELLY, M.A., ANDERSON, K., CASTRO, P.D.J., SAVARD, C., LOO, S., TERESKI, J., LEUTENEGGER, C.M. & VEROCAI, G.G. (2026). High prevalence of gastrointestinal parasites in dogs from Saipan, Northern Mariana Islands, including the zoonotic *Ancylostoma ceylanicum*. *Parasites & Vectors*, **19**(1): 93.
<https://doi.org/10.1186/s13071-026-07258-8>
8. KAMANI, J., MASSETTI, L., OLUBADE, T., BALAMI, J.A., SAMDI, K.M., TRAUB, R.J., COLELLA, V. & GONZÁLEZ-MIGUEL, J. (2021). Canine gastrointestinal parasites as a potential source of zoonotic infections in Nigeria: A nationwide survey. *Preventive Veterinary Medicine*, **192**: 105385.
<https://doi.org/10.1016/j.prevetmed.2021.105385>
9. NAMETOV, A., KARMALIYEV, R., SIDIKHOV, B., MURZABAYEV, K., ORYNKHANOV, K., KADRALIYEVA, B., YERTLEUOVA, B., GABDULLIN, D., ABILOVA, Z. & DUSHAYEVA, L. (2025). Stray Dogs as Reservoirs and Sources of Infectious and Parasitic Diseases in the Environment of the City of Uralsk in Western Kazakhstan. *Biology*, **14**(6): 683.
<https://doi.org/10.3390/biology14060683>
10. ADESOYE, O.A., OLANREWAJU, C.A., AMEH, U.C., MALANN, Y.D., AKINLEYE, C.A., AKINSETE, I.O., ADENYI, K.A. & OYENIRAN, O.A. (2024). Prevalence of Gastrointestinal Parasites of Stray Dogs in Suleja Metropolis, Niger State, Nigeria. *Sahel Journal of Life Sciences FUDMA*, **2**(4): 8-14.
<https://doi.org/10.33003/sajols-2024-0204-02>

11. AKANDE, F.A., OBISESAN, O.M., ADENIJI, S.D. & ADELAKUN, D.O. (2022). Detection and identification of gastrointestinal parasites in dogs presented to veterinary clinics in Abeokuta, Southwestern Nigeria. *Sokoto Journal of Veterinary Sciences*, **20**(1): 19–25. <http://dx.doi.org/10.4314/sokjvs.v20i1.3>
12. AMADI, A.N.C., OBETEN, P.I. & CHUKWUEMEKA, B.C. (2021). Prevalence of helminth parasites among dogs and risk factors of zoonotic infections by dog owners in Bende Local Government Area, Abia State, Nigeria. *Nigerian Journal of Parasitology*, **40**(2): <https://dx.doi.org/10.4314/njpar.v42i2.12>
13. EDO-TAIWO, O. & AKPAN-AUGUSTINE, F. (2024). Prevalence of gastrointestinal parasites in different dog breeds from selected areas in Ovia North East LGA, Edo State, Nigeria. *African Journal of Health, Safety & Environment*, **5**(2): 48-56. <https://doi.org/10.52417/ajhse.v5i2.524>
14. EZEMA, K.U., MALGWI, S.A., ZANGO, M.K., KYARI, F., TUKUR, S.M., MOHAMMED, A. & KAYERI, B.K. (2019). Gastrointestinal parasites of dogs (*Canis familiaris*) in Maiduguri, Borno State, Northeastern Nigeria: Risk factors and zoonotic implications for human health. *Veterinary World*, **12**(7): 1150–1153. <https://doi.org/10.14202/vetworld.2019.1150-1153>
15. ADAMU, I.B., AHMED, A., HASSAN, A.W., BALARABE, A., BASHIR, A.I. & SALIHU, S.A. (2024). Assessment of Rainfall and Temperature Trend in Zaria and its Environs, Kaduna State, Nigeria. *Bima Journal of Science and Technology*, **8**(2): 148-159. <https://doi.org/10.56892/bima.v8i2.668>
16. THRUSFIELD, M. (2005) *Veterinary Epidemiology*. (2nd Ed), Blackwell Science Ltd., London, 228-247 pp.
17. HANSEN, J. & PERRY, B. (1994). *The Epidemiology, Diagnosis, and Control of Helminth Parasites of Ruminants*. (4th Ed), International Laboratory for Research on Animal Diseases, Nairobi, 74 pp.
18. SOULSBY, E.J.L. (1982) *Helminths, Arthropods and Protozoa of Domesticated Animals*. (7th Ed), Bailliere Tindall, London, 630-637 pp.
19. FUSI, J., PERIC, T., PROBO, M., COTTICELLI, A., FAUSTINI, M. & VERONESI, M.C. (2021). How Stressful Is Maternity? Study about Cortisol and Dehydroepiandrosterone-Sulfate Coat and Claws Concentrations in Female Dogs from Mating to 60 Days Post-Partum. *Animals*, **11**(6), 1632. <https://doi.org/10.3390/ani11061632>
20. YIRSA, T., BIHONE, A., TESHAGER, G., MUKTAR, Y. & BERIHUN, A. (2025). Prevalence of gastrointestinal nematode parasites of dogs and associated risk factors in Gondar town, Northwest Ethiopia. *Heliyon*, **11**(2): e41174. <https://doi.org/10.1016/j.heliyon.2024.e41174>
21. MARTINS, A.J.D.A., ROCHA, A.C.D.S., ASSIS-SILVA, Z.M.D., MAIA, G.O., ALVES-RIBEIRO, B.S., DUARTE, R.B., MORAES, I.D.S., URZEDO, N.F.D., FERNANDES-SILVA, L., GOMES, A.P.C., FELIZARDA, S.M., OLIVEIRA, M.P., SATURNINO, K.C., REZENDE, H.H.A., RODRIGUES, R.M., RAMOS, D.G.D.S. & BRAGA, Í.A. (2025). Risk of Environmental Contamination by Gastrointestinal Parasites in Public Areas of the Central Plateau Microregion of Brazil: A Public Health Concern. *Pathogens*, **14**(3): 211. <https://doi.org/10.3390/pathogens14030211>
22. LOPEZ-ALAMILLO, S., PADYALA, P., CAREY, M., DUFFEY, M.M. & WEATHERHEAD, J.E. (2025). Human toxocariasis. *Clinical Microbiology Reviews*, **38**: e00101-23. <https://doi.org/10.1128/cmr.00101-23>
23. PALANIAPPAN, V., GOPINATH, H. & KARTHIKEAN, K. (2025). Cutaneous larva migrans, *Clinical & Experimental Dermatology*, **25**: llaf375. <https://doi.org/10.1093/ced/llaf375>
24. ROUSSEAU, J., CASTRO, A., NOVO, T. & MAIA, C. (2022). *Dipylidium caninum* in the twenty-first century: epidemiological studies and reported cases in companion animals and humans. *Parasites & Vectors*, **15**(1): 131. <https://doi.org/10.1186/s13071-022-05243-5>
25. MAGANIRA, J.D. (2025). Environmental contamination with taeniid cestode eggs: A systematic literature review. *Food & Waterborne Parasitology*, **41**: e00294. <https://doi.org/10.1016/j.fawpar.2025.e00294>
26. DUBIE, T., SIRE, S., FENTAHUN, G. & BIZUAYEHU, F. (2023). Prevalence of Gastrointestinal Helminths of Dogs and Associated Factors in Hawassa City of Sidama Region, Ethiopia. *Journal of Parasitology Research*, **23**: 6155741. <https://doi.org/10.1155/2023/6155741>
27. MARTINS, A.J.D.A., ROCHA, A.C.D.S., ASSIS-SILVA, Z.M.D., MAIA, G.O., ALVES-RIBEIRO, B.S., DUARTE, R.B., MORAES, I.D.S., URZEDO, N.F.D., FERNANDES-SILVA, L., GOMES,

- A.P.C., FELIZARDA, S.M., OLIVEIRA, M.P., SATURNINO, K.C., REZENDE, H.H.A., RODRIGUES, R.M., RAMOS, D.G.D.S. & BRAGA, Í.A. (2025). Risk of Environmental Contamination by Gastrointestinal Parasites in Public Areas of the Central Plateau Microregion of Brazil: A Public Health Concern. *Pathogens*, **14**(3): 211. <https://doi.org/10.3390/pathogens14030211>
28. NAGAMORI, Y., WARREN, Z., HOUMA, M. & SAMARAKOON, N. (2025). Regional and seasonal variability in canine parasitism across the United States. *Veterinary Parasitology*, **339**: 110579. <https://doi.org/10.1016/j.vetpar.2025.110579>