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Prevalence of single and mixed parasitic infections of dogs in Egbeda communities, Ibadan, Oyo State, Nigeria

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Abstract

Dogs harbour a wide array of parasites and have been implicated in the transmission of zoonotic diseases to humans. In a community-based cross-sectional study, 292 dogs and 241 dog owners were examined for parasites in urban and rural communities of Egbeda Local Government Area, Oyo State, Nigeria. A questionnaire was used to obtain socio-demographic information of dog owners and identify possible risk factors. Ectoparasites were collected from dog fur and preserved in 70% alcohol before identification. Freshly passed stools from dogs and their owners were collected and examined for intestinal parasites by modified sucrose floatation technique. Ectoparasites were present on 199 (68.2%) dogs, while 239 (81.8%) had intestinal parasites. Six ectoparasite species identified were *Ctenocephalides canis* (5.5%), *C. felis* (39.7%), *Rhipicephalus sanguineus* (51.3%), *Haemaphysalis leachii* (48.9), *Trichodectes canis* (2.1%) *and Linognathus* spp (1.7%). Gastrointestinal parasites identified in dogs were *Toxocara canis (55.8%), Ascaris* spp (36%), *Ancylostoma* spp (40.1%), *Trichuris* spp (7.5%), *Isospora* spp (14.4%) *and Toxascaris leonina* (15.1%). Prevalence of gastrointestinal as well as ectoparasites were higher in rural communities with more mongrels infected compared to exotic breeds ($p < 0.001$). *Ascaris lumbricoides, Ancyclostoma* spp *and Trichuris* spp were identified in 99 (41.1%) of the dog owners. There was a significant relationship ($r=0.36$, $p < 0.001$) between the prevalence of infection in dogs and their owners. Most (75%) of the dog owners were aware only of the possibility of contracting rabies but not other zoonotic parasitic infections from their dogs. The high prevalence of gastrointestinal and ectoparasites of dogs in these communities suggests a very high risk of parasite transmission among dogs, their owners and other inhabitants of the community. The need for intervention programs including regular anti-parasitic treatment of dogs and health education which emphasizes the dangers of zoonotic infections in these communities is imperative.

Keywords: Dog owners, Ectoparasites, Gastrointestinal parasites, Urban and Rural dogs, Zoonoses

Introduction

Dogs, one of the most common domestic animals worldwide, offer significant social and emotional benefits to their owners and are also used for hunting and security purposes. However, in spite of their benefits, dogs could be major public health threats as suggested by Umar (2009) because of their roles in the spread of a wide spectrum of zoonotic infections. These infections may be symptomatic or asymptomatic over time. Dogs have been implicated in the transmission of more than 60 zoonotic infectious diseases (Macpherson, 2005). They harbour a wide range of gastrointestinal parasites including; *Taenia* spp*, Echinococcus* spp*, Dipylidium caninum*, *Toxocara canis*, *Ancylostoma* spp, *Giardia* spp, and *Cryptosporidium* spp (Perera *et al.,* 2013). These parasites constitute a potential source of human infection from environment contaminated with dog faeces harbouring various infective stages of these parasites and which may persist in the environment for long periods of time (Degefu *et al*., 2011). Zoonotic diseases caused by intestinal helminth infections include visceral and ocular larval migrans caused by *Toxocara canis* and hookworm related cutaneous larval migrans resulting in anorexia, diarrhoea, anaemia and intestinal disorders (Singla & Juval, 2005; Moudgil *et al.,* 2012; Neves *et al*., 2014; De *et al.,* 2016). Ectoparasites of dogs such as ticks and fleas may act as vectors for pathogenic parasites, and can also transmit viruses, bacteria, protozoa or act as intermediate hosts for filarids and cestodes (Fuehrer *et al*., 2012). Fleas and mites can infest humans directly leading to the development of dermatitis (Aujla *et al.,* 2000; Scott *et al.,* 2001; Sood *et al.,* 2012).

Due to the lack of adequate policies regarding pet ownership and community health care in Nigeria, the dog population in most urban and rural communities are composed of roaming and homeless dogs. These free roaming dogs frequent public parks, playgrounds and house yards in search of food where they also contaminate the ground with their infective faeces. Dogs have also been reported to act as a transport host of many roundworms of man when they ingest infected human faeces (Traub *et al*., 2002, Dantas-Torres & Otranto, 2014). The risk of infection is increased by a favourable ecological condition that enhances egg development and human behavioural factors. The warm and humid climate supports the breeding and development of the parasites' infective stages in the environment. This, in turn, results in a continuous cycle of infection especially in the rural region where open defecation and inadequate personal hygiene is prevalent.

Prevalence of parasites in dogs varies due to various factors including the season of the year, climate, frequency and quality of veterinary care, and the dogs' living conditions (Mircean *et al*., 2010). This study provides information on the prevalence of gastrointestinal and ectoparasites in household dogs in Egbeda, Ibadan while highlighting likely zoonotic transmissions of such infections.

Materials and Methods

Study area

The study was conducted in Egbeda Local Government Area, Oyo State. The LGA is located between latitude 7º21 and 8ºN as well as between longitude 4º02 and 4º28E, with a total land area of approximately 191km^2 and has a population of 281,573 (NPC, 2006). Egbeda is bounded in the East by Osun River, in the North by Lagelu LGA and in the South by Ona- Ara LGA. It is located in the rain-forest agro-ecological zone of sub-Sahara Africa. The mean annual rainfall and temperature of the area are about 2500 – 2600mm and 27.5°C respectively.

Egbeda LGA has four urban and seven rural wards. A descriptive cross-sectional study was carried out in 4 political wards made up of two (2) urban political wards: [Ward 7 (Olodo) and ward 10 (Alakia, Olode)] and 2 rural political wards: [Ward 9 (Egbeda) and ward 1 (Erunmu)].

Study design and population

A total of 292 dogs and their respective owners were selected in a house-to-house screening which was carried out after obtaining the informed consent of dog owners. In households with more than one dog, only one dog (chosen by the dog owner) was included in this study to avoid a mix-up of dog faecal samples. Interviews were conducted with pre-tested structured questionnaires to obtain demographics, knowledge of the dog owners about parasitic zoonotic infections, and their attitude and practise which predisposes these dog owners to infection. The study was approved by the Ethical Committee of the Oyo State Ministry of Health.

A total of 292 dogs made up the study population of 205 mongrels and 87 exotic breeds. These consisted of 168 females and 124 males with 184 of the dogs living in urban communities, while 108 were owned by rural dwellers. The dogs were categorized into 3 age groups; with 120 being less than 6 months old, 62 above 6 months but less than 12months old and 110 were 12 months and above.

Faecal sample collection

Freshly voided faecal samples were collected from the dogs with the assistance of dog owners into labelled sterile bottles. Also, faecal samples were collected from corresponding dog owners for parasite examination. All samples were transported on ice to the Parasitology Laboratory, Department of Zoology, University of Ibadan and processed for microscopic examination.

Examination of dog's skin for ectoparasite

Fleas and lice were collected from the dogs by rubbing the entire body with a piece of cotton wool soaked in ether and then the entire fur was combed from the head region to the limbs, onto a clean large white paper spread underneath the dog (Adamu *et al.,* 2012) while ticks were removed with a pair of forceps. The ectoparasites recovered from each dog were preserved separately in 70% alcohol. The specimens from each dog were counted, identified and grouped according to the body region of collection.

Parasitological examination

Collected faecal samples from dogs and their respective owners were examined using a modified sucrose floatation technique (Gillespie & Bradbury, 2017; Mohaghegh *et al.,* 2017). Approximately 2-3g of faeces from each subject was mixed in 5ml of water. The mixture was sieved through a tea strainer into 15ml centrifuge tube and centrifuged at 2500rpm for 10minutes.The supernatant was discarded and sucrose solution (specific gravity 1.27), was added to the tube to the mark of 14ml. The sediment was mixed with the sucrose solution and centrifuged at 2500rpm for 5mins, and more sucrose solution was added until convex meniscus was visible at the top of the tubes. Coverslips were gently placed on top of the tubes and then allowed to stand for 30 seconds. The coverslips were removed and transferred to separate microscope slides for examination. Egg and oocyst counts were identified based on microscopic and morphological appearances (Gupta & Singla 2012. The species and the number of each species encountered were manually counted recorded for each sample.

The ectoparasites stored in 70% alcohol were transferred into watch glasses containing 10% potassium hydroxide (KOH) solution for 24-36 hours at room temperature until the body contents were clear and then mounted in Canada balsam (Ugbomoiko *et al.,* 2008). Ectoparasites were identified using standard keys and guides (Soulsby, 1982).

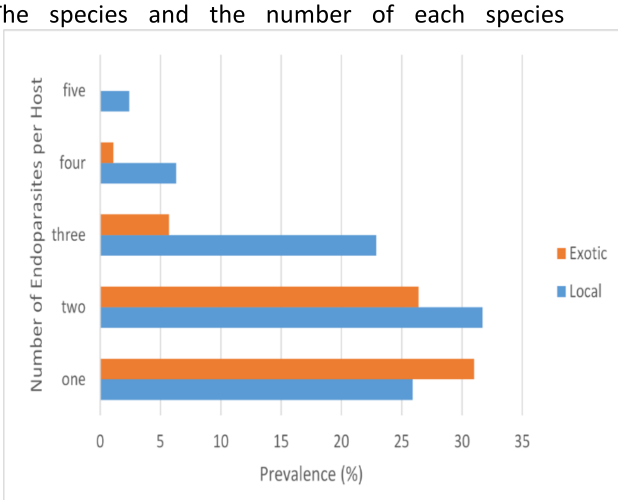

Figure 1: Prevalence of single and mixed endoparasite infections in the breeds of dogs

Data analysis

Data were analysed using SPSS (IBM Corp. Released 2013. SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.). Prevalence and frequencies were expressed as percentages. The intensity of infection/infestation was calculated as the mean number of parasite egg or oocyst per infected host. Chi-square test was used to determine the significant differences of categorical variables and one-way ANOVA was used to determine significant differences in mean. The risk was estimated using odds ratio for the 2×2 contingency tables.

Results

Prevalence of gastrointestinal parasites in dogs

The overall prevalence of gastrointestinal parasites in dogs was 81.8%. Out of the 292 dog faecal samples examined 239 harboured one or more gastrointestinal parasite species. The profile of the parasites found in the faecal samples examined were *T. canis* (55.8%), *Ancylostoma* spp (40.1%), *Ascaris* spp (36%), *T. leonina* (15.1%), *Isospora* spp (14.4%) and *Trichuris* spp (7.5%). Higher prevalence of infection (90.7%, $p < 0.001$) was recorded in the dogs from rural communities than urban dwellers. Mixed infection was significantly ($p < 0.001$) common in Mongrels than the exotic breeds of dogs (Figure 1). Infections with *Toxocara* were significantly higher ($p < 0.001$) in dogs less than 6 months old and decreased in older dogs, while the prevalence of hookworm infection increased with the age of dogs (Figure 2). The other parasites did not show significant age-related variations.

Prevalence of ectoparasites in dogs

The overall prevalence of ectoparasites identified in dogs was 68.2%. Theticks (*Rhipicephalus sanguineus* and *Haemaphysalis. leachii*), fleas (*Ctenocephalides. canis* and *C. felis*) and lice (*Trichodectes canis* and *Linognathus* spp) were identified on the dogs examined (Figure 3). Single parasite infestation was observed in 101 (50%) of the infested dogs and the other 101 (50%) harboured mixed infestations. A total of 3,415 ectoparasites were recovered with ticks (2,528, 74%) having been the most prevalent; 768 (22.5%) were fleas and 91 were lice (2.7%). Prevalence of infestation was significantly higher (p < 0.001) in the rural (84.2%) than the urban (60.3%) areas (Table 1). Though the ectoparasite infestation in the male or female dogs was not significantly (p = 0.22) different (p = 0.22), female dogs had more ectoparasites (72.4%) than the males (65.3%); aalso, 173 (84.4%) of the mongrel and 29 (33.3%) exotic dogs had ectoparasite infestation (p < 0.001). Mongrels had infestation with all the ticks, lice and fleas species identified while only ticks (*R. sanguineus* and *H. leachii*) and a flea species (*C. felis*) were identified on the exotic dogs. The overall prevalence of ectoparasite was not age-dependent (p = 0.99), though infestation with ticks increased (p < 0.05) with an increase in the age of the dogs (Table 2). The overall mean density of infestation was 11.69 ± 0.88 ectoparasites/dog. The heaviest infestation density (15.59 ± 1.69) was observed in dogs >12 months old (p = 0.429). Ectoparasite density was significantly higher (p = 0.003) in dogs from rural (16.75 ± 1.66) than those in the urban (8.73 ± 0.93)

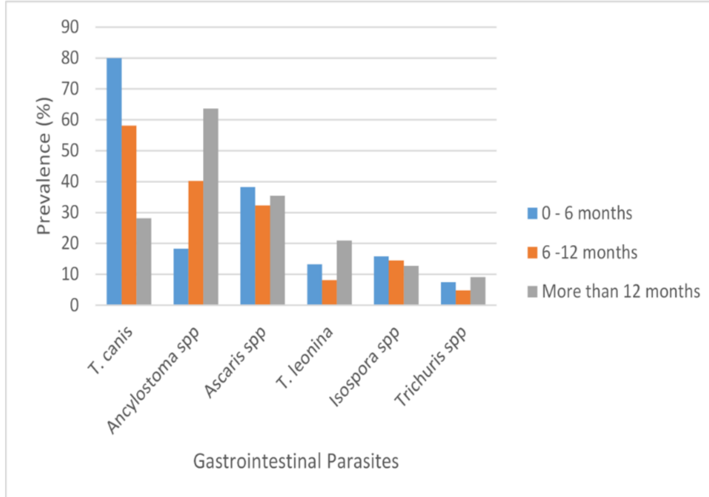

Figure 2: Age related prevalence of gastrointestinal parasite in dogs in Egbeda comminuties, Ibadan

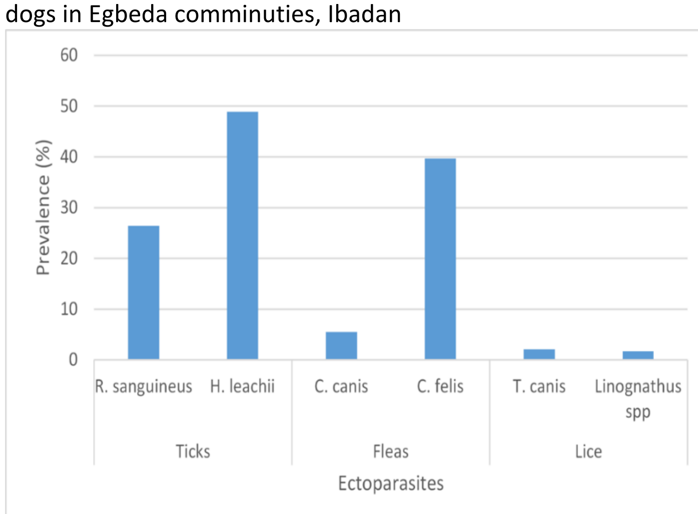

Figure 3: Distribution of ectoparasite species on dogs in Egbeda communities, Ibadan

Table 1: Prevalence of ectoparasite infestation of dogs in rural and urban Egbeda communities

Ectoparasites	Overall N=292 NI (%)	Rural N=108 NI (%)	Urban N=184 NI (%)	OR (95% CI)	p-value
Single infestation					
Flea	47(16.1)	23(7.9)	24(8.2)	1.80(0.96 – 0.07)	0.07
Tick	68(23.3)	24(8.2)	44(15.1)	0.91(0.52 – 1.60)	0.77
Lice	6(2.1)	1(0.34)	5(1.7)	0.33(0.04 – 2.90)	0.42
Total	121(41.4)	48(16.4)	73(25)	1.22(0.75 – 1.97)	0.46
Double infestation					
Flea + Tick	76(26)	41(14.1)	35(11.9)	2.61(1.52 – 4.45)	0.00*
Lice + Tick	5(1.7)	2(0.68)	3(1)	1.14(0.19 – 6.93)	1.00
Total	81(27.7)	43(14.7)	38(13)	2.58(1.52 – 4.36)	0.00*
Overall infested	202(69.2)	91(31.2)	111(38)	3.52 (1.94 – 6.39)	0.00*

NI (Not infested), N (Total No examined), OR (Odds ratio)

Table 2: Mean Intensity of ectoparasites in the different ages of dogs in Egbeda communities

Parasites	< 6 months Mean ± SE)	6-12months Mean ± SE	>12 months Mean± SE	p value
R. sanguineus	0.56 ± 0.16	0.61 ± 0.17	2.68± 0.48	< 0.0001*
H. leachii	5.11 ± 1.05	6.00 ± 1.19	10.39±1.20	0.002*
C. canis	0.07 ± 0.03	0.02 ± 0.02	0.21± 0.08	0.063
C. felis	3.53 ± 0.52	2.58 ± 0.61	1.38 ± 0.29	0.003*
T. canis	0.00 ± 0.00	0.11 ± 0.11	0.40 ± 0.22	0.110
Linognathus spp	0.08 ± 0.08	0.00 ± 0.00	0.53 ± 0.31	0.163
Total	9.35 ± 1.22	9.32 ± 1.40	15.59±1.69	0.429

*means with significant difference

communities. The intensity of infestation was also higher ($p < 0.001$) in mongrels compared to the exotics.

Higher infestation (40%) was recorded from the head and neck regions of the dogs though this was not significantly different ($p = 0.8007$) from the rate of occurrence on other body parts. The least infested part of the body was the fore and hind limbs (16.6%) (Table 3).

Prevalence of parasites among dog owners

Of the 241 dog owners examined, 99 (41.1%) were positive for gastrointestinal parasites and 83 (83.8%) dogs from infected owners were also infected with gastrointestinal parasites. Most of the dog owners had similar infections with their dogs. The species of parasites found among the dog owners include; *Ascaris lumbricoides* (31.1%), *Ancylostoma* spp (29.5%) and *Trichuris* spp (1.2%). There was however no significant association ($p = 0.4$) between the prevalence of gastrointestinal parasites in dogs and their owners.

Knowledge, attitude and practice (KAP)

Table 4 summarizes KAP of dog owners about diseases transmissible by their dogs. Less than 25% of owners had knowledge of the possible zoonotic transmission of helminth parasites by dogs. However, 81.5% and 70.2% of urban and rural dog owners respectively were aware of the risk of rabies transmission to humans from dogs. Dogs from the urban communities received more veterinary care/treatment ($p>0.05$) compared to those from rural areas. A majority (61.4%) of rural dog owners have never given medical care to their dogs.

Discussion

Several canine parasites have zoonotic importance and therefore portend public health hazards. The high prevalence of gastrointestinal parasites obtained in this study could be due to environmental contamination providing ready access to infective stages of the parasites, since most of these dogs reportedly roam and defecate indiscriminately within these areas resulting in cycles of infection and re-infection. Also, the freshly voided faeces examined provided a higher chance of recovering more infective parasitic stages than faeces exposed to the environment in which some parasite may have been destroyed. The overall prevalence of gastrointestinal obtained was higher than the prevalence (43.3%) reported by Ayinmode *et al.* (2016) who examined the faeces of dogs shed on the street of Ibadan metropolis. Sowemimo & Asaolu (2008) also recorded a much lower prevalence (24%) in dogs presented to veterinary clinics in Ibadan. However, the prevalence of gastrointestinal parasites ranging from 56.1 – 99% have previously been reported in Nigeria and elsewhere (Traub *et al*., 2002; Umar, 2009; Idika *et al*., 2017).

The prevalence of ectoparasites recorded is similarly reported by Agbolade *et al*. (2008). However, Babamale *et al*. (2018) and Omonijo & Sowemimo (2017) recorded a higher prevalence of 81.4% and 85% in Kwara and Ekiti States in Nigeria respectively. The high prevalence of gastrointestinal and ectoparasite recorded in this study could also be attributable to high environmental contamination which poses a high risk for the dogs since most of the dogs roam the communities scavenging for food (Onyeabor, 2014; Ayinmode *et al*., 2016).

The close bonds of these animals with their owners as recorded in this study present risk of zoonotic infections for the dog owners and other inhabitants of these communities. The presence of other susceptible animals (cat, goat and sheep) may be contributory to the high prevalence of parasite recorded because where dogs have frequent

Table 3: Distribution of ectoparasites on body parts of infested dogs in Egbeda communities

Ectoparasites	Parts of the Body N (% occurrence)				Total ectoparasite Count (%)
	Head and neck	Belly	Back	Limbs	
R. sanguineus	166(41.5)	78(19.5)	109(27.3)	47(11.7)	400 (11.7)
H. leachii	1055(49.6)	224(10.5)	446(21)	403(18.9)	2128(62.3)
C. canis	9(27.3)	21(63.6)	3(9.1)	0(0)	33 (1)
C. felis	70(9.5)	468(63.7)	95(12.9)	101(13.8)	735(21.5)
T. canis	25(49)	0(0)	9(17.7)	17(33.3)	51(1.5)
Linognathus sp	41(60.2)	27(39.8)	0(0)	0(0)	68(2)
Total	1366 (40)	818 (24)	662(19.4)	568(16.6)	3415

Table 4: Knowledge, attitude and practice of dog owners regarding zoonotic disease in Egbeda communities

Variables	Response	Urban n=184 Frequency (%)	Rural n=57 Frequency (%)	P value
Where do dogs usually roam?	Anywhere within/outside the house	78(42.4%)	52(91.2%)	P<0.05
	Confined to dog kernel in the compound	45(24.5%)	0(0%)	
	Inside the house only	3(1.6%)	0(0%)	
	Within the compound only	58(31.5%)	5(8.8%)	
The usual place for dog defecation?	Within and outside house premises	93(50.4%)	57(100%)	P<0.05
	Within house premises	91(49%)	0(0%)	
Last treatment (veterinary care) of dogs	<12months	118(64.1%)	20(35.1%)	P<0.05
	>12months	10(5.4%)	2(3.5%)	
	Never	56(30.4%)	35(61.4%)	
Do you/your children play with your dogs	Yes	179(97.3%)	57(100%)	P>0.05
	No	5(2.7%)	0(0%)	
Dog owner's knowledge of possible diseases/condition transmitted by dogs	Rabies	150(81.5%)	40(70.2%)	P>0.05
	Wound from dog bite	2(1.1%)	0(0%)	
	Scabies	0(0%0	5(8.7%)	
	Worms	44(23.9%0	12(21.1%)	
	Dysentery	0(0%)	0(0%)	
	Other bacteria/viral diseases	3(1.6%)	0(0%)	

contact with other animals harbouring parasites there is a resulting higher risk of infection in the dogs (Bryson *et al*., 2000).

High prevalence of *Toxocara* spp. (54.8%) recorded in dogs in this study provides a high chance of zoonotic infection for humans if transmission occurs. Infection with *T. canis* decreased with the age of the dogs, these findings is in accordance with previous studies (Sowemimo & Asaolu, 2008; Ugbomoiko *et al*., 2008). The high prevalence of toxocariasis reported in puppies may be due to transplacental infection of the foetus (Becker *et al.,* 2012) and age-dependent immunity acquired by repeated exposure which results in reduced infection in older dogs (Odeniran & Ademola, 2013). Human infections may result in visceral larva migrans, and in severe cases could lead to blindness (Taylor, 2001; Singla *et al.,* 2005). The diagnosis of toxocariasis in humans is however problematic because the larval stage of *T. canis* cannot be detected directly. Since larvae stages do not develop into egg-laying adult worms, direct diagnosis is almost impossible. However, this can be done indirectly by antibody detection in blood or by other biological methods such as tissue histology at *post mortem* for suspected human cases (Rubinsky *et al.,* 2010).

The high prevalence of *Ascaris* spp recorded in dogs and their owners in this study are similar to the prevalence (31% and 36%) reported by Traub *et al*. (2002) in North-eastern India. Shalaby *et al*. (2010) had suggested that dogs act as a reservoir host of *A. lumbricoides*, thereby increasing the risk of infections to human. Viable eggs of *Ascaris* spp and *Trichuris* spp, after passing through the GIT have been found in dog faeces and multifactorial analyses have suggested that *Ascaris*-positive dogs ingested the parasites from faeces in their owner's household (Traub *et al*., 2002). The fact that most of the dog owners were infected with similar parasites as their dogs support the speculations of the mechanical role of dogs in the transmission of these parasites to their owners and community since the dogs are not confined to only their owner's household.

The presence of ectoparasites in most of the dogs examined presents a major risk of infestation for their owners and for other animals. Ticks had the highest prevalence in this study and these results are consistent with other studies from Iran and Nigeria (Mirzaei *et al*., 2014; Omonijo & Sowemimo, 2017; Babamale *et al*., 2018), however, our study did not reveal a particular reason for the higher prevalence of *H. leachii* over *R. sanguineus*.

The infestation of dogs with *C. felis* (the cat flea) was higher compared to dog flea (*C. canis*), this is also consistent with the earlier report by Babamale *et al.* (2018) and Bond *et al.* (2007) in Nigeria and the United Kingdom respectively. This is not unusual as *C. felis* has a higher prevalence rate than *C. canis* globally (Dobler & Pfeffer, 2011). Also, *C. canis* is reportedly the most predominant species on dogs in rural areas, while *C. felis* is most common in urban areas (Alcaino *et al*., 2002). From our study, a higher prevalence of both fleas in rural than urban areas were reported. Ectoparasites did not show any significant preference for any body part in this study though ticks and flea were more prevalent on the head and trunk region which may be easier feeding areas, this finding is consistent with the record of Omonijo & Sowemimo (2017). The high prevalence of these ectoparasites may cause serious problems of discomfort to the dogs because of their biting, which results in allergic reactions and itching. Furthermore, they act as vectors for numerous parasitic and microbial agents of veterinary and human importance. *Rhipicephalus sanguineus*is capable of transmitting canine leishmaniosis and Ehrlichiosis (Dantas-Torres *et al.,* 2010 and Rene *et al*., 2012; Kottadamane *et al.,* 2017) while the flea species are an intermediate host for *Dipylidium caninum*.

Most of the dog owners reported that their dogs roam freely without restrictions and they can contaminate the environment with excrements, thus the recorded presence of infective stages of parasites in dog faeces and at a high intensity suggests that these dogs are significant transmitters and contaminators of the environments. Majority of these dogs do not receive antiparasitic treatments and can, therefore, be potential sources of zoonotic parasites, providing a continuous source of infection for humans and other paratenic hosts (Macpherson, 2013).

The higher prevalence of parasitic infection recorded in mongrel than the exotic dogs could result from the higher level of care and veterinary attention the exotic dogs received (Ahmed *et al.*, 2014).

Tylkowska *et al.* (2010) stated that the prevalence of parasitic infection in dogs is dependent on the environment of the dog. Therefore, the higher prevalence reported in the rural communities could be because knowledge and perceptions of zoonotic parasitic diseases were inadequate due to the low level of education and exposure of dwellers. Habluetzel *et al.* (2003) also observed that twice as many dogs from rural areas had nematodes infections when compared with urban dogs. Urban dog owners may also feel more encouraged to treat their dogs due to their close proximity to veterinary clinics, which are non-existent in these rural communities.

The number of dogs with gastrointestinal and ectoparasites in the study area is high in both rural and urban areas and most of the dog owners are not aware of possible zoonotic transmissions. The importance of these dog parasites to human health makes it necessary to implement measures that reduce the risk of transmission of these zoonotic parasites from dogs to humans in these communities. Interventions should also focus on educating dog owners about the risks of infection with zoonotic parasites and access to veterinary clinics, especially for rural communities.

Conflicts of Interest

The authors declare no conflict of interest.

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