



Parasitic diseases of dogs in Osun State, south-west Nigeria, and its zoonotic implications

Ola-Fadunsin, S. D.

Department of Veterinary Pathology and Microbiology
Faculty of Veterinary Medicine, Universiti Putra Malaysia
43400 UPM Serdang, Selangor, Malaysia
email: olashodam2@yahoo.com

Abstract

Parasitism is one of the most common disease conditions seen in dogs especially in developing countries like Nigeria. A ten-year (2006 to 2015) retrospective study of parasitic diseases diagnosed in dogs at the major Veterinary clinics in Osun State was analysed. Out of the 2,820 cases of canine parasitic conditions presented during the study period, helminthosis had the highest occurrence of 2,025(71.8%). This was followed by tick infestation, babesiosis, mange and lice infestation having 1197(42.4%), 557(19.8%), 260(9.2%) and 176(6.2%) respectively. However there was a low occurrence of trypanosomiasis 11(0.4%), ehrlichiosis 32(1.1%), flea infestation 34(1.2%) and myiasis 35(1.2%). Within the studied period, the highest occurrence of parasitism was observed in 2014 (434, 15.4%) followed by 2015(336, 11.9%) and 2013(330, 11.7%), while lowest occurrence was recorded in 2007 (182, 6.4%) followed by 2009(221, 7.8%) and 2010(221, 7.8%). March (283, 10.0%) and February (267, 9.5%) had the highest occurrence of parasitism while, August (178, 6.3%) and November (214, 7.6%) had the lowest occurrence of parasitism based on monthly distribution. Breed, age and season were significantly associated with parasitism ($p < 0.05$). In conclusion, due to the high occurrence of parasitic diseases, it is recommended that pet owners are to pay attention to the overall welfare of their dogs as some of these parasitic disease conditions are zoonotic.

Keywords: Dogs, Osun State; parasitic diseases; occurrence; zoonotic; Nigeria.

Introduction

Dogs are believed to have come a long way with its association with man. They are believed to be one of the earliest animal to be domesticated by man. Dogs are one of the most important domestic animals seen in almost every human settlement globally. They are kept to perform numerous valuable roles in the society [1]. In Nigeria, the dog population has been variously estimated at between 3 and 5 million, but the estimates are not based on established parameters [2]. Although this number may have increased in recent times due to the high interest of Nigerians for dogs for the purpose of dog breeding and security. Dogs are kept as pets, for security purposes, for hunting, breeding, as well as a source of animal protein among some ethnic groups [3] and for combatting crime by the military and para-

military organizations. Dogs as pet contribute to the general well-being (physical, social and emotional) of their owners particularly children [4].

Parasitism is one of the most common disease conditions seen in dogs especially in developing countries like Nigeria. Parasites causes harmful effects and poses serious health challenges in domestic dogs (*Canis lupus familiaris*), such as reduced growth rate, generalized ill health, lowered resistance to other infectious disease and reduced work efficiency [5]. Varying clinical signs such as restlessness, unthriftiness, fever, anaemia, diarrhea, abdominal pain, nausea or vomiting, hair loss, dehydration, electrolyte in balance and death has been associated with parasitic infections in dogs [6].

Some parasitic infections (endo and ecto) of dogs pose a great threat to the global public health due to

their zoonotic importance [7, 8]. Some zoonotic canine parasites are, protozoa (especially *Toxoplasma gondii*), nematodes (*Trichinella spiralis*, *Toxocara canis*, *Ancylostoma caninum*), cestodes (*Echinococcus granulosus*, *Dipylidium caninum*, *Taenia saginata*, *Taenia solium*), arthropods (*Sarcoptes scabiei* and *Pulex irritans*) [9, 10]. The transmission of these zoonotic canine parasites can be directly from contact with dogs and indirectly with dogs' secretions and excretions, infected water and food [11]. Zoonotic parasitic diseases of dogs are cosmopolitan in distribution and are among the ten most common infections in the world especially in developing countries [9]. Clinical signs such as diarrhea, muscle aches, irritations, itching and fever are seen in man infected with canine zoonotic parasites depending on the parasite involved [10, 11].

In Nigeria, the dog populations have been identified to serve as host for various endoparasitic and ectoparasitic conditions which includes helminthoses, myiasis, babesiosis, anaplasmosis, trypanosomosis, ehrlichiosis, tick infestation, lice infestation, mite infestation (mange) and flea infestation [1, 6, 7, 12].

There remain a paucity of information on the prevalence of canine parasitic diseases in Osun State, Nigeria. This study was carried out with the aim of providing information on the diagnosed parasitic conditions of owned dogs in the State. This is to add to the existing information as well as to the knowledge of the epidemiology of parasitic diseases of dogs in Nigeria and as such assist the government in formulating policies on the parasitic diseases of dog prevalent in the study area as well as their zoonotic implications to the persons residing in the area.

Materials and methods

Study area

This study was conducted in Osun State which is situated in the south-west part of Nigeria between Latitude 7° 59'N and Longitude 4° 56'E. Its climate is characterized by the wet season (March, April, May, June, July, September and October) and the dry season (November, December, January, February and August) [13].

Clinical records of all diagnosed and confirmed cases of parasitic diseases of dogs presented to the major state veterinary clinics located in Osogbo, Ilesa, Ede and Ikirun from January 2006-December 2015 was collected. The records included all the animal information such as breed, age and sex as well as the date of presentation to the hospital. Diagnosis of each disease was carried out in the clinic based on case history, physical examination and clinical signs. Cases were confirmed in the laboratory by blood and faecal examination using a light microscope [14].

Data analysis

We conducted descriptive statistics (in percentages) and

univariate analysis (*chi-square*) with values of $p < 0.05$ been considered significant. The odds ratios and 95% confidence interval on the odds ratios were also calculated for all the factors to determine the significance and strength of association between each factor and each parasitic condition. The odds ratios were calculated with respect to a reference category as indicated in respective tables. All statistical tests were conducted using statistical package for social sciences (SPSS) version 22 (SPSS Inc., Chicago).

Results

From the ten year parasitic diseases reported in the major Veterinary clinics of Osun State, a total of 2,820 dogs were diagnosed with one parasitic condition or the other while some had two or more infections. Of the canine parasitic conditions recorded, helminthoses had the highest occurrence of 2025 (71.8%) followed by tick infestation been 1,197 (42.4%). Trypanosomiasis and ehrlichiosis had the lowest occurrence of 11 (0.4%) and 32 (1.1%) respectively.

Based on the yearly distribution of the diagnosed canine parasitic diseases, the highest occurrence of parasitic condition was recorded in 2014 (434) followed by 2015 (336) and 2013 (330), while lowest occurrence was recorded in 2007 (182), 2009 (221) and 2010 (221). The highest prevalence of helminthoses was observed in 2015 (281/336, 83.6%) and 2014 (336/434, 77.4%), while the lowest prevalence was recorded in 2010 (136/221, 61.5%) and 2008 (160/259, 61.8%). Babesiosis was most prevalent in 2014 (114/434, 26.3%) and 2010 (57/221, 25.8%) and least prevalent in 2008 (32/259, 12.4%) and 2007 (23/182, 12.6%). Ehrlichiosis had its peak prevalence in 2007 (10/182, 5.5%) and 2008 (8/259, 3.1%), while there was no case diagnosed in 2006, 2009, 2011 and 2012. There was no case of trypanosomiasis in all the years other than 2012 to 2015 with the highest prevalence recorded in 2012 (3/293, 1.0%). Tick infestation was most prevalent in 2014 (225/434, 51.8%) and 2008 (128/259, 49.4%) and least prevalent in 2007 (59/182, 32.4%) and 2011 (88/268, 32.8%). Lice infestation had its peak prevalence in 2006 (33/276, 12.0%) and 2014 (35/434, 8.1%) with least prevalence in 2010 (5/221, 2.3%) and 2009 (6/221, 2.7%). The highest prevalence of flea infestation was recorded in 2014 (11/434, 2.5%) and 2012 (7/293, 2.4%) with no case recorded in 2007 and 2011. Within the years, mange was most prevalent in 2007 (28/182, 15.4%) and 2015 (46/336, 13.7%) and least prevalent in 2011 (17/268, 6.3%) and 2006 (20/276, 7.2%). The highest prevalence of myiasis was recorded in 2011 (11/268, 4.1%) while the lowest prevalence was recorded in 2013 (1/330, 0.3%) (Table 1).

Based on the monthly distribution of canine parasitic diseases diagnosed in the major veterinary clinics in Osun State (Table 1), the highest occurrence of parasitic condition was recorded in March (283) and

Table 1. Distribution of canine parasitic disease cases diagnosed at the major veterinary clinics in Osun State, Nigeria, from 2006-2015.

Number of Parasitic Disease Condition (%)										
	No of Dogs	Helminthoses	Babesiosis	Ehrlichiosis	Trypanosomiasis	Tick infestation	Lice infestation	Flea infestation	Mange	Myiasis
Yearly										
2006	276	213 (77.2)	48(17.4)	0(0.0)	0(0.0)	109 (39.5)	33(12.0)	2(0.7)	20 (7.2)	2(0.7)
2007	182	115 (63.2)	23(12.6)	10(5.5)	0(0.0)	59(32.4)	6(3.3)	0(0.0)	28 (15.4)	1(0.5)
2008	259	160 (61.8)	32(12.4)	8(3.1)	0(0.0)	128 (49.4)	12(4.6)	1(0.4)	25 (9.7)	4(1.5)
2009	221	139 (62.9)	49(22.2)	0(0.0)	0(0.0)	90(40.7)	6(2.7)	1(0.5)	18 (8.1)	1(0.5)
2010	221	136 (61.5)	57(25.8)	2(0.9)	0(0.0)	93(42.1)	5(2.3)	0(0.0)	21 (9.5)	1(0.5)
2011	268	189 (70.5)	42(15.7)	0(0.0)	0(0.0)	88(32.8)	15(5.6)	4(1.5)	17 (6.3)	11 (4.1)
2012	293	205 (70.0)	61(20.8)	0(0.0)	3(1.0)	124 (42.3)	18(6.1)	7(2.4)	24 (8.2)	5(1.7)
2013	330	251 (76.1)	65(19.7)	3(0.9)	2(0.6)	128 (38.8)	21(6.4)	7(2.1)	25 (7.6)	1(0.3)
2014	434	336 (77.4)	114 (26.3)	5(1.2)	1(0.2)	225 (51.8)	35(8.1)	11(2.5)	36 (8.3)	7(1.6)
2015	336	281 (83.6)	66 (19.6)	4(1.2)	5(1.5)	153 (45.5)	25(7.4)	1(0.3)	46 (13.7)	2(0.6)
	2820	2025 (71.8)	557 (19.8)	32(1.1)	11(0.4)	1197 (42.4)	176(6.2)	34(1.2)	260 (9.2)	35 (1.2)
Monthly										
January	251	186 (74.1)	46(18.3)	1(0.4)	1(0.4)	97 (38.6)	14(5.6)	1(0.4)	23 (9.2)	0(0.0)
February	267	191 (71.5)	55(20.6)	6(2.2)	2(0.7)	123 (46.1)	17(6.4)	4(1.5)	21 (7.9)	1(0.4)
March	283	191 (67.5)	69(24.4)	3(1.1)	0(0.0)	156 (55.1)	29(10.2)	10(3.5)	26 (9.2)	2(0.7)
April	260	160 (61.5)	48(18.5)	3(1.2)	0(0.0)	132 (50.8)	27(10.4)	4(1.5)	31 (11.9)	1(0.4)
May	237	163 (68.8)	54(22.8)	4(1.7)	0(0.0)	115 (48.5)	17(7.2)	3(1.3)	24 (10.1)	7(3.0)
June	245	168 (68.6)	51(20.8)	7(2.9)	3(1.2)	110 (44.9)	13(5.3)	2(0.8)	13 (5.3)	3(1.2)
July	218	169 (77.5)	42(19.3)	2(0.9)	2(0.9)	88 (40.4)	12(5.5)	2(0.9)	17 (7.8)	1(0.5)
August	178	144 (80.9)	21(11.8)	1(0.6)	0(0.0)	58 (32.6)	10(5.6)	2(1.1)	13 (7.3)	4(2.2)
September	215	159 (74.0)	39(18.1)	2(0.9)	0(0.0)	77 (35.8)	9(4.2)	0(0.0)	17 (7.9)	4(1.9)
October	216	156 (72.2)	32(14.8)	1(0.5)	1(0.5)	68 (31.5)	11(5.1)	4(1.9)	31 (14.4)	12 (5.6)
November	214	154 (72.0)	40(18.7)	1(0.5)	0(0.0)	81 (37.9)	10(4.7)	0(0.0)	21 (9.8)	0(0.0)
December	236	184 (78.0)	60(25.4)	1(0.4)	2(0.8)	92 (39.0)	7(3.0)	2(0.8)	23 (9.7)	0(0.0)
	2820	2025 (71.8)	557 (19.8)	32(1.1)	11(0.4)	1197 (42.4)	176(6.2)	34(1.2)	260 (9.2)	35 (1.2)

February (267), while lowest occurrence was recorded in August (178) and November (214). Peak prevalences of 144(80.9%) due to helminthoses, 60(25.4%) due to babesiosis, 6(2.2%) due to ehrlichiosis and 3(1.2%) due to trypanosomiasis was recorded in August, December, February and June respectively. While the minimum prevalences of 160(61.5%) due to helminthoses, 21(11.8%) due to babesiosis and 1(0.4%) due to

ehrlichiosis was recorded in April, August and January respectively with no case of trypanosomiasis reported in March, April, May, August, September and November. Highest prevalences of 156(55.1%) due to tick infestation, 10(3.5%) due to lice infestation and 27(10.4%) due to flea infestation was recorded between March and April with lowest prevalences of these ectoparasitic conditions reported between September and

December. Mange and myiasis were most prevalent in October while mange was least prevalent in May and no case of myiasis was diagnosed between November to January.

The association between breeds, age, sex and season with the occurrence of the various parasitic conditions showed a non-defined pattern in terms of significance. Table 2 revealed that the exotic breeds of dogs were 1.4 times less likely to have helminthoses compared to the indigenous breeds. Dogs less than one year old were 3.3 times more susceptible to helminthoses compared to dogs older than 8 years. Helminthoses is 1.3 times less likely to occur in the wet season compared to the dry season. There was no significant disparity in the prevalence of helminthoses between sex, although male dogs showed higher resistance compared to female dogs.

Table 3 shows the association between breeds, age, sex and season with the occurrence of haemoparasitic diseases. The exotic breeds were 1.4 times more susceptible to babesiosis compared to the indigenous breeds. Age, sex and season were not significantly associated with the prevalence of babesiosis. There was no significant association between the studied variables and the prevalence of ehrlichiosis and trypanosomiasis although, the exotic breeds of dogs had a higher prevalence of parasitic disease conditions compared to the cross and indigenous breeds. Older dogs (above 8 years old) were more susceptible to ehrlichiosis and trypanosomiasis compared to the other age categories. Female dogs were more resistant to ehrlichiosis and trypanosomiasis compared to male dogs. The occurrence of ehrlichiosis was higher in the wet season compared to the dry season but lower in the wet season compared to the dry season for trypanosomiasis. Tick infestation was 1.3 and 0.6 times more prevalent in the exotic and cross breeds compared to the indigenous breeds of dogs.

The association between breeds, age, sex and season with the occurrence of ectoparasitic diseases is presented in Table 4. There was a progressive pattern in the prevalence of tick infestation with age, while it was about 1.3 times more prevalent in the wet season compared to the dry season. The relationship between tick infestation and sex was not significant although a higher prevalence was recorded in the male. Indigenous breeds were about twice less resistant to lice infestation compared to the exotic and cross breeds.

Also, lice infestation was 1.5 times more prevalent in the wet season compared to the dry season. Age and sex showed no significant relationship with the possibility of been infested with lice. The relationship between the studied variables and the occurrence of flea infestation shows that the exotic and the cross breeds were 6.3 and 2.4 times more resistant to flea infestation compared to the indigenous breed although the later association was not significant. Dogs between 1 to 8 years were 25 times more resistant to flea infestation compared to dogs that are above 8 years' old. There was no significant relationship between sex and season with the occurrence of lice infestation. There was no significant association between breeds, age, sex and season with the occurrence of mange although, the indigenous breeds were less resistant compared to the exotic and cross breeds. Dogs that are above 8 years were less resistant compared to dogs in the other age category. Female dogs were more susceptible to the condition than male dogs as the condition occurred more in the wet season than the dry season. Myiasis was 3.3 and 7.1 times more prevalent in the indigenous breeds compared to the exotic and cross breeds respectively. Myiasis occurred 4.2 times more in the wet season as against the dry season. There was no significant relationship between the occurrence of myiasis with age and sex.

Table 2. Univariate association between breeds, age, sex and season with the occurrence of helminthic disease among dogs diagnosed with canine parasitic disease conditions at the major Veterinary Clinics in Osun State, Nigeria, from 2006-2015.

Variables	Parasite +ive	Parasite -ive	Total helminthoses	OR	95% CI	<i>p</i>
Breeds						
Exotic	963(68.6)	330(31.4)	1404	0.71	0.59-0.86	<0.01*
Cross	411(74.3)	142(25.7)	553	0.94	0.74-1.21	0.64
Indigenous ^a	651(75.4)	212(24.6)	863	1.00		
Age						
<1 year	1514(74.3)	524(25.7)	2038	3.25	1.22-8.81	0.02*
>1-8 years	503(65.8)	262(34.2)	765	2.16	0.80-5.89	0.13
>8 years ^a	8(47.1)	9(52.9)	17	1.00		
Sex						
Male	984(71.6)	391(28.4)	1375	0.98	0.83-1.15	0.78
Female ^a	1041(72.0)	404(28.0)	1445	1.00		
Season						
Wet	1166(69.7)	508(30.3)	1674	0.77	0.65-0.91	<0.01*
Dry ^a	859(75.0)	287(25.0)	1146	1.00		

^a Reference category, * Significant, OR = Odds Ratio, CI = Confidence Interval.

Table 3. Univariate association between breeds, age, sex and season with the occurrence of haemoparasitic diseases among dogs diagnosed with canine parasitic disease conditions at the major Veterinary Clinics in Osun State, Nigeria, from 2006-2015.

Variables	Parasite +ive	Parasite -ive	Total babesiosis	OR	95% CI	p
Breeds						
Exotic	327(23.3)	1077(76.7)	1404	1.39	1.12-1.72	<0.01*
Cross	75(13.6)	478(86.4)	553	0.72	0.53-0.97	0.03*
Indigenous ^a	155(18.0)	708(82.0)	863	1.00		
Age						
< 1 year	369(18.1)	1669(81.9)	2038	0.72	0.24-2.57	0.55
>108 years	184(24.1)	581(75.9)	765	1.03	0.35-3.70	0.99
>8 years ^a	4(23.5)	13(76.5)	17	1.00		
Sex						
Male	280(20.4)	1095(79.6)	1375	1.08	0.90-1.30	0.43
Female ^a	277(19.2)	1168(80.8)	1445	1.00		
Season						
Wet	335(20.0)	1339(80.0)	1674	1.04	0.86-1.26	0.68
Dry ^a	222(19.4)	924(80.6)	1146	1.00		
Ehrlichiosis						
Breeds						
Exotic	20(1.4)	1384(98.6)	1404	2.06	0.85-5.64	0.11
Cross	6(1.1)	547(98.9)	553	1.57	0.48-5.16	0.45
Indigenous ^a	6(0.7)	857(99.3)	863	1.00		
Age						
< 1 year	21(1.0)	2017(99.0)	2038	0.17	0.03-3.69	0.18
> 1 – 8 years	11(1.4)	754(98.6)	765	0.23	0.04-5.37	0.26
>8 years ^a	1(5.9)	16(94.1)	17	1.00		
Sex						
Male	16(1.2)	1359(98.8)	1375	1.05	0.52-2.14	0.89
Female ^a	16(1.1)	1429(98.9)	1445	1.00		
Season						
Wet	22(1.3)	1652(98.7)	1674	1.51	0.72-3.35	0.28
Dry ^a	10(0.9)	1136(99.1)	1146	1.00		
Trypanosomiasis						
Breeds						
Exotic	7(0.5)	1397(99.5)	1404	1.44	0.38-6.85	0.63
Cross	1(0.2)	552(99.8)	553	0.52	0.02-4.89	0.63
Indigenous ^a	3(0.3)	860(99.7)	863	1.00		
Age						
< 1 year	6(0.3)	2032(99.7)	2038	0.05	0.01-1.16	0.06
> 1 – 8 years	4(0.5)	761(99.5)	765	0.09	0.01-2.21	0.11
>8 years ^a	1(5.9)	16(94.1)	17	1.00		
Sex						
Male	6(0.4)	1369(99.6)	1375	1.26	0.37-4.50	0.71
Female ^a	5(0.3)	1440(99.7)	1445	1.00		
Season						
Wet	6(0.4)	1668(99.6)	1674	0.82	0.24-2.93	0.75
Dry ^a	5(0.4)	1141(99.6)	1146	1.00		

^a Reference category, * Significant, OR = Odds Ratio, CI = Confidence Interval.

Table 4. Univariate association between breeds, age, sex and season with the occurrence of ectoparasitic diseases among dogs diagnosed with canine parasitic disease conditions at the major Veterinary Clinics in Osun State, Nigeria, from 2006-2015.

Variables	Parasite +ive	Parasite -ive	Total	OR	95% CI	<i>p</i>
Tick infestation						
Breeds						
Exotic	671(47.8)	733(52.2)	1404	1.30	1.10-1.55	<0.01*
Cross	170(30.7)	383(69.3)	553	0.63	0.50-0.79	<0.01*
Indigenous ^a	356(41.3)	507(58.7)	863	1.00		
Age						
< 1 year	834(40.9)	1204(59.1)	2038	0.38	0.13-1.02	0.04*
> 1-8 years	352(46.0)	413(54.0)	765	0.47	0.16-1.27	0.14
> 8 years ^a	11(64.7)	6(35.3)	17	1.00		
Sex						
Male	595(43.3)	780(56.7)	1375	1.07	0.92-1.24	0.39
Female ^a	602(41.7)	843(58.3)	1445	1.00		
Season						
Wet	746(44.6)	928(55.4)	1674	1.24	1.06-1.44	<0.01*
Dry ^a	451(39.4)	695(60.6)	1146	1.00		
Lice infestation						
Breeds						
Exotic	69(4.9)	1335(95.1)	1404	0.53	0.38-0.74	<0.01*
Cross	30(5.4)	523(94.6)	553	0.59	0.37-0.9	0.01*
Indigenous ^a	77(8.9)	786(91.1)	863	1.00		
Age						
< 1 year	146(7.2)	1892(92.8)	2038	1.20	0.21-6.32	0.94
> 1 – 8 years	29(3.8)	736(96.2)	765	0.63	0.11-3.79	0.63
> 8 years ^a	1(5.9)	16(94.1)	17	1.00		
Sex						
Male	82(6.0)	1293(94.0)	1375	0.91	0.67-1.24	0.55
Female ^a	94(6.5)	1351(93.5)	1445	1.00		
Season						
Wet	118(7.0)	1556(93.0)	1674	1.42	1.03-1.98	0.03*
Dry ^a	58(5.1)	1088(94.9)	1146	1.00		
Flea infestation						
Breeds						
Exotic	6(0.4)	1398(99.6)	1404	0.16	0.06-0.39	<0.01*
Cross	6(1.1)	547(98.9)	553	0.42	0.16-1.01	0.05
Indigenous ^a	22(2.5)	841(97.5)	863	1.00		
Age						
< 1 year	31(1.5)	2007(98.5)	2038	0.25	0.4-5.40	0.26
> 1 – 8 years	2(0.3)	763(99.7)	765	0.04	0.01-1.32	0.04*
> 8 years ^a	1(5.9)	16(94.1)	17	1.00		
Sex						
Male	16(1.2)	1359(98.8)	1375	0.93	0.47-1.85	0.85
Female ^a	18(1.2)	1427(98.8)	1445	1.00		
Season						
Wet	25(1.5)	1649(98.5)	1674	1.92	0.91-4.34	0.09
Dry ^a	9(0.8)	1137(99.2)	1146	1.00		
Mange						
Breeds						
Exotic	123(8.8)	1281(91.2)	1404	0.86	0.64-1.15	0.29
Cross	50(9.0)	503(91.0)	553	0.89	0.61-1.28	0.52
Indigenous ^a	87(10.1)	776(89.9)	863	1.00		
Age						
< 1 year	153(7.5)	1885(92.5)	2038	0.61	0.16-3.97	0.50
> 1 – 8 years	105(13.7)	660(86.3)	765	1.19	0.31-7.81	0.88
> 8 years ^a	2(11.8)	15(88.2)	17	1.00		
Sex						
Male	112(8.1)	391(28.4)	1375	0.98	0.83-1.15	0.78
Female ^a	1041(72.0)	404(28.0)	1445	1.00		
Season						
Wet	159(95)	1515(90.5)	1674	1.09	0.84-1.41	0.54
Dry ^a	101(8.8)	1045(91.2)	1146	1.00		

Table 4. (cont'd)

Variables	Parasite +ive	Parasite -ive	Total	OR	95% CI	p
Myiasis						
Breeds						
Exotic	11(0.8)	1393(99.2)	1404	0.30	0.14-0.62	<0.01*
Cross	2(0.4)	551(99.6)	553	0.14	0.02-0.51	<0.01*
Indigenous	22(2.5)	841(97.5)	863	1.00		
Age						
< 1 year	25(1.2)	2013(98.8)	2038	0.20	0.03-4.37	0.21
> 1-8 years	9(1.2)	756(98.8)	765	0.19	0.03-4.46	0.22
> 8 years	1(5.9)	16(94.1)	17	1.00		
Sex						
Male	20(1.5)	1355(98.5)	1375	1.41	0.72-2.81	0.33
Female ^a	15(1.0)	1430(99.0)	1445	1.00		
Season						
Wet	30(1.8)	1644(98.2)	1674	4.16	1.70-12.12	<0.01*
Dry	5(0.4)	1141(99.6)	1146	1.00		

^a Reference category, * Significant, OR = Odds Ratio, CI = Confidence Interval.

Discussion

Parasitism is a common and important cause of disease with negative effect on growth and performance of affected dogs. To the best of our knowledge, this present study provides the first report of the occurrence of parasitic infections in dogs in Osun State, Nigeria. Helminthoses was the most prevalent parasitic condition encountered in our study and this is consistent with earlier reports in other parts of Nigeria [1, 6, 7, 12] and other parts of the world [15, 16] which revealed that helminthoses is the most encountered parasitic condition in dogs. The high prevalence of helminthoses may be attributed to poor environmental and kennel hygiene, favourable climatic conditions for the survival of infective stages outside the host and the numerous route of transmitting helminthic parasites in dogs. There was a high prevalence of tick infestation in our study which supports previous works [7, 17]. Ticks have been reported to be the most abundant ectoparasite infecting dogs in Nigeria and other part of the world such as Iran [18, 19]. The low occurrence of trypanosomiasis, ehrlichiosis, in our study is in line with report by previous researchers in Nigeria [1, 20] who reported low prevalence of these diseases in their study. Babesiosis, lice infestation, flea infestation, mange and myiasis have been reported to affect dogs in different parts of Nigeria [17, 18, 21].

The high occurrence of parasitic conditions recorded between 2013 and 2015 may be associated with an increase in the number of dogs presented to the State Veterinary clinics for treatments as the Veterinary Department of the State is putting in great effort in sensitizing the public about the need to bring their pets (dogs) to the clinics for any form of medical attention. The highest level of parasitic disease occurrence was recorded between February to April which coincides with the beginning of the wet season. This findings agrees with earlier findings by Mbaya *et al* [7]. Rainfall has been reported to have a positive correlation with the increase in the prevalence of parasitic diseases in dogs [22].

Breeds of animals play an important role in the epidemiology of parasitic diseases as some breeds are more resistant to some diseases while some are more susceptible. The breeds of dogs raised in Nigeria can be broadly grouped as exotic (which includes the German shepherd, Rottweiler, Caucasian breeds, etc.), indigenous (local) and a cross between the indigenous and the exotic breed with no emphases on the extent of the genetic properties of the cross. Our study showed that the exotic breeds of dogs had a lower prevalence of helminthoses, lice infestation, flea infestation, mange and myiasis compared to the indigenous breeds and their crosses. This is in agreement with report by Akeredolu and Sowemimo [23] who documented that exotic breeds of dogs had a lower prevalence of helminths infections compared to the Nigerian indigenous breeds. Omudu *et al* [17] reported a higher prevalence of flea infestation in the Nigerian indigenous breeds of dogs compared to the exotic breeds of dogs. Tarafder and Samad [16] documented there was a lower prevalence of mange in the exotic breeds compared to the indigenous breed and their crosses. Ogo *et al* [21] reported a lower prevalence of myiasis in the exotic breeds compared to the indigenous breed and their crosses. The lower prevalence of lice infestation in the exotic breeds in relation to the indigenous breed and its cross is in line with the findings of Ugochukwu and Nnadozie [24]. The low prevalence of these parasitic diseases seen in this study may be attributed to the special care and good hygienic practice given to exotic breeds due to the cost of their purchase as only wealthy individuals keep exotic breeds of dogs.

Also, the restricted access of exotic breeds to outdoor and contact with other dogs and livestock may have contributed to the lower prevalence of these parasitic diseases recorded among the exotic breeds. On the other hand, the exotic breeds shows a significantly higher level of susceptibility to tick infestation and the tick-borne haemoparasites recorded in our study (babesiosis and ehrlichiosis). The relationship between trypanosomiasis and the different breeds of dogs was significant with the

exotic breeds been more susceptible compared to the other breeds. This findings collaborates previous reports by Okubanjo *et al* [25] who reported a higher prevalence of tick-borne canine haemoprotozoans in exotic breeds compared to the indigenous breeds. This findings can be associated with the tenderness of the skin and the abundance of fur of most exotic breeds of dogs which may cause ticks to be attracted to them than the indigenous breeds and their crosses. Ticks has been incriminated for the transmission of canine babesiosis and canine ehrlichiosis in Nigeria [24, 25], this may be the reason for the similar effect of tick infestation, babesiosis and ehrlichiosis on the breeds of dogs as reported in this study. The poor acclimatization of exotic breeds of dogs to the local environment may contribute to their higher susceptibility to diseases compared to the indigenous breeds.

Age is an important risk factor associated with the incidence and distribution of human and animal diseases within a population. The prevalence of parasitic infections in dogs has been reported to be age dependent [25, 26]. In line with this, we report that young dogs (<1 year) are significantly more susceptible to helminthoses compared to the old dogs (>1 year), and this may be attributed to the low immunity of young dogs compared to the old dogs. Also, this studies showed that older dogs (>1 year) are significantly more susceptible to tick and flea infestation compared to the young dogs (<1 year), which may be due to the large body sizes processed by the older dogs and the fact that older dogs roam more and they frequently interact with other dogs or livestock as against younger dogs which are kept in confinement. The non-significant relationship between age and the other parasitic disease conditions (Babesiosis, ehrlichiosis, trypanosomiasis, lice, mange and myiasis) reported in our study may be associated with other factors (genetic and non-genetic) as the epidemiology of diseases is determined by multiple factors. The epidemiology of canine parasitic diseases is a complex study, particularly in developing countries, given the high numbers of stray dogs with poor or no documented histories [26].

Season was significantly associated with the prevalence of helminthoses, tick infestation, lice infestation and myiasis in our study. Higher prevalence of these parasitic condition occurred in the wet season compared to the dry season with exception of helminthoses. Mbaya *et al* [7] reported a significantly higher prevalence of endoparasitic and ectoparasitic conditions in dogs during the wet season than the dry season. Climatic seasons are determined by the amount of rainfall, mean temperature, relative humidity, solar radiation and wind strength, which are important indices in the epidemiology of parasitic diseases in dogs as these either favours or hinders the survival of parasites and its vectors, the transmission of parasitic diseases and the development of diseases in the host [27].

Interestingly, dog sex was not significantly associated with any of the parasitic condition reported in this study. This does not stand alone as previous researchers have reported a non-significant association between sex of dogs and canine parasitic diseases in Nigeria [24, 25]. Despite this non-significant association, male dogs were more susceptible to babesiosis, ehrlichiosis, trypanosomiasis, tick infestation and myiasis compared to female dogs. This may be attributed to the roaming behavior seen in male dogs particularly during the mating season which may predispose them to these conditions been vector and vector borne diseases.

This study shows the occurrence of different parasitic diseases in dogs with helminthoses (71.8%) been the most prevalent parasitic condition recorded. Canine helminthoses in Nigeria is majorly caused by *Ancylostoma caninum*, *Toxocara canis*, *Echinococcus granulosus*, *Dipylidium caninum*, *Trichuris vulpis* and *Strongyloides stercoralis* [7, 12,] and these helminths are zoonotic. Considering the public health implication of these helminths, preventive measures should be taken to reduce the risk of transmission to humans. Regular public awareness through health education on the media will go a long way to reduce the risk of infection. Government at all levels should formulate policies that will educate pet owners on the following (a) routine and adequate deworming exercise and proper care in terms of good and hygienic environment for their pets. (b) patronizing of qualified veterinary doctors and (c) establishment of programs centered on enlightening the populace of possible zoonotic (parasitic) diseases.

Acknowledgements

Special thanks is given to the Director of the Department of Veterinary Services, Osun State: Dr. Isaac Oluwabukola Aluko, the veterinarians and staff of the department for giving us access to the clinical records used for this study and to Dr. Ademola Isaiah Oluwafemi for the corrections and observations given.

References

1. Kundu, F. S., Terzungwe, M. T., Idusiye, J. M. and Ternenge, T. A. 2015. Retrospective study of disease incidence and other clinical conditions diagnosed in owned dogs in Delta State, Nigeria. *J. Adv. Vet. Anim. Res.*, 2(4): 435-449.
2. Oboegbulem, S. I. and Nwakonobi, I. E. 1989. Population density and ecology of dogs in Nigeria: A pilot study. *Rev. Sci. Tech. Off. Int. Epiz.*, 8(3): 733-745.
3. Hambolu, S. E., Dzikwi, A. A., Kwaga, J. K. P., Kazeem, H. M., Umoh, J. U. and Hambolu, D. A. 2014. Dog ecology and population studies in Lagos State, Nigeria. *Global Journal of Health Science*, 6: 209-220.
4. Robertson, I. D., Irwin, P. J., Lymbery, A. J. and Thompson, R. C. A. 2000. The role of companion animals in the emergence of parasitic disease. *International Journal of Parasitology*, 30: 1369-1377.
5. Qadir, S., Dixit, A. K., Dixit, P. and Sharma, R. L. 2010.

- Intestinal helminths induce haematological changes in dogs from Jabalpur, India. *Journal of Helminthology*, 29: 1-3.
6. Karshima, S. N., Tizhe, E. V. and Bukar, D. P. 2010. A retrospective study of parasitic diseases of dogs and cats in Jalingo, north-eastern Nigeria between 1998 and 2008. *Sokoto Journal of Veterinary Sciences*, 8 (1 and 2).
 7. Odeniran, A. W., Aliyu, M. M., Nwosu, C. O., Ibrahim, U. I. and Shallaguwa, J. M. 2008. A ten-year retrospective study of the prevalence of parasitic infections of dogs at the University of Maiduguri Veterinary Teaching Hospital, Nigeria. *Nigerian Veterinary Journal*, 29(2): 31-136.
 8. Deplazes, P., van Knapen, F., Schweiger, A. and Overgaauw, P.A. 2011. Role of pet dogs and cats in the transmission of helminthic zoonoses in Europe, with a focus on echinococcosis and toxocarosis. *Veterinary Parasitology*, 24: 41-53.
 9. Stojčević, D., Sušić, V. and Lučinger, S. 2010. Contamination of soil and sand with parasite elements as a risk factor for human health in public parks and playgrounds in Pula, Croatia. *Veterinarski Arhiv*, 80: 733-742.
 10. Bowman, D. D., Montgomery, S. P., Zajac, A. M., Eberhard, M. L. and Kazacos, K. R. 2010. Hookworms of dogs and cats as agents of cutaneous larva migrans. *Trends in Parasitology*, 26: 162-167.
 11. Lappin, M. R. 2002. Pet ownership by immunocompromised people. *Bayer Zoonosis Symposium. North American Veterinary Conference*, 24(5): 16-25.
 12. Odeniran, P.O. and Ademola, I. O. 2013. Prevalence of zoonotic nematode species in dogs and risk perception by dog owners in Ibadan, Nigeria. *Nigerian Veterinary Journal*, 34(3): 851-858.
 13. Ayoade, S. S. 1982. Climate change. In: Baobour, K. M., Oguntuyinbo, J. S., Onyemelukwe, J. O. C., Nwafor, J.C. (Eds.), *Nigeria in maps*. London: Holder and Stoughton, pp. 14-15.
 14. Genchi, C., Venco, L. and Genchi, M. 2007. Guideline for the laboratory diagnosis of canine and feline *Dirofilaria* infections. Genchi, C., Rinaldi, L., Cringoli, G. *Veterinary Parasitology and Parasitic Diseases*, 8, Naples.
 15. Singh, H., Jyoti, Haque, M., Singh, N. K. and Rath, S. S. 2011. Prevalence of canine parasitic infections in and around Ludhiana, Punjab. *Journal of Veterinary Parasitology*, 25: 2.
 16. Tarafder, M. and Samad, M. A. 2010. Prevalence of clinical diseases of pet dogs and risk perception of zoonotic infection by dog owners in Bangladesh. *Bangladesh Journal of Veterinary Medicine*, 8(2): 163-174.
 17. Omudu, E.A., Okpe, G. and Adelusi, S. M. 2010. Studies on dog population in Makurdi, Nigeria (II): A survey of ectoparasite infestation and its public health implications. *Journal of Research in Forestry, Wildlife and Environment*, 2(1).
 18. Agbolade, O. M., Soetan, E. O., Awesu, A., Ojo, J. A., Somoye, O. J. and Raufu, S. T. 2008. Ectoparasites of domestic dogs in some Ijebu communities, south-west Nigeria. *World Applied Sciences Journal*, 3 (6): 916-920.
 19. Mirzaei, M., Khovand, H. and Akhtardanesh, B. 2016. Prevalence of ectoparasites in owned dogs in Kerman City, south-east of Iran. *Journal of Parasitic Diseases*, 40(2): 454-458.
 20. Nwoha, R. I. O., Daniel-Igwe, G., Onuekwusi, G. C., Onyeabor, A., Igwe, K. C. and Okah, U. 2013. Incidences of haemoparasites in dogs in Ikwoano Local Government Area of Abia State. *Journal of Veterinary Science and Technology*, 4: 4.
 21. Ogo, N.I., Onovoh, E., Ayodele, D. R., Ajayi, O. O., Chukwu, C. O., Sugun, M. and Okeke, I. O. 2009. Cutaneous canine myiasis in the Jos Metropolis of Plateau State, Nigeria, associated with *Cordylobia anthropophaga*. *Veterinarski Arhiv*, 79(3): 293-299.
 22. Confalonieri, U. E. C., Margonari, C. and Quintão, A. F. 2014. Environmental change and the dynamics of parasitic diseases in the Amazon. *Acta Tropica*, 129: 33-41.
 23. Akeredolu, A. B. and Sowemimo, O. A. 2014. Prevalence, intensity and associated risk factors for *Toxocara canis* infection in Nigerian dogs. *Journal of Parasitology and Vector Biology*, 6(8): 111-116.
 24. Ugochukwu, E. I. and Nnadozie, C. C. 1986. Ectoparasitic infestation of dogs in Bendel State, Nigeria. *International Journal of Zoonoses*, 12(4): 308-12.
 25. Okubanjo, O. O., Adeshina, O. A., Jatau, I. D. and Natala, A. J. 2013. Prevalence of *Babesia canis* and *Hepatozoon canis* in Zaria, Nigeria. *Sokoto Journal of Veterinary Sciences*, 11(2).
 26. Amisah-Reynolds, P. K., Monney, I., Adowah, L. M. and Agyemang, S. O. 2016. Prevalence of helminths in dogs and owners' awareness of zoonotic diseases in Mampong, Ashanti, Ghana. *Journal of Parasitology Research*.
 27. Patz, J. A., Graczyk, T. K., Geller, N., Vittor, A. Y. 2000. Effects of environmental change on emerging parasitic diseases. *International Journal of Parasitology*, 30, 1395-1405.

Citation

Ola-Fadunsin, S. D.

Parasitic diseases of dogs in Osun State, south-west Nigeria, and its zoonotic implications, pages 211-219.

<http://dx.doi.org/10.4314/njpar.v39i2.17>

Nigerian Journal of Parasitology

ISSN 1117 4145, Volume 39[2] September 2018

