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ORIGINAL ARTICLE

Retrospective Occurrence and Risk Factors Associated with Cattle Parasitic Infections in Osun State, Nigeria

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SUMMARY

Parasitism is one of the major constraints for profitable dairy and beef industry in tropical and subtropical countries including Nigeria. Data was obtained from cattle diagnosed and treated for parasitic diseases at the major Veterinary clinics in Osun State between January 2006 and December 2016. A total of 393 cattle were treated for different parasitic diseases. Of the 393 cattle infected, 265 (67.4%) were White Fulani, 60 (15.3%) Sokoto Gudali, 42 (10.7%) Red Bororo and 26 (6.6%) Keteku breeds. Two hundred and forty two (61.6%) were young cattle while 151 (38.4%) were adult cattle. Male cattle were 146 (37.2%) of the total number, while 247 (62.8%) were female. Two hundred and ninety six (75.3%) and 97 (24.7%) cases occurred during the dry and wet seasons respectively. Helminthoses 235 (59.8%), babesiosis 6 (1.5%), trypanosomiasis 306 (77.9%), tick infestation 18 (4.6%) and mange 20 (5.1%) were the parasitic diseases diagnosed, with trypanosomiasis and helminthoses having the highest occurrence. Most cases of parasitic diseases (345/393; 87.8%) were recorded between 2006 and 2008. Three hundred and twenty (81.4%) cases were recorded in January, July and August. From the data obtained, breeds of cattle, age, sex and season were statistically associated ($p<0.05$) with parasitic diseases. Two hundred and seven (52.7%) of the cattle were infected with single, while 186 (47.3%) were infected with two parasites, and the difference was not significant ($p>0.05$). There was a significant association ($p<0.05$) between breeds of cattle, age, sex and seasons with the prevalence of cattle co-infected with parasites. There was a correlation between babesiosis and tick infestation. These findings showed that cattle parasitic infections are endemic in Osun State.

Key words: Cattle, Osun State, Parasitic Diseases, Occurrence.

INTRODUCTION

In Nigeria, livestock such as sheep, goats and cattle are a major component of the nation's livestock industry (Lawal-Adebowale, 2012), they contribute about 12.7% of the total agricultural GDP (CBN, 1999). The worth of the nation's livestock is estimated to the tone of USD 6 billion (Akande *et al*., 2010) and they contribute greatly to the Agricultural component of the Gross Domestic Product (GDP) of which

cattle production makes up to 40% (McIntyre *et al*., 1992). The population of cattle in Nigeria is about 14 million (Lawal-Adebowale, 2012) and is one of the major source of protein provided by meat and milk. Cattle farming is a source of employment, income, farm power and organic manure for arable Agriculture in the country (Ikhatua and Asaka, 2000). Traditionally, cattle can be an important component of the social system, representing a family wealth and they can be regarded as a survival means by nomadic (Fabiyi, 1984).

Parasitic infections are major health problem in domestic ruminants throughout the world (Swarnakar *et al*., 2015). Parasitic diseases have a debilitating impact on human and animal health worldwide particularly in developing countries. Haemoparasitism have largely been shown to cause destruction of red blood cells resulting in anaemia, jaundice, anorexia, weight loss and infertility, and as such poses a serious threat to the food security of Nigeria (Samdi *et al*., 2010). The effect of haemoparasites on cattle production is difficult to quantify (Samdi et al., 2010) but losses in traction power, milk and meat production and costs of control programs have been attributed to haemoparasites (ILIR, 1997). Haemoparasites and their vectors (ticks and blood-sucking flies) have a worldwide distribution, stretching from the polar circle to the equator and are mainly important in Sub-Saharan Africa (Okorafor and Nzeako, 2014). The prevalence of haemoparasites of cattle in Nigeria is generally considered to be very high due to the preponderance of their arthropod vectors (Okorafor and Nzeakor, 2010; Musa *et al*., 2014).

Parasitic disease such as helminthoses has been implicated as one among the health problems constraining the productivity of cattle (Ogudo *et al*., 2015). Helminths are known to be a key constraint to ruminant well-being and productive performance (Keyyu *et al*., 2005; Hesterberg *et al*., 2007). Death of animals due to parasitic diseases may not be alarming at times but its indirect effects on livestock production and their zoonotic impact on human health are of greater implication (Nwosu *et al*., 2007; Ekong *et al*., 2012). Indirect and economic losses associated with helminthoses include a decline in productive ability of cattle such as decreased growth rate, weight loss, diarrhea, anorexia, gastroenteritis, abdominal distention, emaciation and sometimes anaemia (Nahed-Toral *et al*., 2003; Swai *et al*., 2006).

There remains a paucity of information on parasitic diseases of cattle in south-west Nigeria (Adedipe *et al*., 2014) and this appears to be the first in Osun State. Considering the importance of parasitic infections in cattle and their implication to the cattle industry and public health, this study aimed to determine the occurrence of parasitic diseases of cattle in Osun State using clinical records, so as to provide a baseline data on cattle parasitic conditions in the State. The findings from this study will assist in the formulation of government policies for improved cattle production.

MATERIALS AND METHODS

Study Area

This study was conducted in Osun State which is located in the south western part of Nigeria and lies between latitude 7° 59`N and longitude 4° 56`E. Its climate is characterized by the wet season (March - October) and the dry season (November, December - February and August) (Ayoade, 1982).

Clinical records of all diagnosed and confirmed cases of parasitic diseases of cattle presented to the major State Veterinary clinics located in Osogbo, Ilesa, Ede and Ikirun from January 2006 – December 2015 were collected. The records included all the animal information such as breed, age and sex as well as the date of presentation to the clinic. 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 and ticks using a stereomicroscope.

Statistical analysis

We conducted the descriptive statistics using percentages and tabulations. The univariate analysis (chi square) test and odds ratios with its 95% confidence interval were used to determine the association between each epidemiological factor and the parasitic diseases. The odds ratios were calculated with respect to a reference category as indicated in respective tables. Graph was drawn on excel sheet and Spearman's correlation was used to measure the strength of association. All statistical tests were conducted using statistical package for social sciences (SPSS) version 22 (SPSS Inc., Chicago). Values of $p<0.05$ were considered significant.

RESULTS

A total of 393 cattle were diagnosed for different parasitic diseases in the major veterinary clinics in Osun State during the ten year study. The demographic information of cattle presented at the major Veterinary clinics in Osun State from 2006 - 2015 is shown in Table I. Out of a total of 393 cases presented, 265 (67.4%; 95 % CI 62.7 – 71.9) were White Fulani and 26 (6.6%; 95 % CI 4.5 – 9.4) were Keteku. Cattle presented were majorly young ones (242, 61.6%; 95% CI 56.7 – 66.3), while 151 (38.4%; 95% CI 33.7 – 43.3) were adults. Higher number of female 247 (62.8%; 95% Cl 58.0 – 67.5) were presented compared to male, and more cases were diagnosed during the dry season (296, 75.3%) as against the wet season.

Table II shows the distribution (%) of disease conditions among cattle. Trypanosomiasis and helminthoses were the most prevalent with 306/393 (77.9%; 95% CI 73.6 – 81.8) and 235/393 (59.8%; 95% CI 54.9 – 64.6) respectively. Mange, tick infestation and babesiosis had occurrence ranging from 1.5% – 5.1%. There was a significant difference ($p<0.05$) in the prevalence of these parasitic diseases.

Table III illustrates the yearly and monthly distribution of cattle parasitic disease cases diagnosed at the major Veterinary clinics in Osun State from 2006 - 2015. Of the 393 cases, 240, 60, 45, 24 and 12 were diagnosed in 2008, 2007, 2006, 2011 and 2015, respectively. There was no parasitic disease condition recorded in 2010, 2012

TABLE I: Demographic information of cattle presented major Veterinary clinics in Osun State from 2006 - 2015

Variables	Number Presented	Percentage (%)	95% CI
Breed			
White Fulani	265	67.4	62.7 – 71.9
Sokoto Gudali	60	15.3	12.0 – 19.1
Red Bororo	42	10.7	7.9 – 14.0
Keteku	26	6.6	4.5 – 9.4
Age			
Young	242	61.6	56.7 – 66.3
Adult	151	38.4	33.7 – 43.3
Sex			
Male	146	37.2	32.5 – 42.0
Female	247	62.8	58.0 – 67.5
Season			
Dry season	296	75.3	70.9 – 79.4
Wet season	97	24.7	20.6 – 29.1

TABLE II: Distribution (%) of disease conditions among the 393 cattle parasitic cases presented in the major Veterinary clinics in Osun State from 2006 - 2015

Disease Condition	Number of cases	Percentage (%)	95% CI
Helminthoses	235	59.8 [a]	54.9 – 64.6
Babesiosis	6	1.5 [b]	0.6 – 3.2
Trypanosomiasis	306	77.9 [c]	73.6 – 81.8
Tick infestation	18	4.6 [d]	2.8 – 7.0
Mange	20	5.1 [d]	3.2 – 7.6

Different alphabets superscripts (a,b,c,d) indicate significant differences (P<0.05) between rows

TABLE III: Yearly and monthly distribution of cattle parasitic disease cases diagnosed at the major Veterinary clinics in Osun State from 2006 - 2015

	Number of Parasitic Disease Condition (%)					
	No of cattle	**Helminthoses**	**Babesiosis**	**Trypanosomiasis**	**Tick infestation**	**Mange**
			Yearly			
2006	45	13 (28.9) [a]	6 (13.3) [a]	6 (13.3) [a]	12 (26.7) [a]	20 (44.4) [a]
2007	60	0 (0.0) [b]	0 (0.0) [b]	60 (100.0) [b]	0 (0.0) [b]	0 (0.0) [b]
2008	240	186 (77.5) [c]	0 (0.0) [b]	234 (97.5) [b]	0 (0.0) [b]	0 (0.0) [b]
2009	6	0 (0.0) [b]	0 (0.0) [b]	6 (100.0) [b]	0 (0.0) [b]	0 (0.0) [b]
2010	0	0 (0.0) [b]	0 (0.0) [b]	0 (0.0) [c]	0 (0.0) [b]	0 (0.0) [b]
2011	24	24 (100.0) [d]	0 (0.0) [b]	0 (0.0) [c]	0 (0.0) [b]	0 (0.0) [b]
2012	0	0 (0.0) [b]	0 (0.0) [b]	0 (0.0) [c]	0 (0.0) [b]	0 (0.0) [b]
2013	6	0 (0.0) [b]	0 (0.0) [b]	0 (0.0) [c]	6 (100.0) [c]	0 (0.0) [b]
2014	0	0 (0.0) [b]	0 (0.0) [b]	0 (0.0) [c]	0 (0.0) [b]	0 (0.0) [b]
2015	12	12 (100.0) [d]	0 (0.0) [b]	0 (0.0) [c]	0 (0.0) [b]	0 (0.0) [b]
			Monthly			
January	240	180 (75.0) [a]	0 (0.0) [a]	240 (100.0) [a]	0 (0.0) [a]	0 (0.0) [a]
February	0	0 (0.0) [b]	0 (0.0) [a]	0 (0.0) [b]	0 (0.0) [a]	0 (0.0) [a]
March	6	6 (100.0) [a]	0 (0.0) [a]	0 (0.0) [b]	0 (0.0) [a]	0 (0.0) [a]
April	24	12 (50.0) [c]	6 (25.0) [b]	12 (50.0) [c]	6 (25.0) [b]	0 (0.0) [a]
May	19	0 (0.0) [b]	0 (0.0) [a]	0 (0.0) [b]	6 (31.6) [c]	13 (68.4) [b]
June	6	6 (100.0) [a]	0 (0.0) [a]	0 (0.0) [b]	0 (0.0) [a]	0 (0.0) [a]
July	36	0 (0.0) [b]	0 (0.0) [a]	36 (100.0) [a]	0 (0.0) [a]	0 (0.0) [a]
August	44	19 (43.2) [c]	0 (0.0) [a]	18 (40.9) [c]	0 (0.0) [a]	7 (15.9) [c]
September	6	0 (0.0) [b]	0 (0.0) [a]	0 (0.0) [b]	6 (100.0) [c]	0 (0.0) [a]
October	0	0 (0.0) [b]	0 (0.0) [a]	0 (0.0) [b]	0 (0.0) [a]	0 (0.0) [a]
November	12	12 (100.0) [a]	0 (0.0) [a]	0 (0.0) [b]	0 (0.0) [a]	0 (0.0) [a]
December	0	0 (0.0) [b]	0 (0.0) [a]	0 (0.0) [b]	0 (0.0) [a]	0 (0.0) [a]
	393	235 (59.8)	6 (1.5)	306 (77.9)	18 (4.6)	20 (5.1)

Different alphabets superscripts (a,b,c,d) indicate significant differences (P<0.05) between rows

TABLE IV: Univariate association between breeds, age, sex and season with the occurrence of helminthoses among cattle presented at the major Veterinary clinics in Osun State from 2006 - 2015

Variables	Parasite +ive	Parasite -ive	OR	95% Cl	p
Breeds					
White Fulani	163 (61.5)	102 (38.5)	5.30	2.12 – 14.86	<0.01*
Sokoto Gudali	42 (70.0)	18 (30.0)	7.57	2.67 – 23.76	<0.01*
Red bororo	24 (57.1)	18 (42.9)	4.34	1.48 – 14.04	0.01*
Keteku [a]	6 (23.1)	20 (76.9)	1.00		
Age					
Young	150 (62.0)	92 (38.0)	1.27	0.84 – 1.92	0.27
Adult [a]	85 (56.3)	66 (43.7)	1.00		
Sex					
Male	109 (74.7)	37 (25.3)	2.82	1.81 – 4.45	<0.01*
Female [a]	126 (51.0)	121 (49.0)	1.00		
Season					
Dry	211 (71.3)	85 (28.7)	7.60	4.47 – 12.77	<0.01*
Wet [a]	24 (24.7)	73 (75.3)	1.00		

[a] Reference category, * Significant, OR = Odds Ratio, CI = Confidence Interval

and 2014, while 6 cases were diagnosed each in 2009 and 2013.

The occurrence of helminthoses within the years was 2011 (100.0%), 2015 (100.0%), 2008 (77.5%), 2006 (28.9%) and 0.0% in the other years. Babesiosis and mange were diagnosed only in 2006 with no case recorded in the other years. Trypanosomiasis was prevalent in 2007 (100.0%), 2009 (100.0%), 2008 (97.5%) and 2006 (13.3%) and not recorded in the other years. Tick infestation was recorded only in 2013 and 2006 with 100.0% and 26.7%, respectively. The differences in the prevalence of parasitic diseases within the years was significant ($p<0.05$).

In the monthly occurrence of cattle parasitic diseases (Table III), the highest occurrence during the study period were recorded in January and August with 240 and 44 cases, respectively. The lowest numbers of cases were recorded in March, June and September having 6 cases each. No case was recorded in February, October and December. Of the 235 cases of helminthoses, 180 cases (75.0%), 6 (100.0%), 12 (50.0%), 6 (100.0%), 19 (43.2%) and 12 cases (100.0%) occurred in January, March, April, June, August and November, respectively with no case observed in the other months. The 6 cases (6/24, 25.0%) of babesiosis was only observed in April with other months having no case recorded. Of the 306 trypanosomiasis cases, 240 (100.0%), 12 (50.0%), 36 (100.0%) and 18 (40.9%) were reported in January, April, July and August respectively. Tick infestation cases were observed in April 6/24 (25.0%), May 6/19 (31.6%) and September 6/6 (100.0%). Of the 20 cases of mange, May and August had 13 (68.4%) and 7 (15.9%), respectively with no cases recorded in the other months. The differences in the number of parasitic disease conditions observed in the months was significant ($P<0.05$).

The univariate association between breeds, age, sex and season with the occurrence of helminthoses is presented in Table IV. Within breeds, the Sokoto Gudali, White Fulani and Red bororo breeds had higher odds of helminthoses (7.6, 5.3 and 4.3) respectively than the Keteku breed. Male cattle had higher odds of helminthoses (2.8) than female cattle. The occurrence of helminthoses was 7.6 times more likely to

TABLE V: Univariate association between breeds, age, sex and season with the occurrence of babesiosis among cattle presented at the major Veterinary Clinics in Osun State from 2006 - 2015

Variables	Parasite +ive	Parasite -ive	OR	95% Cl	p
Breeds					
White Fulani [a]	6 (2.3)	259 (97.7)	1.00		
Sokoto Gudali	0 (0.0)	60 (100.0)	X	X	
Red bororo	0 (0.0)	42 (100.0)	X	X	
Keteku	0 (0.0)	26 (100.0)	X	X	
Age					
Young	6 (2.5)	236 (97.5)	3.80	0.56 – 8.87	0.21
Adult [a]	1 (0.7)	150 (99.3)	1.00		
Sex					
Male	6 (4.1)	140 (95.9)	10.49	3.53 – 18.45	0.01*
Female [a]	1 (0.4)	246 (99.6)	1.00		
Season					
Dry	1 (0.3)	295 (99.7)	0.05	0.01 – 0.36	<0.01*
Wet [a]	6 (6.2)	91 (93.8)	1.00		

[a] Reference category, * Significant, OR = Odds Ratio, CI = Confidence Interval, X = Not applicable

TABLE VI: Univariate association between breeds, age, sex and season with the occurrence of trypanosomiasis among cattle presented at the major Veterinary Clinics in Osun State from 2006 - 2015

Variables	Parasite +ive	Parasite -ive	OR	95% Cl	p
Breeds					
White Fulani	216 (81.5)	49 (18.5)	14.50	5.70 – 41.37	<0.01*
Sokoto Gudali	48 (80.0)	12 (20.0)	12.81	4.35 – 42.02	<0.01*
Red bororo	36 (85.7)	6 (14.3)	18.76	5.57 – 72.32	<0.01*
Keteku [a]	6 (23.1)	20 (76.9)	1.00		
Age					
Young	192 (79.3)	50 (20.7)	1.25	0.21 – 0.55	0.38
Adult [a]	114 (75.5)	37 (24.5)	1.00		
Sex					
Male	96 (65.8)	50 (34.2)	0.34	0.83 – 1.15	<0.01*
Female [a]	210 (85.0)	37 (15.0)	1.00		
Season					
Dry	258 (87.2)	38 (12.8)	6.93	4.11 – 11.70	<0.01*
Wet [a]	48 (49.5)	49 (50.5)	1.00		

[a] Reference category, * Significant, OR = Odds Ratio, CI = Confidence Interval

be diagnosed during the dry season than the wet season. Young cattle had higher odds of helminthoses (1.3) than adult cattle. There was a significant association ($p<0.05$) between cattle breeds, sex and season with the occurrence of helminthoses. The univariate association between breeds, age, sex and season with the occurrence of babesiosis among cattle is presented in Table V. Male cattle had a higher odds of

babesiosis (10.5) than female cattle. The occurrence of babesiosis was 20 times more likely to be diagnosed during the wet season than the dry season. Young cattle had higher odds of babesiosis (3.8) than adult cattle. The occurrence of babesiosis was significantly associated ($p<0.05$) with cattle sex and season.

Table VI illustrates the univariate association between breeds, age, sex and season with the occurrence of trypanosomiasis among cattle. Higher odds of 18.8, 14.5 and 12.8 were observed in Red bororo, White Fulani and Sokoto Gudali breeds, respectively compared to the Keteku breed. Lower odds of 0.3 was recorded in the male cattle compared to female cattle. There was a higher odds (6.9) of trypanosomiasis occurring during the dry season than the wet season. Young cattle had higher odds of trypanosomiasis (1.3) than adult cattle. The association between cattle breeds, sex and season with trypanosomiasis was significant ($p<0.05$).

Table VII illustrates the univariate association between breeds, age, sex and season with the occurrence of tick infestation among cattle presented at the major Veterinary clinics in Osun State from 2006 – 2015. The White Fulani breed was 2.3 times less infected with ticks compared to the Sokoto Gudali breed. Young cattle had higher odds (12.0) of tick infestation than adult cattle. Male cattle had a higher odds (3.6) of been infested with ticks compared to female cattle. The occurrence of tick infestation was 50 times more likely to be diagnosed during the wet season than the dry season. There was a significant association ($p<0.05$) between age, sex and season with the occurrence of tick infestation.

The univariate association between breeds, age, sex and season with the occurrence of mange among cattle is illustrated in Table VIII. The White Fulani breed was 50 times less likely to be infected with mange compared to the Keteku breed. Lower odds of 0.9 to mange was recorded in the male cattle compared to female cattle. The chances for mange to occur in the dry season was 0.16 times compared to the wet season. The association between cattle breeds and season with the occurrence of mange was significant ($p<0.05$).

Two hundred and seven (52.7%) of the cattle diagnosed with parasitic diseases were infected with a single disease condition, while 186 (47.3%) had double infections of parasitic disease conditions (figure I). The

TABLE VII: Univariate association between breeds, age, sex and season with the occurrence of tick infestation among cattle presented at the major Veterinary Clinics in Osun State from 2006 - 2015

Variables	Parasite +ive	Parasite -ive	OR	95% Cl	p
Breeds					
White Fulani [a]	12 (4.5)	253 (95.5)	1.00		
Sokoto Gudali	6 (10.0)	54 (90.0)	2.34	0.78 – 6.45	0.12
Red bororo	0 (0.0)	42 (100.0)	X	X	
Keteku	0 (0.0)	26 (100.0)	X	X	
Age					
Young	18 (7.4)	224 (92.6)	12.01	2.16 – 21.30	<0.01*
Adult [a]	1 (0.7)	150 (99.3)	1.00		
Sex					
Male	12 (8.2)	134 (91.8)	3.59	1.33 – 10.56	0.01*
Female [a]	6 (2.4)	241 (97.6)	1.00		
Season					
Dry	1 (0.3)	295 (99.7)	0.02	0.00 – 0.08	<0.01*

Wet [a]	18 (18.6)	79 (81.4)	1.00

[a] Reference category, * Significant, OR = Odds Ratio, CI = Confidence Interval, X = Not applicable

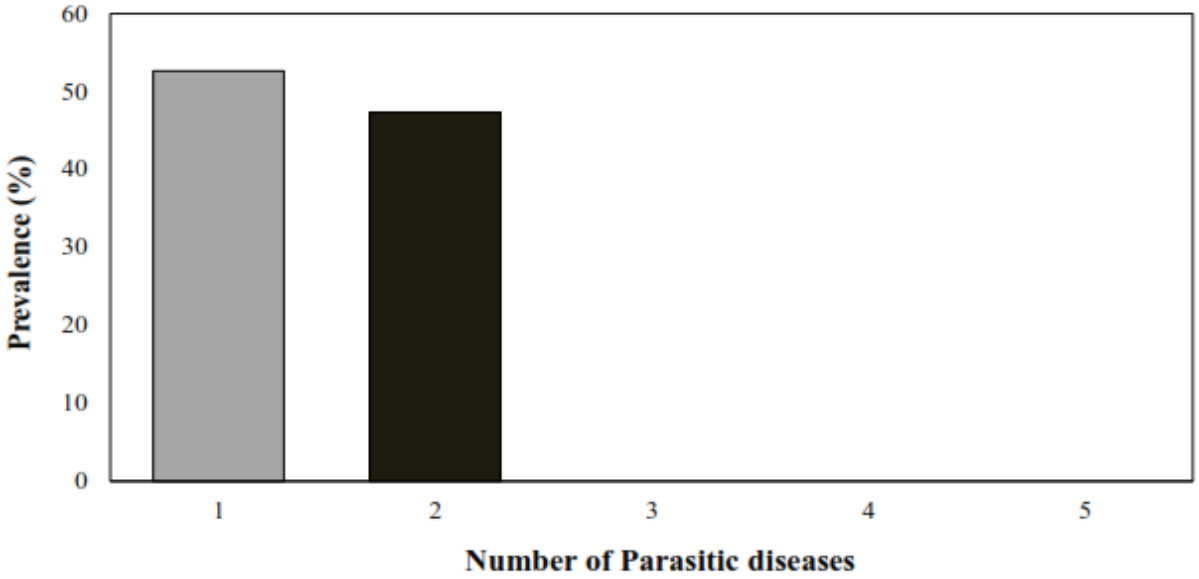

Figure I: Prevalence (%) of parasitic diseases co-infection among cattle presented at the major Veterinary Clinics in Osun State from 2006 - 2015. No cattle was infected with more than two parasitic disease conditions

TABLE VIII: Univariate association between breeds, age, sex and season with the occurrence of mange among cattle presented at the major Veterinary Clinics in Osun State from 2006 – 2015

Variables	**Parasite +ive**	**Parasite -ive**	**OR**	**95% Cl**	**p**
Breeds					
White Fulani	6 (2.3)	259 (97.7)	0.02	0.01 – 0.06	<0.01*
Sokoto Gudali	0 (0.0)	60 (100.0)	X	X	
Red bororo	0 (0.0)	42 (100.0)	X	X	
Keteku [a]	14 (53.8)	12 (46.2)	1.00		
Age					
Young	20 (8.3)	222 (91.7)	X	X	
Adult [a]	0 (0.0)	151 (100.0)	X		
Sex					
Male	7 (4.8)	139 (95.2)	0.91	0.33 – 2.32	0.86
Female [a]	13 (5.3)	234 (94.7)	1.00		
Season					
Dry	7 (2.4)	289 (97.6)	0.16	0.06 – 0.41	<0.01*
Wet [a]	13 (13.4)	84 (86.6)	1.00		

[a] Reference category, * Significant, OR = Odds Ratio, CI = Confidence Interval, X = Not applicable

difference was not significant (p>0.05). No cattle was diagnosed with more than two parasitic diseases concurrently.

The prevalence (%) of parasitic disease co-infection among the various cattle breeds and other epidemiological factors in cattle presented at the major Veterinary Clinics in

Osun State from 2006 – 2015 is presented in Table IX. One hundred and thirty three (50.2%) of the White Fulani breed haboured a single parasitic disease condition, while 132 (49.8%) haboured double parasitic disease conditions. Twenty four (40.0%) of Sokoto Gudali breed haboured a single parasitic disease condition, while 36 (60.0%) haboured double. Of the Red bororo breed, 24 (57.1%) was infected with one parasitic disease condition, while 18 (42.9%) was infected with two. The Keteku breed of cattle was only infected with one parasitic disease. One hundred and four (43.0%) of young cattle had a single parasitic disease condition, while 138 (57.0%) haboured double parasitic disease conditions. One hundred and three (68.2%) of adult cattle was infected with one parasitic disease condition, while 48 (31.8%) was infected with two. Of the male cattle, 68 (46.6%) haboured a single parasitic disease condition, while 78 (53.4%) haboured double. One hundred and thirty nine (56.3%) of female was infected with one parasitic disease condition, while 108 (43.7%) haboured double. In the season category, 116 (39.2%) cattle was infected with one parasitic disease condition, while 180 (60.8) was infected with two during the dry season. Ninety one (93.8%) cattle haboured a single parasitic disease condition, while 6 (6.2%) haboured double parasitic disease conditions during the wet season.

TABLE IX: Prevalence (%) of parasitic diseases co-infection among the various cattle breeds and other epidemiological factors in cattle presented at the major Veterinary Clinics in Osun State from 2006 – 2015

Variables	N	Number of parasitic diseases (co-infection)	
		1	2
Breeds			
White Fulani	265	133 (50.2) [a, 1]	132 (49.8) [a, 1]
Sokoto Gudali	60	24 (40.0) [a, 1]	36 (60.0) [a, 2]
Red bororo	42	24 (57.1) [a, 1]	18 (42.9) [a, 1]
Keteku	26	26 (100.0) [b, 1]	0 (0.0) [b, 2]
Age			
Young	242	104 (43.0) [a, 1]	138 (57.0) [a, 2]
Adult	151	103 (68.2) [b, 1]	48 (31.8) [b, 2]
Sex			
Male	146	68 (46.6) [a, 1]	78 (53.4) [a, 1]
Female	247	139 (56.3) [a, 1]	108 (43.7) [a, 2]
Season			
Dry	296	116 (39.2) [a, 1]	180 (60.8) [a, 2]
Wet	97	91 (93.8) [b, 1]	6 (6.2) [b, 2]

Different alphabetical superscripts (a,b,c,d,e) indicate significant differences (P<0.05) across columns (of the same variable category). Different numbered superscripts (1,2,3,4) indicate significant differences (P<0.05) across rows (of the same parasitic diseases co-infection category)

Table X shows the Spearman's (rho) correlation coefficient for the co-occurrence of parasitic diseases among cattle presented at the major Veterinary Clinics in Osun State from 2006 – 2015. The correlation between babesiosis and tick infestation was significant (p<0.05) and positively associated.

DISCUSSION

Parasitism is one of the major causes of economic losses in the cattle industry. It exerts a major health concern in domestic ruminants throughout the world (Swarnakar *et al*., 2015). A larger proportion of the cattle population in Nigeria is located in the northern region (Lawal-Adebowale, 2012). This may account for the small number of cattle presented and diagnosed for parasitic disease conditions during the ten year

period. The breeds of cattle documented in our study has been reported to be raised in southwest Nigeria (Oyo and Ogun States) with the White Fulani breed of cattle been the most predominant breed (Daodu *et al*., 2009; Akande *et al*., 2010). Young cattle were diagnoses for parasitism more than

TABLE X: Spearman's (rho) correlation coefficient for the co-occurrence of parasitic diseases among cattle presented at the major Veterinary Clinics in Osun State from 2006 - 2015

	Helminthoses	**Babesiosis**	**Trypanosomiasis**	**Tick infestation**	**Mange**
Helminthoses	1.000				
Babesiosis	-0.152**	1.000			
Trypanosomiasis	-0.037	0.066	1.000		
Tick infestation	-0.267**	0.568**	-0.235**	1.000	
Mange	-0.282**	-0.029	-0.434**	-0.051	1.000

** Correlation is significant at the 0.01 level (2-tailed)

adult cattle and female cattle were more infected with parasitism than their male counterpart. This outcome does not stand alone, as Paul *et al*. (2016) reported similar findings from their study done in Maiduguri, Nigeria. This can be attributed to the development of immunity in adult cattle due to incidences of previous infections.

Trypanosomiasis and helminthoses were the major parasitic diseases affecting cattle in the study area, with occurrence of 77.9% and 59.8% respectively. This result is similar to that recorded as a result of an abattoir study in Ibadan, Oyo State where *Trypanosoma brucei* was the most prevalent cattle haemoparasite among other cattle haemoparasites (Okorafor and Nzeako, 2014). Also, Yahaya and Tyav (2014) reported a 34.9% prevalence for helminth parasites in Kano State. The occurrences of trypanosomiasis and helminthoses from our study is higher than those reported by the aforementioned studies, the differences may be attributed to the nature of our study. Also, variation in geographical location, presence and spread of competent vector(s) may have also contributed to the differences. The high prevalence of trypanosomiasis seen in our study may be associated with the high density of its vector (*Glossina* spp.) as cattle move from Northern to Southern Nigeria. Studies have revealed a wide geoecological distribution of animal trypanosomiasis in Nigeria extending from the mangrove forest to the Sudan savanna, due to the existence of tsetse flies in these areas (Davies, 1977; Anene *et al*., 1999). These occurrences of cattle trypanosomiasis have been attributed to movement of cattle from tsetse fly infested to tsetse fly free areas (Anene *et al*., 1999). Musa *et al*. (2014) who studied the prevalence of tick infestation on different breeds of cattle in Maiduguri, Northeastern Nigeria reported a 63.4% prevalence. Biu and Wakawa (2004) reported a prevalence of 25.4% from their study on chorioptic mange infestation in cattle in Borno State. Paul *et al*. (2016) documented a prevalence of 4.2% for *Babesia* species in their study conducted in Maiduguri Nigeria. Differences in climatic conditions as well as the duration and time of our study may have contributed to the lower prevalence reported in our study.

The yearly and monthly variation of the various parasitic diseases may be associated with the irregularities of nomadic in their migrations to the southern part of the country as they are the major cattle farmers in Nigeria.

The epidemiology of various parasitic diseases of cattle has been reported to be breed, age, sex and season dependent (Biu and Wakawa, 2004; Eyo *et al*., 2014; Okorafor and Nzeako 2014; Swarnakar *et al*., 2015). The Keteku breed of cattle have significantly lower infection rate of babesiosis, trypanosomiasis and tick infestation than the White Fulani, Sokoto Gudali and Red bororo breeds of cattle. The

Keteku breed is a cross between Muturu and N'Dama (Blench *et al*., 1998). The N'Dama breeds has been reported to possess trypanotolerant genes and they are resistant to tick infestation (Mattioli *et al*., 2000), while the Muturu breeds has a unique adaptive attributes (Mwai *et al*., 2015). The attributes of these breeds that makes up the Keteku breed may have contributed to low infection rate of parasitism observed in the Keteku breed of cattle.

Young cattle had a higher infection rate of all the parasitic diseases than the adult cattle. This findings confirms earlier reports by previous researchers who documented that young cattle are more susceptible to mange (Biu and Wakawa, 2004), helminthoses (Kemal and Terefe, 2013), tick infestation (Eyo *et al*., 2014), babesiosis and trypanosomiasis (Paul *et al*., 2016). The higher infection rate of parasitic diseases seen in the young cattle might be due to a limited previous exposure to parasitism and the naiveness of their immune system. Also, the soft and thin skin of young cattle could aid in the penetration of tick mouthparts for feeding resulting in a higher prevalence of tick infestation and babesiosis in young cattle (Sajid *et al*., 2009).

Sex of an animal is an important indices in the epidemiology of parasitic diseases (Eyo *et al*., 2014; Yahaya and Tyav, 2014; Paul *et al*., 2016). In this study, male cattle were significantly more infected with helminthoses, babesiosis and tick infestation than female cattle. This result agrees with Yahaya and Tyav (2014) and Qadeer *et al*. (2015) who reported that male cattle had a higher prevalence of helminthoses than their female counterpart in Kano and Adamawa States respectively. The aggressive nature of male animals when feeding may cause them to pick up more ova of helminths on the pasture, making them more susceptible to helminthoses. Furthermore, male domestic ungulates are said to be more susceptible to infections with gastrointestinal tract parasites than females due to hormones debilitating immune functions, which favor the growth and spread of parasites in male guts (Hillgarth and Wingfield, 1997; Apio *et al*., 2006). In line with our findings, Musa *et al*. (2014) and Sam-Wobo *et al*. (2016) reported a higher prevalence of tick infestation and babesiosis respectively in male cattle than female cattle. This high prevalence seen in male cattle may be attributed to the practice in the tropics where male cattle are largely used for farming activities and are moved from place to place in search of food and in the process get infested with ticks, while their female counterpart are mainly confined for breeding purposes and therefore are less exposed to tick infestations. Larvae of ticks are known to climb blades of grasses and shrubs to attach themselves to passing hosts mostly males during grazing (Soulsby, 1982; Musa *et al*., 2014). Ticks are the major vector for bovine babesiosis (Horak *et al.,* 2002) and so a high prevalence of tick infestation reported in male cattle may accompany a high prevalence of babesiosis in them. Female cattle had a higher infection rate of mange and trypanosomiasis compared to male cattle. This agrees with works done in Maiduguri Borno State by Biu and Wakawa (2004) who reported that female cattle were more infected with mange than male cattle. Also, Sam-Wobo *et al*. (2016) reported a higher prevalence of trypanosomiasis in female cattle than in the male cattle in their study conducted in Abeokuta, Ogun State.

The higher prevalence of babesiosis, tick infestation and mange recorded during the rainy season may be due to high moisture content and lower temperature which favours the growth and development of parasites and their vectors (Yahaya and Tyav, 2014). Rainfall has been reported to favour the development and abundance of ticks and as such have a positive effect on the prevalence of tick borne diseases (Greenfield, 2011). Abundance of rainfall may reduce the flight activity of biting flies (Ola-Fadunsin, 2017) and this may be the

reason for the lower prevalence of trypanosomiasis during the wet season as biting flies (*Glossina* species) is the vector of trypanosomiasis in Nigeria. The abundance of flukes (metacercariae) in the pasture at the end of the rainy season (Kemal and Terefe, 2013) could be the reason for higher prevalence of helminthoses during the dry season in our study.

The occasional free veterinary services and public awareness programs carried out by the Veterinary department and the government of Osun Sate may have contributed to the lower number of cattle been diagnosed with more than one parasitic disease at the same time. The number of parasitic diseases co-infection varied between breeds, age, sex and season. This outcome may be associated with multiple reasons as environmental factors, management factors, nutritional status and physiological status of animals affects the epidemiology of diseases in animals (Gachohi *et al*., 2010; Simking *et al*., 2014).

From this study, there was a positive and moderate association between the occurrence of babesiosis and tick infestation. The association between the other parasitic disease conditions was negative with a negligible correlation as described by Mukaka (2012). Bovine babesiosis has been reported to occur in places wherever the tick vector exist (Spickler and Roth, 2008), this explains the positive and moderate association between the occurrence of babesiosis and tick infestation reported in our study.

In conclusion, the result of the present study has shown that parasitism is one of the diseases affecting cattle in Osun State. The occurrence of cattle parasitism in Osun State is breed, age, sex and season dependent. Also, more cattle have single infection rather than mixed infections of different parasitic conditions.

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