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# A retrospective evaluation of parasitic conditions and their associated risk factors in sheep and goats in Osun state, Nigeria

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### Abstract

Parasitism in small ruminants remains a great threat to the advancement of the livestock industry in most tropical countries. This study is aimed at appending and updating current literature on prevalence of parasitic diseases of small ruminants (sheep and goat) prevalent in Osun state, southwest Nigeria. A ten-year data (2006–2015) involving 321 sheep and 1,210 goats was analysed. Helminthoses (78.8% in sheep; 52.9% in goats) and mange (18.4% in sheep; 49.6% in goats) were the most prevalent parasitic diseases affecting sheep and goats and they occurred all the year round. Other parasitic diseases diagnosed during this period were babesiosis, tick infestation, myiasis, lice infestation, flea infestation, anaplasmosis, coccidiosis and trypanosomiasis. It was observed that age and sex were associated with parasitic diseases in sheep, while it was age and seasons in goats. This study shows that parasitic diseases are common among small ruminants in the state.

*Keywords:* Goats, Osun state, Parasitic diseases, Retrospective study, Sheep

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### Introduction

With the present economic situation in Nigeria, one of the most important and immediate way for the nation is to become self-sufficient in agriculture. Small ruminants (sheep and goats) are a major component of the ruminant industry in the country with an estimated population of sheep and goats at 22.1 million and 34.5 million, respectively (Adebowale, 2012). Small ruminant production contributes significantly to the nation's economy as they represent about one-third of the country agricultural gross domestic product (Adebowale, 2012). Small ruminants are very important source of protein to man in terms of meat and milk in both developed and developing economies (Wesongah *et al.*, 2003). In Nigeria, small ruminants are useful for the provision of meat, milk, household income,

manure, skin and sociocultural purposes (Okaiyeto *et al.*, 2008; Okorafor *et al.*, 2015).

Parasitism exerts great economic impact on production animals worldwide, especially in developing countries mainly due to sub-clinical gastrointestinal parasitism (Perry & Randolph, 1999). Endoparasitism (helminthoses and coccidiosis) has a global distribution and is one of the major causes of mortality and morbidity in tropical and sub-tropical regions of the world, specifically where adequate water and hygiene are deficient (Singla, 1995; Nwoke *et al.*, 2015). In Nigeria, helminthoses is an important killer disease of small ruminants as about 20% of the total sheep and goats in Nigeria are either slaughtered or died due to this condition (Kuil, 2009). Helminthosis is the most common cause of

diarrhoea in ruminants; as both young and old animals are susceptible (Singh *et al.*, 2016). This is more associated with overgrazing the pastures which force animals to graze closely to faecal materials, where infective larva of helminth parasites are mostly concentrated (Agbajelola & Falohun, 2015).

Haemoparasitism is also a major setback to livestock production in Nigeria and other Sub-Saharan Africa countries. Small ruminants in Nigeria are infected with a variety of blood parasites including *Anaplasma* spp., *Theileria* spp, *Babesia* spp, *Trypanosoma* spp. and *Ehrlichia* (*Cowdria*) spp. (Okaiyeto *et al.*, 2008). Haemoparasitism have largely been shown to cause destruction of red blood cells resulting in anaemia, jaundice, anorexia, weight loss and infertility, and which has profound consequences for the animal health and economy and possess a serious threat to the food safety of Nigeria (Samdi *et al.*, 2010).

Retrospective study of animal diseases is a quick and inexpensive means of identifying the strategy for effective disease control when analyzed statistically (Abiola *et al.*, 2016). Therefore the objectives of this study are to determine the prevalence and associated risk factors of different parasitic disease conditions of small ruminants among the parasitic cases presented to the four major Veterinary clinics in Osun state, southwest Nigeria. The knowledge of these findings will assist in the formulation of government policies for a better management, prevention and control measures against parasitic diseases of small ruminant in the state. This study also aimed at appending and updating current literature on parasitic diseases of small ruminants prevalent in Osun state.

## Materials and Methods

### Study area

Osun state sits within latitude 7° 59'N and longitude 4° 56'E in the southwestern part of Nigeria. The state is characterised by tropical dry and wet climate with a lowland tropical rain forest vegetation. The dry season occurs in a 5 month period (November, December, January, February and August), while the wet season covers a 7 month period (March, April, May, June, July, September and October) (Ayoade, 1982). Osun state is bordered in the north by Kwara state, in the east partly by Ekiti state and partly by Ondo state, in the south by Ogun state and in the west by Oyo state.

### Data collection

A ten-year clinical record (2006–2015) were collected from the major state veterinary clinics located in Osogbo, Ilesa, Ede and Ikirun. From these

records, data on diagnosed parasitic disease cases were extracted. The records included 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. Where possible, cases were confirmed in the Laboratory by blood and faecal examination using a light microscope and with direct identification for the ticks using a stereomicroscope.

### Data 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 with more than 50 cases (helminthoses and mange). The odds ratios were calculated with respect to a reference category as indicated in the respective tables. 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 321 cases of sheep parasitic diseases was recorded during the ten-year study (2006-2015). The most common breed of sheep was the West African Dwarf breeds which numbered 180 (56.1%). Other breeds included: Yankasa (98, 30.5%); Balami (15, 4.7%) and Uda (28, 8.7%). More of the sheep were adult (215, 67.0%) as against young (106, 33.0%). Two hundred and thirty seven (73.8%) were male while 84 (26.2%) were female. More sheep were diagnosed with parasitic diseases during the wet season (182, 56.7%) than the dry season (139, 43.3%). The total number of goat parasitic disease cases documented was 1,210. The West African Dwarf breed of goat was the most numerous (906, 74.9%), followed by the Red Sokoto (241, 19.9%) and Sahel (63, 5.2%) breeds. In respect to age, adult goats (711, 58.8%) were more numerous than young goats (499, 41.2%). Female were more in number than male with (723, 59.8%) and (487, 40.2%). More cases were presented during the wet season (682, 56.4%) as against the dry season (528, 43.6%) (Table 1).

Helminthoses (253, 78.8%) was the most prevalent sheep parasitic disease follow by mange (59, 18.4%) (Table 2). Babesiosis, myiasis and trypanosomiasis were the least prevalent. The difference in the number of the parasitic diseases of sheep reported was statistically significant ( $p < 0.05$ ). Helminthoses

**Table 1:** Demographic information of sheep and goats presented at the major Veterinary clinics in Osun state from 2006 - 2015

Variables	Sheep		Goats	
	Number Presented (%)	95% CI	Number Presented (%)	95% CI
<b>Breed</b>				
Yankasa	98 (30.5)	25.7 – 35.7		
Balami	15 (4.7)	2.7 – 7.4		
Uda	28 (8.7)	6.0 – 12.2		
WAD	180 (56.1)	50.6 – 61.4	906 (74.9)	72.3 – 77.3
Sahel			63 (5.2)	4.1 – 6.6
Red Sokoto			241 (19.9)	17.7 – 22.2
<b>Age</b>				
Young	106 (33.0)	28.0 – 38.3	499 (41.2)	38.5 – 44.0
Adult	215 (67.0)	61.7 – 72.0	711 (58.8)	56.0 – 61.5
<b>Sex</b>				
Male	237 (73.8)	68.8 – 78.4	487 (40.2)	37.5 – 43.0
Female	84 (26.2)	21.6 – 31.2	723 (59.8)	57.0 – 62.5
<b>Season</b>				
Wet season	182 (56.7)	51.2 – 62.1	682 (56.4)	53.6 – 59.1
Dry season	139 (43.3)	38.0 – 48.8	528 (43.6)	40.9 – 46.4

**Table 2:** Distribution (%) of parasitic diseases among sheep and goats presented in the major Veterinary clinics in Osun state from 2006 – 2015

Disease Condition	Sheep		Goats	
	Number of cases (%)	95% CI	Number of cases (%)	95% CI
Helminthoses	253 (78.8) <sup>a</sup>	74.1 – 83.0	640 (52.9) <sup>a</sup>	50.1 – 55.7
Babesiosis	2 (0.6) <sup>b</sup>	0.1 – 2.0	3 (0.2) <sup>b</sup>	0.1 – 0.7
Tick infestation	14 (4.4) <sup>c</sup>	2.5 – 7.0	20 (1.7) <sup>c</sup>	1.0 – 2.5
Myiasis	2 (0.6) <sup>b</sup>	0.1 – 2.0	3 (0.3) <sup>b</sup>	0.1 – 0.7
Lice infestation	19 (5.9) <sup>c</sup>	3.7 – 8.9	39 (3.2) <sup>d</sup>	2.3 – 4.3
Mange	59 (18.4) <sup>d</sup>	14.4 – 22.9	600 (49.6) <sup>a</sup>	46.8 – 52.4
Trypanosomiasis	2 (0.6) <sup>b</sup>	0.1 – 2.0		
Flea infestation			10 (0.8) <sup>c</sup>	0.4 – 1.5
Anaplasmosis			1 (0.1) <sup>b</sup>	<0.1 – 0.4
Coccidiosis			2 (0.2) <sup>b</sup>	<0.1 – 0.6

Data with different superscripts within columns are significantly different ( $P < 0.05$ )

(640, 52.9%) was the most numerous goat parasitic disease also, closely followed by mange (600, 49.6%). Other parasitic diseases diagnosed were lice infestation (39, 3.2%), tick infestation (20, 1.7%), flea infestation (10, 0.8%), babesiosis and myiasis (3, 0.3%) each, coccidiosis (2, 0.2%) and anaplasmosis (1, 0.1). There was a statistically significant ( $p < 0.05$ ) difference in the number of diagnosed goat parasitic diseases.

Table 3 shows the yearly distribution of sheep parasitic disease cases diagnosed from 2006 - 2015.

In general, more cases were presented in 2006, 2013 and 2015 with the least number of cases presented in 2011. The prevalence of helminthoses fluctuated slightly within the years and peaked in 2014. Babesiosis and myiasis were only diagnosed in 2013 and 2010 respectively. The occurrences of tick infestation did not follow a defined pattern but peaked in 2014. Lice infestation and mange recorded an irregular pattern of occurrence within the years and peaked in 2015 and 2006 respectively.

**Table 3:** Yearly distribution of sheep parasitic disease cases diagnosed at the major Veterinary clinics in Osun state from 2006 – 2015

Year	No of sheep	Number of Parasitic Disease Condition (%)						
		Helminthoses	Babesiosis	Tick infestation	Myiasis	Lice infestation	Mange	Trypanosomiasis
2006	55	35 (63.6)	0 (0.0)	2 (3.6)	0 (0.0)	2 (3.6)	18 (32.7)	0 (0.0)
2007	31	28 (90.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	3 (9.7)	0 (0.0)
2008	26	19 (73.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	7 (26.9)	0 (0.0)
2009	30	27 (90.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (3.3)	4 (13.3)	1 (3.3)
2010	34	30 (88.2)	0 (0.0)	0 (0.0)	2 (5.9)	0 (0.0)	2 (5.9)	0 (0.0)
2011	13	9 (69.2)	0 (0.0)	1 (7.7)	0 (0.0)	3 (23.1)	3 (23.1)	0 (0.0)
2012	20	16 (80.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	4 (20.0)	0 (0.0)
2013	41	30 (73.2)	2 (4.9)	4 (9.8)	0 (0.0)	1 (2.4)	11 (26.8)	1 (2.4)
2014	32	30 (93.8)	0 (0.0)	5 (15.6)	0 (0.0)	4 (12.5)	2 (6.3)	0 (0.0)
2015	39	29 (74.4)	0 (0.0)	2 (5.1)	0 (0.0)	8 (20.5)	5 (12.8)	0 (0.0)
	321	253 (78.8)	2 (0.6)	14 (4.4)	2 (0.6)	19 (5.9)	59 (18.4)	2 (0.6)

**Table 4:** Monthly distribution of sheep parasitic disease cases diagnosed at the major Veterinary clinics in Osun state from 2006 – 2015

Month	No of sheep	Number of Parasitic Disease Condition (%)						
		Helminthoses	Babesiosis	Tick infestation	Myiasis	Lice infestation	Mange	Trypanosomiasis
January	28	21 (75.0)	0 (0.0)	0 (0.0)	0 (0.0)	5 (17.9)	2 (7.1)	0 (0.0)
February	21	14 (66.7)	0 (0.0)	2 (9.5)	0 (0.0)	2 (9.5)	9 (42.9)	0 (0.0)
March	45	39 (86.7)	0 (0.0)	1 (2.2)	0 (0.0)	0 (0.0)	5 (11.1)	0 (0.0)
April	23	17 (73.9)	0 (0.0)	0 (0.0)	0 (0.0)	1 (4.3)	5 (21.7)	0 (0.0)
May	24	18 (75.0)	0 (0.0)	3 (12.5)	0 (0.0)	0 (0.0)	3 (12.5)	1 (4.2)
June	14	12 (85.7)	0 (0.0)	0 (0.0)	0 (0.0)	1 (7.1)	2 (14.3)	0 (0.0)
July	19	15 (78.9)	0 (0.0)	1 (5.3)	0 (0.0)	2 (10.5)	3 (15.8)	0 (0.0)
August	33	30 (90.9)	0 (0.0)	2 (6.1)	0 (0.0)	2 (6.1)	5 (15.2)	1 (3.0)
September	24	17 (70.8)	2 (8.3)	3 (12.5)	1 (4.2)	2 (8.3)	6 (25.0)	0 (0.0)
October	33	23 (69.7)	0 (0.0)	0 (0.0)	1 (3.0)	0 (0.0)	9 (27.3)	0 (0.0)
November	32	25 (78.1)	0 (0.0)	2 (6.3)	0 (0.0)	1 (3.1)	7 (21.9)	0 (0.0)
December	25	22 (88.0)	0 (0.0)	0 (0.0)	0 (0.0)	3 (12.0)	3 (12.0)	0 (0.0)
	321	253 (78.8)	2 (0.6)	14 (4.4)	2 (0.6)	19 (5.9)	59 (18.4)	2 (0.6)

Trypanosomiasis was diagnosed only in 2009 and 2013.

The monthly distribution of sheep parasitic disease cases is presented in Table 4. Generally, parasitic diseases of sheep occurred the most in March with other peaks in August, October and November. The occurrence of helminthoses showed no defined pattern but peaked in August. The other parasitic diseases also showed undulating prevalences within the months, although peaks were recorded in the following manner: babesiosis (September); tick infestation (May and September); myiasis (September and October); lice infestation (January); mange (February) and trypanosomiasis (May and August).

Table 5 shows the yearly distribution of goat parasitic disease cases diagnosed from 2006 - 2015. Generally, the highest occurrence of parasitic diseases was observed in 2006, the other years recorded cases ranged from 80 (2011) to 154 (2009). Helminthoses was most prevalent from 2013 to 2015 and least prevalent between 2010 and 2011. Babesiosis was diagnosed only in 2006 and 2014. There was an irregular pattern of occurrence in tick infestation with peak prevalence in 2008. There was a single occurrence of myiasis and anaplasmosis (2013) and coccidiosis (2015). There was a moderate fluctuation in the occurrence of lice infestation, mange and flea infestation with peaks occurrence seen in 2009, 2010 and 2014 respectively. The

**Table 5:** Yearly distribution of goat parasitic disease cases diagnosed at the major Veterinary clinics in Osun state from 2006 – 2015

Year	No of goats	Number of Parasitic Disease Condition (%)								
		Helminthoses	Babesiosis	Tick infestation	Myiasis	Lice infestation	Mange	Flea infestation	Anaplasmosis	Coccidiosis
2006	243	142 (58.4)	2 (0.8)	5 (2.1)	0 (0.0)	7 (2.9)	98 (40.3)	2 (0.8)	0 (0.0)	0 (0.0)
2007	123	55 (44.7)	0 (0.0)	0 (0.0)	0 (0.0)	2 (1.6)	66 (53.7)	0 (0.0)	0 (0.0)	0 (0.0)
2008	97	41 (42.3)	0 (0.0)	5 (5.2)	0 (0.0)	3 (3.1)	54 (55.7)	0 (0.0)	0 (0.0)	0 (0.0)
2009	154	64 (41.6)	0 (0.0)	3 (1.9)	0 (0.0)	10 (6.5)	94 (61.0)	1 (0.6)	0 (0.0)	0 (0.0)
2010	117	40 (34.2)	0 (0.0)	0 (0.0)	0 (0.0)	2 (1.7)	75 (64.1)	0 (0.0)	0 (0.0)	0 (0.0)
2011	80	37 (46.3)	0 (0.0)	0 (0.0)	0 (0.0)	2 (2.5)	43 (53.8)	0 (0.0)	0 (0.0)	0 (0.0)
2012	88	43 (48.9)	0 (0.0)	2 (2.3)	0 (0.0)	3 (3.4)	45 (51.1)	1 (1.1)	0 (0.0)	0 (0.0)
2013	100	59 (59.0)	0 (0.0)	0 (0.0)	3 (3.0)	3 (3.0)	42 (42.0)	0 (0.0)	1 (1.0)	0 (0.0)
2014	97	69 (71.1)	1 (1.0)	3 (3.1)	0 (0.0)	5 (5.2)	45 (46.4)	5 (5.2)	0 (0.0)	0 (0.0)
2015	111	90 (81.1)	0 (0.0)	2 (1.8)	0 (0.0)	2 (1.8)	38 (34.2)	1 (0.9)	0 (0.0)	2 (1.8)
	1210	640 (52.9)	3 (0.2)	20 (1.7)	3 (0.2)	39 (3.2)	600 (49.6)	10 (0.8)	1 (0.1)	2 (0.2)

**Table 6:** Monthly distribution of goat parasitic disease cases diagnosed at the major Veterinary clinics in Osun state from 2006 – 2015

Month	No of goats	Number of Parasitic Disease Condition (%)								
		Helminthoses	Babesiosis	Tick infestation	Myiasis	Lice infestation	Mange	Flea infestation	Anaplasmosis	Coccidiosis
January	90	42 (46.7)	1 (1.1)	1 (1.1)	0 (0.0)	1 (1.1)	45 (50.0)	0 (0.0)	0 (0.0)	0 (0.0)
February	97	50 (51.5)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.0)	50 (51.5)	0 (0.0)	0 (0.0)	1 (1.0)
March	99	52 (52.5)	0 (0.0)	1 (1.0)	0 (0.0)	2 (2.0)	52 (52.5)	0 (0.0)	0 (0.0)	0 (0.0)
April	95	49 (51.6)	2 (2.1)	3 (3.2)	2 (2.1)	1 (1.1)	52 (54.7)	0 (0.0)	0 (0.0)	0 (0.0)
May	86	56 (65.1)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.2)	34 (39.5)	1 (1.2)	0 (0.0)	0 (0.0)
June	103	54 (52.4)	0 (0.0)	9 (8.7)	0 (0.0)	9 (8.7)	43 (41.7)	1 (1.0)	0 (0.0)	0 (0.0)
July	103	58 (56.3)	0 (0.0)	0 (0.0)	0 (0.0)	2 (1.9)	47 (45.6)	0 (0.0)	0 (0.0)	0 (0.0)
August	123	61 (49.6)	0 (0.0)	2 (1.6)	0 (0.0)	6 (4.9)	74 (60.2)	5 (4.1)	0 (0.0)	1 (0.8)
September	116	65 (56.0)	0 (0.0)	1 (0.9)	0 (0.0)	8 (6.9)	49 (42.2)	2 (1.7)	0 (0.0)	0 (0.0)
October	80	46 (57.5)	0 (0.0)	2 (2.5)	0 (0.0)	3 (3.8)	36 (45.0)	1 (1.3)	0 (0.0)	0 (0.0)
November	121	63 (52.1)	0 (0.0)	0 (0.0)	1 (0.8)	5 (4.1)	64 (52.9)	0 (0.0)	0 (0.0)	0 (0.0)
December	97	44 (45.4)	0 (0.0)	1 (1.0)	0 (0.0)	0 (0.0)	54 (55.7)	0 (0.0)	1 (1.0)	0 (0.0)
	1210	640 (52.9)	3 (0.2)	20 (1.7)	3 (0.2)	39 (3.2)	600 (49.6)	10 (0.8)	1 (0.1)	2 (0.2)

**Table 7:** Univariate association between breeds, age, sex and season with the occurrence of helminthoses among sheep presented at the major Veterinary clinics in Osun state from 2006 - 2015

Variables	Parasite +ve	Parasite -ve	OR	95% CI	p
Breeds					
Yankasa	77 (78.6)	21 (21.4)	0.98	0.54 – 1.81	0.94
Balami	14 (93.3)	1 (6.7)	3.73	0.63 – 8.97	0.19
Uda	20 (71.4)	8 (28.6)	0.67	0.28 – 1.73	0.39
WAD sheep <sup>a</sup>	142 (78.9)	38 (21.1)	1.00		
Age					
Young	97 (91.5)	9 (8.5)	4.06	1.98 – 9.05	<0.01*
Adult <sup>a</sup>	156 (72.6)	59 (27.4)	1.00		
Sex					
Male	195 (82.3)	42 (17.7)	2.08	1.16 – 3.67	0.01*
Female <sup>a</sup>	58 (69.0)	26 (31.0)	1.00		
Season					
Wet	141 (77.5)	41 (22.5)	0.83	0.48 – 1.43	0.51
Dry <sup>a</sup>	112 (80.6)	27 (19.4)	1.00		

<sup>a</sup> Reference category, \* Significant, OR = Odds Ratio, CI = Confidence Interval

**Table 8:** Univariate association between breeds, age, sex and season with the occurrence of mange among sheep presented at the major Veterinary clinics in Osun state from 2006 – 2015

Variables	Parasite +ive	Parasite -ive	OR	95% CI	p
Breeds					
Yankasa	18 (18.4)	80 (81.6)	0.93	0.49 – 1.75	0.84
Balami	2 (13.3)	13 (86.7)	0.64	0.09 – 1.64	0.61
Uda	4 (14.3)	24 (85.7)	0.69	0.19 – 2.01	0.55
WAD sheep <sup>a</sup>	35 (19.4)	145 (80.6)	1.00		
Age					
Young	9 (8.5)	97 (91.5)	0.31	0.14 – 0.63	<0.01*
Adult <sup>a</sup>	50 (23.3)	165 (76.7)	1.00		
Sex					
Male	34 (14.3)	203 (85.7)	0.40	0.22 – 0.72	<0.01*
Female <sup>a</sup>	25 (29.8)	59 (70.2)	1.00		
Season					
Wet	33 (18.1)	149 (81.9)	0.96	0.54 – 1.71	0.89
Dry <sup>a</sup>	26 (18.7)	113 (81.3)	1.00		

<sup>a</sup> Reference category, \* Significant, OR = Odds Ratio, CI = Confidence Interval

monthly distribution of goat parasitic disease cases is presented in Table 6. Generally, more cases were presented in the second half of the year with emphases on August (123 cases) and November (121 cases). The occurrences of each of the parasitic diseases showed no particular trend in their prevalence. Peaks of each disease condition are as follows: coccidiosis (February and August); babesiosis and myiasis (April); helminthoses (May), tick infestation and lice infestation (June); mange and flea infestation (August) while anaplasmosis (December).

The occurrence of helminthoses in sheep is age and sex dependent. Young sheep were 4.1 times more likely to be infected compared to adult sheep, while male sheep were 2.1 times more likely to be infected than their female counterpart. The association between breeds, season and the occurrence of helminthoses in sheep was not statistically significant ( $p>0.05$ ) (Table 7). The relationship between breed of sheep, age, sex and season with the occurrence of mange is presented in Table 8. There was no statistically association ( $p>0.05$ ) between breeds, season and the occurrence of mange. Adult sheep were 3.2 times more likely to be infected with mange compared

to young sheep, while female were 2.5 times more likely to be infected with mange compared to the male counterpart.

Table 9 shows the association between breeds, age, sex and season with the occurrence of helminthoses in goats. The infection rate of helminthoses was 2.2 times higher in young goats compared to adult goats. Helminthoses occurred 1.3 times more in the wet season than the dry season. The relationship between breeds, sex and the occurrence of helminthoses in goats was not statistically significant ( $p>0.05$ ). Table 10 illustrates the association between breeds, age, sex and season with the occurrence of mange in goats. Age of goats and season of presentation were the risk factors significantly associated ( $p<0.05$ ) with the occurrence of mange in goats. Adult goats were about twice more prone to mange compared to young goats,

while mange occurred 1.4 times more in the dry season than the wet season.

#### Discussion

This study clearly showed that more goats were diagnosed for parasitic diseases than sheep. This may translate to the fact that more goats are being raised in Osun state than sheep. This finding collaborates the census figure of small ruminants by Adebowale (2012), who observed, there were more goats than sheep in the southern part of the country. Similarly, Abiola *et al.* (2016) reported that more goats were presented to the Veterinary Teaching Hospital, University of Ibadan than sheep in their 10 years study. The higher population of goats to sheep in the southwest may be influenced by the social value on goats to the Yoruba people as female goats are required as part of bride price and are kept

**Table 9:** Univariate association between breeds, age, sex and season with the occurrence of helminthoses among goats presented at the major Veterinary clinics in Osun state from 2006 – 2015

Variables	Parasite +ive	Parasite -ive	OR	95% CI	p
<b>Breeds</b>					
Sahel	26 (41.3)	37 (58.7)	0.63	0.37 – 1.05	0.08
Red Sokoto	135 (56.0)	106 (44.0)	1.14	0.85 – 1.51	0.39
WAD goat <sup>a</sup>	479 (52.9)	427 (47.1)	1.00		
<b>Age</b>					
Young	320 (64.1)	179 (35.9)	2.18	1.73 – 2.77	<0.01*
Adult <sup>a</sup>	320 (45.0)	391 (55.0)	1.00		
<b>Sex</b>					
Male	243 (49.9)	244 (50.1)	0.82	0.65 – 1.03	0.09
Female <sup>a</sup>	397 (54.9)	326 (45.1)	1.00		
<b>Season</b>					
Wet	380 (55.7)	302 (44.3)	1.30	1.03 – 1.63	0.03*
Dry <sup>a</sup>	260 (49.2)	268 (50.8)	1.00		

<sup>a</sup> Reference category, \* Significant, OR = Odds Ratio, CI = Confidence Interval

**Table 10:** Univariate association between breeds, age, sex and season with the occurrence of mange among goats presented at the major Veterinary clinics in Osun state from 2006 – 2015

Variables	Parasite +ive	Parasite -ive	OR	95% CI	p
<b>Breeds</b>					
Sahel	36 (57.1)	27 (42.9)	1.30	0.78 – 2.19	0.32
Red Sokoto	105 (43.6)	136 (56.4)	0.75	0.56 – 1.00	0.05
WAD goat <sup>a</sup>	459 (50.7)	447 (49.3)	1.00		
<b>Age</b>					
Young	207 (41.5)	292 (58.5)	0.57	0.46 – 0.72	<0.01*
Adult <sup>a</sup>	393 (55.3)	318 (44.7)	1.00		
<b>Sex</b>					
Male	248 (50.9)	239 (49.1)	1.09	0.87 – 1.38	0.45
Female <sup>a</sup>	352 (48.7)	371 (51.3)	1.00		
<b>Season</b>					
Wet	313 (45.9)	369 (54.1)	0.71	0.57 – 0.90	<0.01*
Dry <sup>a</sup>	287 (54.4)	241 (45.6)	1.00		

<sup>a</sup> Reference category, \* Significant, OR = Odds Ratio, CI = Confidence Interval

In memory of the enacted marital relationship (Abiola *et al.*, 2016). The WAD sheep and WAD goat were the most numerous breeds of small ruminants that were presented with parasitic diseases from our study, this may imply that these breeds are the most predominant breeds of sheep and goat in the southwest region of Nigeria, as previously reported by Adebowale (2012). Adult of both sheep and goats were diagnosed for parasitic diseases than their young counterpart. This may be associated with the roaming nature of adult sheep and goat thereby making them infected with parasitic conditions. Previous studies in Nigeria (Nwoke *et al.*, 2015) and Ethiopia (Mandado *et al.*, 2016) have shown that adult sheep and goats were more prone to parasitic diseases than the young ones. Parasitic diseases were more prevalent during the wet season than dry season in both sheep and goats. In agreement with our report, Omoike *et al.* (2014) reported a higher prevalence of parasitic diseases of sheep and goat during the wet season than dry season in their study conducted in Edo state south of Nigeria. This may be due to high moisture content and lower temperature which is seen during the wet seasons, favours the growth and development of parasites and their vectors (Yahaya & Tyav, 2014).

Of the parasitic diseases diagnosed in our study area, helminthoses was the most prevalent disease in both sheep and goats, followed by mange, this was supported by the report of Peter *et al.* (2015) in a similar study in Maiduguri Nigeria. They argued that the peculiarity of the management system in their study area where animals roam freely within the environment, consuming garbage sometimes from refuse heaps may have resulted to the high prevalence of helminthoses they recorded. Helminthoses is a dominant parasitic disease among ruminants because of their efficient life cycle ranging from the very simple to the extremely complicated stage (Adejinmi *et al.*, 2015). Babesiosis, tick infestation, myiasis, lice infestation, trypanosomiasis, flea infestation, anaplasmosis and coccidiosis has been reported in sheep and goats in Nigeria (Okaiyeto *et al.*, 2008; Jatau *et al.*, 2011; Peter *et al.*, 2015; Anyanwu *et al.*, 2016).

The highest occurrence of parasitic diseases of sheep was recorded in March and October while the highest occurrence of parasitic diseases in goat was recorded in August and November. This may translate that more of these animals are brought into the state during this period as their need is increased at this time, as it coincides with the period of religious festivities.

Age and sex were the risk factors significantly associated with the prevalence of helminthoses in

sheep from our study. Young sheep had a higher prevalence of helminthoses compared to adult sheep. This conforms to the findings of Solomon-Wisdom *et al.* (2013), who also reported a higher prevalence of helminthoses among young sheep than adult sheep. The high prevalence obtained in young sheep in this study could be as a result of the limited previous exposure to parasitism and the under development of their immune system. Male sheep had a higher prevalence of helminthoses compared to female sheep. This is in agreement with the works carried out by Zeleke *et al.* (2013), who recorded a higher prevalence of fasciolosis in male sheep than female sheep in their study conducted in Basona Werana district of central Ethiopia. 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 favour the growth and spread of parasites in male guts (Apio *et al.*, 2006).

This study reports that adult sheep had a higher prevalence of mange than young sheep while female had a higher prevalence of mange than their male counterpart. Similar findings were reported in Southern Ethiopia by Mandado *et al.* (2016). The difference in the grazing behavior of young and adult sheep, where young sheep are raised in confinement as against adult sheep that roam the environment resulting in contact with other infested sheep may contribute to the higher prevalence recorded in adult sheep as against young sheep. The higher prevalence recorded in female sheep may indicate that female animals are more affected by non-sex related diseases since parturition and lactation cause relaxation of the natural immunity of female animals (Craig, 1998).

Age is an important risk factor associated with helminthoses in goats (Raza *et al.*, 2007). We observed that young goats were more susceptible to helminthoses than adult goats. A study carried out in Gombe and Nassarawa states of Nigeria by Lah (2003) and Adua & Hassan (2016) respectively, reported that kids were more susceptible to helminths infestation than adult goats. These authors attributed the higher prevalence in kids to poor management and sanitation. Although resistance build up by adult goats may have also resulted to the low prevalence recorded in the adult. The present investigation has shown that seasonal variation is a significant risk factor associated with the prevalence of caprine helminthoses and mange

during the study period. In this regard, higher prevalence of helminthoses was recorded during the wet season compared to the dry season. This corroborates the observations made by Adua & Hassan (2016) who reported a higher helminths (nematodes) infection rate in the wet season than in the dry season. Increased moisture level is an important biotic factor that favours the development and survival of the infective stages of helminths especially in the tropics (Hassan *et al.*, 2013); and this may be the reason for the higher prevalence of these parasitic diseases during the wet season than the dry season. On the other hand, higher prevalence of mange was recorded during the dry season as against the wet season. This agrees with report by Omoike *et al.* (2014) and Yasmine *et al.* (2015) who reported similar findings in goats in their studies conducted in Nigeria and Ethiopia respectively. The wind associated with the dry season may have favoured the transmission leading to the high prevalence recorded.

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Adult goats were more infected with mange than young goats. In line with our findings, Tesfaheywet & Lemma (2012) and Mandado *et al.* (2016) reported that adult goats were more prone to mange than young goats in Ethiopia. Having more access to grazing or pasture areas by adult goats may have contributed to the high prevalence of mange seen in the age group (Tesfaheywet & Lemma, 2012). In conclusion, this study shows that parasitic diseases are common among small ruminants in Osun state. Parasitism has been one of the limiting disease entities that causes set back to the small ruminants production in most parts of the world including Nigeria. There is therefore, need for prevention and control programs against these parasitic conditions of sheep and goats in Nigeria by educating and encouraging livestock farmers on the need for good management practice and to seek regular veterinary attention for their livestock. These, when carried out will improve the health status and production potentials of these animals, as well as the financial returns to the owners.

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