

## Logit Modelling For Risk Factors Associated with Strongyle in Cattle of Southern Agricultural Zone, Nasarawa State, Nigeria

Sani, F. O<sup>1\*</sup>, Adua, M. M<sup>1.</sup>, Ari, M. M<sup>1.</sup>, Baba, M. K<sup>12.</sup>, Adamu, M. B., Daleku D. M.

<sup>1</sup>Department of Animal Science, Nasarawa State University Keffi, Nigeria

<sup>2</sup>Department of Animal Nutrition, Biotechnology and Fisheries, University of Agriculture in Krakow, Poland

\*Corresponding author: [osezefarida2014@gmail.com](mailto:osezefarida2014@gmail.com); +2349161091717



### Abstract

*Strongyle parasitism in developing cattle can cause sickness and lower cattle productivity. Mathematical models may be utilized to increase performance, lower production costs, and minimize nutrient excretion by allowing for more diversity in estimating needs and feed consumption in each individual production environment. Therefore, this study was carried out to model some risk factors associated with prevalence of strongyle infection in some cattle in Nasarawa State. The use of logistic regression model was employed. Faecal samples, ticks, and blood from 100 cattle of a different breed, age and sex and body condition scores were collected. Determination of strongyle infection, tick species, and blood parasites were performed according to standard procedures. About 53% of the animals were found with strongyle species. The most prevailing tick species affecting the cattle was *Boophilus* spp. (65.39%). Single haemoparasitic infection due to *Anaplasma* species and mixed haemoparasites species were significantly ( $P < 0.05$ ) higher compared to single infection by *Babesia* spp. There was significant ( $P < 0.05$ ) difference between cattle infested with or without ticks about strongyle infection. White Fulani and Red Bororo showed higher percentage of strongyle than Sokoto Gudali and Muturu breed of cattle. Body condition and faecal consistency scores were significantly ( $P < 0.05$ ) associated with prevalence of strongyle. The estimate statistics between White Fulani and Sokoto Gudali cattle was negative (-1.756) and the corresponding odd ratio was 0.173. The model revealed a negative estimate and a significant ( $P < 0.05$ ) Wald statistic between adult and young cattle and the odd ratio was 0.155. Replacement of cattle having loose faecal consistency with those with normal consistency could reduce the chances of strongyle prevalence by 28.6 percent in the herd. The area under receiver operating characteristics (AUROC) was 0.87 greater than the optimum margin of 0.5. Haemoglobin (g/dl) and red blood cell count ( $\times 10^9/L$ ) were lower in infected animals but had higher lymphocytes percentage than uninfected. It was concluded that strongyle prevalence is associated and can be predicted using breed, age, body condition scores, and faecal consistency of cattle. Strongyle infection also affects some of their haematological parameters.*

**Keywords:** Strongyle, Model Logistic, Cattle and ticks, Haemoparasites, Haematology

**Running Title:** Logit Modelling For Risk Factors Associated With Strongyle In Cattle



### Modélisation Logistique Des Facteurs De Risque Associés Aux Strongyles Chez Les Bovins De La Zone Sud d'Agricole, État De Nasarawa, Nigéria

#### Résumé

*Le parasitisme par les strongyles dans les bovins en développement peut entraîner des maladies et réduire la productivité des animaux. Les modèles mathématiques peuvent être utilisés pour améliorer les performances, réduire les coûts de production et minimiser l'excrétion de nutriments en permettant une plus grande diversité dans l'estimation des besoins et de la consommation alimentaire dans chaque environnement de production individuel. Par conséquent, cette étude a été réalisée pour modéliser certains facteurs de risque associés à la prévalence des infections par les strongyles chez des bovins dans l'État de Nasarawa. Le modèle de régression logistique a été utilisé. Des échantillons de fèces, des tiques et du sang*

ont été collectés auprès de 100 bovins de différentes races, âges, sexes et scores d'état corporel. La détermination de l'infection par les strongyles, des espèces de tiques et des parasites sanguins a été effectuée selon des procédures standard. Environ 53 % des animaux ont été trouvés porteurs de strongyles. L'espèce de tique la plus répandue affectant les bovins était *Boophilus spp.* (65,39 %). Les infections hémoparasitaires simples dues aux espèces *Anaplasma* et les infections hémoparasitaires mixtes étaient significativement ( $P < 0,05$ ) plus fréquentes que les infections simples par *Babesia spp.* Il y avait une différence significative ( $P < 0,05$ ) entre les bovins infestés ou non par des tiques en ce qui concerne l'infection par les strongyles. Les races *White Fulani* et *Red Bororo* ont montré un pourcentage plus élevé de strongyles que les races *Sokoto Gudali* et *Muturu*. Les scores d'état corporel et de consistance des fèces étaient significativement ( $P < 0,05$ ) associés à la prévalence des strongyles. Les statistiques d'estimation entre les bovins *White Fulani* et *Sokoto Gudali* étaient négatives (-1,756) et le rapport de cotes correspondant était de 0,173. Le modèle a révélé une estimation négative et une statistique de Wald significative ( $P < 0,05$ ) entre les bovins adultes et jeunes, avec un rapport de cotes de 0,155. Le remplacement des bovins ayant une consistance de fèces liquide par ceux ayant une consistance normale pourrait réduire les chances de prévalence des strongyles de 28,6 % dans le troupeau. La surface sous la courbe des caractéristiques de fonctionnement du récepteur (AUROC) était de 0,87, supérieure à la marge optimale de 0,5. L'hémoglobine (g/dl) et le nombre de globules rouges ( $\times 10^9/L$ ) étaient plus bas chez les animaux infectés mais avaient un pourcentage de lymphocytes plus élevé que chez les non-infectés. Il a été conclu que la prévalence des strongyles est associée à et peut être prédite en utilisant la race, l'âge, les scores d'état corporel et la consistance des fèces des bovins. L'infection par les strongyles affecte également certains de leurs paramètres hématologiques.

---

**Mots-clés** : Strongyle, Modèle Logistique, Bovins et tiques, Hémoparasites, Hématologie

## Introduction

Strongyle parasitism can cause sickness and lower cattle productivity (Radostits *et al.*, 2007; Audu *et al.*, 2018). Furthermore, parasite loads are linked to changes in bovine behavior, such as time spent grazing, resting, and eating, which suggest discomfort and have welfare effects, even in sub-clinically infected cattle (Hogberg *et al.*, 2021). Mathematical models may be utilized to increase performance, lower production costs, and minimize nutrient excretion by allowing for more diversity in estimating needs and feed consumption in each individual production environment (Tedeschi *et al.*, 2004). It has been employed in animal health for disease management and prediction of trypanosomosis endemicity in cattle (Odeniran *et al.*, 2020). The logistic regression model is the approach of choice for assessing binary response variables in animal research, veterinary science, disease epidemiology in humans, and economics. Logistic regression analysis was used to

investigate potential risk variables for diseases such as milk fever (Hosmer and Lemeshow, 2000), seasonal calving in dairy herds (Fenlon *et al.*, 2017), tick infestation (Yakubu *et al.*, 2015), and antibiotic resistance in poultry (Bamidele *et al.*, 2022). Research to gain a better understanding of the dynamics and distribution of helminths in cattle, particularly Strongyle species, will continue. Until far, research aimed at predicting strongyle infection in cattle using a mathematical model has been limited, particularly in Nigeria. The use of modeling approaches such as logistic regression is critical for estimating the likelihood of cattle contracting strongyle infection and providing baseline epidemiological data and measures for managing the threat presented by these parasite groups in Nigeria. This reduces the possibility of importing strongyle-prone or diseased animals, as well as the cost of treating sick animals in the herd. The study aimed to model some risk factors associated with prevalence of strongyle infection

in some cattle in Southern Agricultural Zone of Nasarawa State, Nigeria using logistic regression model.

## **Materials and Methods**

### ***Study Location***

This study was conducted in Southern Agricultural Zone of Nasarawa State, Nigeria. Nasarawa State is located between latitudes 7° and 9°N and longitudes 7° and 10°E. It is characterized by tropical sub-humid climate with distinct seasons. The wet season begins from April to October and dry season between November and March. Annual rainfall figure ranges from 100mm to about 200mm. Temperature are generally high during the day, particularly between the month of March and April. The mean monthly temperature ranges from 28°C – 38°C (NIMET, 2008).

### ***Sampling of Cattle, Description of Experimental Animals and Design***

The study was conducted by randomly selecting 100 cattle from four Local Government Areas (LGAs): Doma, Lafia, Keana and Obi of the Southern Agricultural Zone of Nasarawa State. Their ages were identified based on dentition and recorded as; calf (under 1 year) adult (2 years to 10 years) and old (above ten years) as described by Lorusso *et al.* (2013). The sex was identified based on the genitals and presence of udder. The breeds of cattle were identified based on characteristics described by Kubkomawa (2017). Body condition scores were categorized as normal and emaciated based on the conformation and appearance of the animals while faecal consistency was regarded as being normal or loose following Ola-Fadunsi *et al.* (2020).

### ***Determination of Strongyle and Tick Parasites***

Faecal samples were collected directly from the rectum of the cattle using latex gloves. Collected faecal samples were preserved in 10% formalin and transported to laboratory. The presence of adult stage of Strongyle helminths were identified using hand lens following helminthological keys earlier described by Soulsby (1982) and Taylor (2001). Simple floatation and sedimentation

method earlier described by Ola-Fadunsi *et al.* (2019) was used subsequently to identify eggs from the faecal samples.

The cattle were thoroughly examined for ticks and the ticks were carefully removed using forceps and ensure there was no damage on the structure and mouth parts of the ticks. Ticks were collected from different parts of the body and placed in 70% alcohol bottle. Ticks collected were transported to the laboratory for identification according to their morphological characteristics.

### ***Haemoparasites and Haematological Parameters Determination***

Two (2) millilitres of blood from the jugular vein were collected using 2mL syringe and 18 gauge needle. The blood was introduced into a sample bottle containing K<sub>2</sub> Ethlene Diamine Tetraacetic Acid (EDTA) to prevent coagulation. The sample collected were preserved in a cold chain containing ice packs and transported to laboratory for haematological parameters analysis and haemoparasites detection.

Thin blood smears were prepared using standard method as described by Ademola and Onyiche (2014) to determine haematological parameters. A drop of blood was placed on one end of a clean, grease free glass slide and made into thin film with aid of a spreader (a clean glass slide). This was done by allowing the spreader to touch the blood at an angle of 45°, and then spread gently but firmly along the surface of the horizontal slide so that the blood is dragged behind the spreader to form the film with a feathered edge. The prepared thin film was then air dried, fixed in methanol for 5 min, and stained in freshly prepared 10% Giemsa stain at pH 7.2 for about 30 min. Afterward, the stained film was rinsed with clean water and allowed to dry. The smears were examined at ×100 magnification (oil immersion) on microscope for the presence and identification of blood parasites based on their morphological characteristics.

The blood samples collected into the K<sub>2</sub> EDTA bottle was used to determine Packed Cell Volume

(PCV), Haemoglobin (g/dl), Red Blood Cell (RBC,  $\times 10^9/L$ ), White Blood Cell (WBC,  $\times 10^9/L$ ), Lymphocyte (%), and Neutrophils as described Adua *et al.* (2020).

### Data Analysis

The prevalence (P) of the parasites was calculated using the formula  $P = d/n \times 100$ . where n= number examined; d = positive cases following Thrusfield (2008). The prevalence of the strongyle in relation to tick infestation, blood parasites prevalence, breeds, age, sex, body condition scores and faecal consistency scores of cattle was expressed in percentage and checked for significance using Chi square test. When there was significance, Kruskal's Wallis Test for non-parametric data was conducted followed by Dunn's test for separation of significantly different means ranks. The haematological parameters of infected and uninfected animals were analyzed using student t. statistical test. The above analyses were performed using SPSS (2010). The logistic procedure of SAS (2003) was for predicting the association between strongyle infection and the risk factors. The hypothesized risk factors (prevalence of ticks and blood parasites, the breed, age, sex, body condition scores and faecal consistency of the cattle) were analysed using univariate Chi square test and only factors that were having  $P < 0.20$  were included in the follow-up multivariate logistic model (Yakubu *et al.*, 2020). Prevalence of blood parasites and sex had  $P > 0.20$  and were not included however prevalence of tick was included but was removed when it had  $P > 0.05$  at the second step of the Wald stepwise elimination method (Noordhuizen *et al.*, 2001). The Chi-square goodness of-fit test was performed to check if the multivariate logistic model fits the data well ( $P > 0.05$ ) (Hosmer and Lemeshow, 2000). The multivariate model (Czopowicz *et al.*, 2012) employed was:

$$P(Y=1) = \frac{1}{1 + \exp[-(B_0 + B_1 \times X_1 + \dots + B_n \times X_n)]}$$

where,

P (Y=1) = probability of a final outcome (prevalence of strongyle)  $b_0$  = intercept  $b_1, b_n$  = regression coefficients for individual risk factors  $X_1, X_n$  = risk factors (ticks, breed, age, sex, faecal consistency score, body condition score).

## Results and Discussions

### Percentage Prevalence of Strongyle, Ticks and Haemoparasites Species of Cattle

Table 1 is the percentage prevalence of strongyle, ticks and blood parasites species of cattle in the study area. Indirect losses associated with helminth infections include the reduction in productive potential such as decreased growth rate, weight loss, diarrhoea, anorexia, and sometimes anaemia (Gonzalez and Gonzalez, 2004; Swai *et al.*, 2006). In this study, about half (53 percent) of the sampled animals were infected with strongyle species. This signifies the importance of this parasite to the productivity of cattle in this region. The result (53%) in the present study is slightly higher than 42.63 %by Luka *et al.* (2018) in North Eastern Nigeria. Aliyu *et al.* (2020), had earlier reported 80 percent prevalence in goat and 75 percent in sheep. According to Mitchell *et al.*, 1985, Bovine strongylosis consist of large group of nematodes that parasitizes the gastrointestinal tract of cattle such as *Haemonchus placei*, *Trichostrongylus axei*, *Cooperia punctata*, *Nematodirus fillicolis* etc which together belong to the super family *Trichostrongyloidea*. The most important predisposing factors of helminth infections are grazing habits, weather, nutritional deficiency, pasture management, immunological status, vector, presence of intermediate host, and the number of infective larvae and eggs in the environment (Audu *et al.*, 2018).

There were significant differences among the different species of ticks that affected the cattle. The most prevailing species was *Boophilus spp.* (65.39%). However, *Hyalomma spp.*, *Amblyomma spp.* and Mixed infected cattle were not significantly ( $P > 0.05$ ) different (Table 1). Single prevalence of *Anaplasma* species and

mixed blood parasites species was significantly ( $P < 0.05$ ) higher compared to single infection by *Babesia spp.* (Table 1).

**Table 1: Percentage prevalence of strongyle, ticks and blood parasites species of cattle**

Type	Number, %	Kruskal-Wallis Test	P. value
Strongyle	N=53 (53)	-	-
Ticks	N=52 (52)	51	0.00
<i>Boophilus spp</i>	65.39 <sup>a</sup>		
<i>Hyalomma spp.</i>	7.69 <sup>b</sup>		
<i>Amblyomma spp</i>	5.77 <sup>b</sup>		
Mixed prevalence	21.15 <sup>b</sup>		
Blood parasites	N=59	58	0.00
<i>Anaplasma spp.</i>	44.07 <sup>a</sup>		
<i>Babesia spp.</i>	11.86 <sup>b</sup>		
Mixed prevalence	44.07 <sup>a</sup>		

ab means on the same column having different superscript are significantly different ( $P < 0.05$ ); N = number of animals

### ***Association Between Ticks, Haemoparasites and Strongyle Prevalence in Cattle***

There were significant differences among cattle infested with or without ticks in relation to strongyle infection (Table 2). Percentage strongyle species found were higher in tick infested cattle (65.39%) than those without ticks (39.58%).

The association between the prevalence of strongyle and ticks in the animals could be related to the environment where these animals are been grazed. The larvae of helminths parasites are usually picked from grazing grasses and legumes where these animals are allowed to feed on. Earlier studies (Dauda *et al.*, 2022) had reported the co-prevalence of ticks and helminths species living in the same herd. According to Nyangiwe *et al.* (2011), engorged female ticks detached from hosts wherever they may roam, feed or rest, and then seek out a sheltered environment to lay their eggs and they quest for their mammal hosts from the soil surface or from the base of the vegetation.

Cattle infected with or without haemoparasites were not differently ( $P > 0.05$ ) affected with strongyle infection. About 59.15% of blood parasites infected cattle were found with strongyle species while 37.93% was obtained from those without the blood parasites (Table 2). Although in this study there seems to be no relationship between strongyle infection and blood parasites infection. However, the host for most blood parasites is tick whose transmission also include grazing pastures same for helminths parasites. According to Lorusso *et al.* (2013), Under the nomadic management, cattle are extensively grazed in pastures and forest, and exposed to infestation who are known vectors of the causative agents of the most important bovine tick-borne parasites in West Africa. Usually low in the dry season, tick loads on cattle tend to increase after the first scattered rains, reaching the highest abundance one month after the heavy rains (i.e., from July to September), when all tick species are expected to be present.

**Table 2: Association between ticks, haemoparasites and strongyle prevalence in cattle**

	Type	
	Ticks	Haemoparasites
	Cattle without ticks; N=48	Cattle infected with blood parasites; N=71
Strongyle spp. prevalence	N=19 (39.58 <sup>b</sup> )	N=34(65.39 <sup>a</sup> )
Chi-square test value	11.46	
P. value	0.00	
	Cattle without blood parasites; N=29	Cattle infected with blood parasites; N=71
Strongyle spp. prevalence	N=11 (37.93)	42(59.15)
Chi-square test value	3.72	
P. value	0.06	

<sup>ab</sup> figures in the same row having different superscript are significantly ( $P < 0.05$ ) different; Figures in parenthesis are percentages; N= number of animals.

### **Chi-Square and Kruskal-Wallis Test for Association Between Cattle Breed, Age, Sex and Prevalence of Strongyle**

There was significant ( $P < 0.05$ ) difference between breeds in relation to strongyle infection. The White Fulani and Red Bororo showed higher percentage of strongyle infection than Sokoto Gudali cattle and Muturu breed of cattle (Table 3).

The significantly higher prevalence of strongyle in White Fulani and Red Bororo cattle breeds indicates that different breeds of cattle have different susceptibility to helminths parasite infections. This also agrees with Audu *et al.* (2008) who found that strongyle is more pronounced in Sokoto Gudali breed of cattle in Borno, Nigeria. According to Burden *et al.* (2010), some of gastrointestinal tract parasites (especially Strongyles) are active blood suckers; where there is heavy parasitic burden, they caused anaemia. The lower prevalence in Sokoto Gudali in this study conform with Mamuda *et al.* (2012) who reported lower prevalence of gastrointestinal nematodes in this breed. According to Williamson and Payne (1978), Sokoto Gudali breeds are relatively resistant to helminthosis compared to crossbreed. Age of cattle significantly ( $P < 0.05$ ) differ in relation to strongyle infection. Young and old cattle showed significantly ( $P < 0.05$ ) higher percentage of infection than adult cattle (Table 3). The resulting higher prevalence in young cattle could be attributed to the facts that cattle keepers usually allow young animals to first enter the grazing area to feed on the succulent leaves which could harbour larvae stages of these parasites. Mahmuda *et al.* (2012) also found that younger cattle have higher prevalence of gastrointestinal parasites than adults.

Sex of cattle did not significantly ( $P > 0.05$ ) differ in relation to strongyle infection. Both female (55.56%) and male (46.43%) cattle had similar percentage of strongyle infection (Table 3). The

similar rate of infection recorded in this finding could be that sex of cattle does not contribute to the prevalence of strongyle nematode. However, Afolabi *et al.* (2017) showed that male animals recorded high percentage of infection.

### **Chi-Square Test for Association Between Body Condition, Faecal Consistency Scores and Prevalence of Strongyle in Cattle**

Body condition score of cattle was significantly ( $P < 0.05$ ) associated with strongyle infection. Emaciated cattle showed higher percentage (68.33%) of strongyle infection than cattle with normal body condition scores (30.00%) (Table 4). The significant association between body condition scores and helminth infection agrees with Ola-Fadunsin *et al.* (2017) that said helminth infection is one of the major challenges affecting cattle in developing countries causing unthriftiness, gut damage, anaemia, diarrhoea, anorexia, gastroenteritis, abdominal distention, emaciation, reduced feed intake, and reduced absorption of nutrients, reduced milk and meat production, and working capacity of the animals. On the contrary, Kabaka *et al.* (2012) documented that there was no significant association between helminth infections in cattle and body condition scores in their study conducted in Kenya.

Faecal consistency of cattle was significantly ( $P < 0.05$ ) associated with strongyle infection. Animals that had loose (66.67%) faecal consistency showed higher percentage of strongyle infection than those with normal consistency (43.10%) (Table 4). The significant association between strongyle infection and faecal consistency could be related to the facts that animals that had loose faecal scores were infected with strongyle parasites. According to Ola-fodunsin *et al.* (2017), helminth infection results to abdominal distention and diarrhea in animals. The larvae stage of of *Haemonchus*, *Ostertagia* and *T. axei* enters the abomasum and omasum and destroys the mucus membranes of cattle (Radostits, 2007).

**Table 3: Chi-square and Kruskal-wallis test for association between cattle breed, age, sex and prevalence of strongyle**

		Type			
		<b>Breed</b>			
		White Fulani; N=53	Sokoto Gudali; N=32	Red Bororo; N=9	Muturu; N=6
Strongyle spp. Prevalence		N=37(69.81 <sup>a</sup> )	N=11(34.38 <sup>b</sup> )	N=4(44.44 <sup>a</sup> )	N=1(16.67 <sup>b</sup> )
Chi-square test value		13.91			
P. value		0.00			
Kruskal-Wallis test P. value		13.77			
		<b>Age</b>			
		Young; N=28	Adult; N=55		
Strongyle spp. Prevalence		N=20(71.43 <sup>a</sup> )	N=19(34.55 <sup>b</sup> )		
Chi-square test value		17.22			
P. value		0.00			
Kruskal-Wallis test P. value		17.05			
		<b>Sex</b>			
		Female; N=72	Male; N=28		
Strongyle spp. Prevalence		N=40(55.56)	N=13(46.43)		
Chi-square test value		0.67			
P. value		0.41			

<sup>ab</sup>= figures in the same row having different superscript are significantly (P<0.05) different; Figures in parenthesis are percentages; N= number of animals.

### ***Logistic Regression Model Predicting Risk Factors Associated with Prevalence of Strongyle in Cattle***

The results of logistic regression model predicting risk factors associated with prevalence of strongyle in cattle is presented in Table 5. Breed, age, faecal consistency and body condition score had significant (P<0.05) Wald statistics. Wald chi-square statistic obtained for breed was significant (P<0.05) for White Fulani

and Sokoto Gudali but not significant (P>0.05) for Muturu and Red Bororo cattle breeds. The estimate statistics between White Fulani and Sokoto Gudali cattle was negative (-1.756) and the corresponding odd ratio was 0.173. Similarly, negative estimate was obtained between White Fulani and Muturu and with Red Bororo and the corresponding odd ratios were 0.109 and 0.649, respectively.

**Table 4: Chi-square test for association between body condition, faecal consistency scores and prevalence of strongyle in cattle**

	Type	
	<b>Body condition scores</b>	
	Normal; N=40	Emaciated; N=60
Strongyle prevalence	N=12 (30.00 <sup>b</sup> )	N=41(68.33 <sup>a</sup> )
Chi-square test value	14.16	
P. value	0.00	
	<b>Faecal consistency scores</b>	
	Normal; N=58	Loose; N=42
Strongyle prevalence	N=25 (43.10 <sup>b</sup> )	N=28(66.67 <sup>a</sup> )
Chi-square test value	5.43	
P. value	0.03	

<sup>ab</sup>= figures in the same row having different superscript are significantly( $P<0.05$ ) different; Figures in parenthesis are percentages; N= number of animals.

The model revealed a negative estimate and a significant ( $P<0.05$ ) Wald statistic for adult when compared to young cattle and the odd ratio was 0.155. However, old cattle had non-significant ( $P>0.05$ ) Wald statistics and a positive estimate. Old cattle and young had 2.163 odd ratio. The estimate for normal faecal consistency was negative (-1.254) and had significant ( $P<0.05$ ) Wald statistics. Odd ratio between normal and loose faecal consistency was 0.286. The odd ratios obtained between White Fulani and Sokoto Gudali indicates for a every single replacement of white Fulani with Sokoto Gudali breed, the infection rate by strongyle will be reduced by about 17.3%. Similarly, for every single introduction of adult cattle, infection due to strongyle parasites would be reduced by 15.5 percent but would increase by 2.163 times when old animals are introduced. Cattle with normal faecal consistency are less likely to be infected and for every single replacement of cattle with loose faecal consistency with normal will reduce the chances of strongyle by 28.6 percent in the

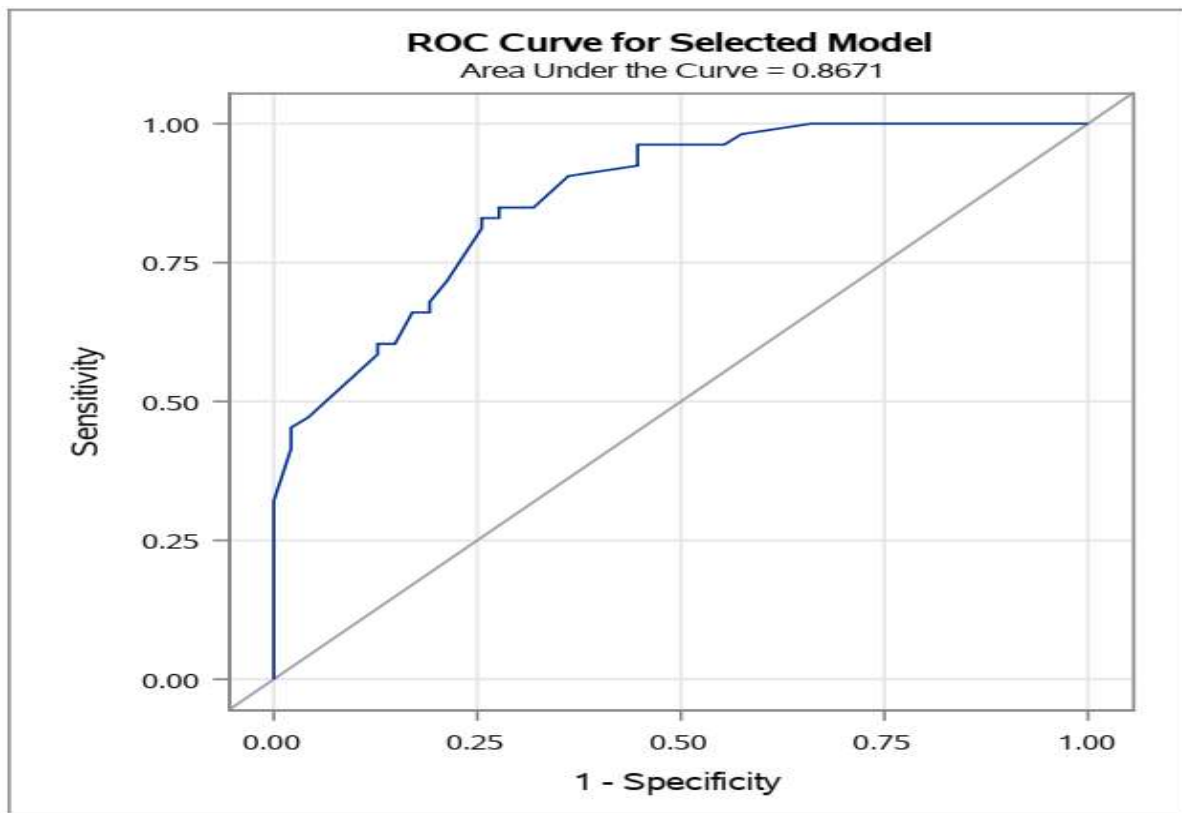
herd. A positive estimate and a significant (0.002) Wald statistics was observed for emaciated animals. The odd ratio was 6.608 between emaciated and cattle with normal body condition scores. The odd ratio greater 1 for emaciated cattle is an indication that introducing a single emaciated animal will raise the infection rate by 6.6 times.

Figure 1 revealed the area under curve receiver operating characteristics (AUROC) of model relating strongyle infection to some risk factors. The AUROC was 0.87 greater than the optimum margin of 0.5. The greater AUROC obtained in this model is an indication that the model explained and provides good prediction of strongyle infection due to the risk factors introduced. According to Detilleux *et al.* (1999), a ROC curve is a plot of a test's true-positive fractions (TPF) versus false-positive fractions (FPF) for each possible test results. It indicates all tradeoffs between sensitivity and specificity that are available.

**Table 5: Logistic regression model predicting risk factors associated with prevalence of strongyle in Cattle**

Parameters	Degree of freedom	Estimate	Standard Error	Wald Chi-Square	P. value	Odds ratio	95% Confidence interval
Breed (ref= WF)				9.469	0.024		
Muturu	1	-2.216	1.282	2.989	0.084	0.109	0.009-1.345
Red Bororo	1	-0.433	0.905	0.228	0.633	0.649	0.110-3.827
Sokoto Gudali	1	-1.756	0.622	7.970	0.005	0.173	0.051-0.585
Age (ref= Young cattle)				14.543	0.001		
Adult	1	-1.865	0.671	7.716	0.006	0.155	0.042-0.578
Old	1	0.772	0.892	0.749	0.387	2.163	0.377-12.414
Faecal Consistency (ref=Loose)				4.699	0.030		
Normal	1	-1.254	0.578	4.699	0.030	0.286	0.092-0.887
Body condition score (ref = normal)				10.131	0.002		
Emaciated	1	1.888	0.593	10.131	0.002	6.608	2.066-21.136

WF= White Fulani; ref= reference category;



**Figure 1:** Area under curve receiver operating characteristics (AUROC) of model relating strongyle infection to some risk factors

### Haematological Parameters of Cattle Infected with Strongyle Parasites

Among the indicators of physiological status and health of animals is the values of their haematological parameters. The result in table 6 is haematological parameters of cattle infected with strongyle parasites. There was significant ( $P<0.05$ ) effect of strongyle parasite on haemoglobin, red blood cell counts and lymphocytes of the animals. Haemoglobin and red blood cell count were lower in infected animals but had higher lymphocytes percentage

than uninfected. However, the level of packed cell volume, white blood cell count and lymphocytes were not different. According to Ola-Fadunsi *et al.* (2020), not all parasitic helminths of cattle are associated with anaemia as such, it is not surprising those strongyle infections in cattle is did not affected the Packed Cell Volume (PCV). This is confirmed in this study since PCV, neutrophil and white blood cell were not different between infected and uninfected cattle.

**Table 6: Haematological parameters of cattle infected with strongyle parasite**

Parameters	Uninfected	Infected	SEM
Packed cell volume (%)	26.53	25.74	0.38
Haemoglobin (g/dl)	8.91 <sup>a</sup>	8.04 <sup>b</sup>	0.17
Red blood cell count ( $\times 10^9/L$ )	4.60 <sup>a</sup>	3.91 <sup>b</sup>	0.11
White blood cell count ( $\times 10^9/L$ )	9.30	10.62	0.37
Neutrophil (%)	36.49	37.81	1.19
Lymphocytes (%)	53.15 <sup>a</sup>	47.23 <sup>b</sup>	1.33

<sup>a</sup><sup>b</sup> means on the same row having different superscript are significantly ( $P<0.05$ ) different; SEM: standard error of mean.

### Conclusion

The study showed that there was high prevalence of strongyle, ticks and blood parasites in the study area. The most abundance tick and blood parasites species affecting cattle in the area are *Boophilus* and *Anaplasma* species respectively. White Fulani, young and old cattle are more susceptible to strongyle infection. There was significant relationship between body condition scores and faecal scores with strongyle infection. Breed, age, body condition scores and faecal consistency scores can be used in predicting the prevalence of strongyle of cattle in the area. Strongyle infected cattle showed reduced levels

of some haematological parameters. Practices and measures such as effective control of strongyle, ticks and blood parasites should be adhered to, introduction of strongyle resistance breeds such as Sokoto Gudali and Muturu, buying or keeping higher number of adult cattle than young or old ones, rigorous check on body condition scores and faecal consistency of animals before purchase especially when planning to establish grower cattle fattening programmes and lastly adequate laboratory analysis of haematological parameters of cattle in the herd to ensure healthy herds can reduce the dangers inflicted by strongyle to cattle in the area.

### References

Adua, M. M., Baba, M. K. and Ibrahim A. O. 2020. Haematological parameters of tick infested bunaji cattle breeds in Lafia, North Central Nigeria. *International Journal of Veterinary and Animal Medicine*. 3(2): 1-4

Afolabi, O. J., Simon-Oke, I. A., and Ademiloye, A. O. 2017. Gastro-intestinal parasites of *Bovine* in Akure abattoirs, Nigeria. *Journal of Entomology and Zoology Studies*, 5(5): 1381-1384

- Aliyu, A. A., Ewah, F. O., Maikenti, J. I., Ayuba, S. O., Aimankhu, O. P., Ahmed, H. O., Haruna, A. and Idris, A. 2020.** Helminth parasites of goats and sheep at slaughter house in Lafia, Nasarawa State, Nigeria. *Fudma Journal of Sciences*, 34(2) 34-40
- Audu, Y., Lekko, Y. M., Umar, M. B., Mshellia, E. S. and Mana H. P. 2018.** Effect of Strongyle on Haematological Parameters of Cattle in Maiduguri, Borno State, Nigeria. *Journal of Agriculture and Veterinary Science (IOSR-JAVS) 11(1): 2319-2380, 2319-2372*
- Bamidele, O., Yakubu, A., Joseph, E. B. and Amole, T. A. 2022.** Antibiotic Resistance of Bacterial Isolates from Smallholder Poultry Droppings in the Guinea Savanna Zone of Nigeria. *Antibiotics*, 11(7): 973
- Burden F. A., Du Toit N., Hernandez-Gil M., Prado-Ortiz O. and Trawford A. F. 2010.** Selected health and management issues facing working donkeys presented for veterinary treatment in rural Mexico: some possible risk factors and potential intervention strategies. *Tropical Animal Health and Production*. 42(4):597–605
- Czopowicz, M., Kaba, J., Szaluś-Jordanow, O., Nowicki, M., Witkowski, L. and Frymus, T. 2012.** Multivariate model for the assessment of risk of fetal loss in goat herds. *Polish Journal of Veterinary Science*, 15: 67–75
- Dauda O. G., Olabanji, Rufai, S. M., Onakhinor, S. M., Akinde, S., Akande F., Fasasi, S. and Adeleke, M. 2022.** Haemoparasites and polyparasitism of intestinal helminths among cattle slaughtered in selected abattoirs in Abeokuta, Ogun State. *Pan African Journal of Life Sciencess*, 6(1): 402-413
- Detilleux, J., Arendt, J., Lomba, F., and Leroy, P. 1999.** Methods for estimating areas under receiver-operating characteristic curves: illustration with somatic-cell scores in subclinical intramammry infections. *Prev Vet Med*. 41:75–88
- Fenlon, C., O’Grady, L., Doherty, M. L., Dunnion, J., Shalloo, L. and Butler, S. T. 2017.** The creation and evaluation of a model predicting the probability of conception in seasonal-calving, pasture-based dairy cows. *J. Dairy Sci*. 100:5550–5563
- Gonzalez, R. and Gonzalez, A. C. 2004.** Alternatives for the control of gastrointestinal nematodes in sheep,” in *Proceedings of the European Population Forum (EPPF’04)*, Matanzas, Cuba
- Hosmer, D. W. and Lemeshow, S. 2000.** Applied Logistic Regression. 2<sup>nd</sup> ed. John Wiley & Sons, Inc. . Pp. 156-164
- Kabaka, W. M., Gitau, G. K., Kitala, P. M., Maingi, N. and Vanleeuwen, J. A. 2012.** Risk factors associated with gastrointestinal nematode infections of cattle in Nakuru and Mukurweini Districts of Kenya. *Bull. Anim. Health Prod. Afr.*, 60 (4): 413-419
- Kubkomawa, H. I. (2017).** Indigenous Breeds of Cattle, their Productivity, Economic and Cultural Values in Sub-Saharan Africa: A Review. *International Journal of Research Studies in Agricultural Sciences (IJRSAS)*, 3(1): 27-43
- Lorusso, V., Picozzi, K., Barend, M. C., de Bronsvort, Majekodunmi A, Charles Dongkum C., Balak G., Igweh, A. and Welburn, S. C., 2013.** Parasites & Vectors 6:171.
- Luka, J., Ajanusi, O. J., Chiezey, N.P., Bale, J.O, Tanko, J.T. and Kamani, J. 2018.** Gastrointestinal parasites of bile and faeces of slaughtered cattle and sheep from Maiduguri municipal abattoir, north eastern Nigeria. *Nigerian Veterinary Journal* 39(4)
- Mahmuda, A., Yakubu, Y., Raji, A. A., Lawal, N., Saidue, B., Danmaigorof, A. and Bello, A. 2012.** Prevalence of gastrointestinal round worms in calves in Sokoto, northwestern,

- Nigeria. *Scientific Journal of Zoology*, 1(2): 26-30
- NIMET 2011.** *Nigeria Metrological Agencies*, Synoptic Office, Lafia, Nasarawa State, Nigeria
- Noordhuizen, J. P., Thrusfield, M. V., Frankena, K. and Graat, E. A. M. 2001.** Application of quantitative methods in veterinary epidemiology. 2nd ed., Wageningen Pers, Wageningen, Holland
- Odeniran, P. O., Onifade, A. A., MacLeod, E. T., Ademola, I. O., Alderton, S. and Welburn, S. C., 2020.** Mathematical modelling and control of African animal trypanosomosis with interacting populations in West Africa-Could biting flies be important in main taining the disease endemicity? *PLoS ONE* 15(11)
- Ola-Fadunsin, S. D., Ganiyu, I. A., Rabi, M., Hussain, K., Sanda, I. M., Baba, A. Y., Furo, N. A., and Balogun, R. B. 2020.** Helminth infections of great concern among cattle in Nigeria: Insight to its prevalence, species diversity, patterns of infections and risk factors, *Veterinary World*, 13(2): 338-344
- Ola-Fadunsin, S.D. 2017.** Investigations on the occurrence and associated risk factors of avian coccidiosis in Osun state, Southwestern Nigeria. *J. Parasitol. Res.*, (8): 6
- Ola-Fadunsin, S. D., Ganiyu, I. A., Rabi, M., Hussain, K., Sanda, I. M., Baba, A. Y., Furo, N. A., Balogun, R. B. 2020.** Helminth infections of great concern among cattle in Nigeria: Insight to its prevalence, species diversity, patterns of infections and risk factors, *Veterinary World*, 13(2): 338-344
- Ola-Fadunsin, S.D., Ganiyu, I.A., Rabi, M., Hussain, K., Sanda, I.M., Musa, S.A., Uwabujo, I.P. and Furo, N.A. 2019.** Gastrointestinal parasites of different avian species in Ilorin, North central, Nigeria. *J. Adv. Vet. Anim. Res.*, 6(1): 108-116
- Radostts, O., Gay, K., Constable, R. 2007.** Helminths of digestive tract. In A textbook of the disease of cattle, sheep, horse, pig and goat's veterinary medication sounders. Elsevier, London, UK. Pp: 1378-1383
- SAS, 2003.** SAS/STAT Users Guide, Campus Drive, Cary, North Carolina, USA
- Soulsby, E.J.L. 1982. Helminths, Arthropods and Protozoa of Domestic Animals. 7th ed. Bailliere Tindall Publishers, London. p787-792
- SPSS. 2010.** Statistical Package for Social Sciences.SPSS Inc., 444 Michigan Avenue, Chicago, IL60611
- Swai, E.S., Mtui, P.F., Mbise, A.N., Kaaya E., Sanka, P. and Loomu, P.M. 2006.** Prevalence of gastrointestinal parasite infections in Maasai cattle in Ngorongoro District, Tanzania, *Livestock Research for Rural Development*, 18(8)
- Taylor, M. A., Coop, R. L., Wall, R.L., 2007.** *Veterinary Parasitology* 3rd ed. Blackwell Publishing Ltd. pp771.
- Tedeschi, L. O., Fox, D. G., Guiroy, and P.J. 2004.** A decision support system to improve individual cattle management: A mechanistic, dynamic model for animal growth. *Agricultural Systems*, 79: 171-204
- Thrusfield, M. 2008.** *Veterinary Epidemiology*, 3rd ed. Oxford: Blackwell Science, Ltd.
- Williamson, G., and Payne, W. J. A. 1990.** An introduction to animal husbandry in the tropics. Longman Group, London
- Yakubu, A., Yahaya, A., Omeje, J. N. 2015.** Heat tolerance traits and tick infestation in some indigenous breeds of cattle in Nigeria. *Slovak J. Anim. Sci.*, 48, (2): 79-85

Date received: 17<sup>th</sup> November, 2022

Date accepted: 26<sup>th</sup> December, 2023.