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ORIGINAL ARTICLE

Prevalence and Determinants of Gastrointestinal Infections in Sheep in Ilorin Metropolis, Kwara State, Nigeria.

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SUMMARY

Gastrointestinal parasites of ruminants are complex multicellular eukaryotic parasites affecting animals globally, with significant impact on livestock productivity, especially in sub-Saharan Africa. This study aim at determining the prevalence of gastrointestinal infections in sheep within Ilorin metropolis and assessing the influence of different predictors on infection rates. The research was conducted in four major markets in Ilorin: Mandate, Ipata, Eyenkorin, and GSS while laboratory analysis was done at the department of Zoology, Kwara State University. A total of 156 sheep were randomly sampled, with faecal samples collected and analysed using Baermann and floatation techniques to identify helminth larvae and eggs, respectively. Results indicated a high prevalence of gastrointestinal infection, with 140 out of 156 sheep (89.7%) testing positive. The youngest age group (6-12 months) had the highest infection rate (87.6%) compared to older age groups. Infection rates among different age groups did not show significant differences (χ^2=2.87, p=0.411). Similarly, sex did not significantly affect infection likelihood, with 90.4% of males and 89.0% of females infected (χ^2=0.0736, p=0.786). Breed-specific infections were highest in Balami (93.8%) compared to Yankasa and Uda breeds, though differences among breeds were not statistically significant (χ^2=4.28, p=0.118). The widespread of gastrointestinal infections among sheep, irrespective of age, sex, breed is of public health importance. Therefore, enhanced management practices and targeted interventions are recommended to mitigate the impact of gastrointestinal infections on livestock productivity in the region.

Keywords: Faecal samples, Gastrointestinal infections, Market, Prevalence.

INTRODUCTION

Livestock production is crucial to the economy, with farmers in northern Nigeria raising ruminants in relatively large numbers. Small ruminants are versatile and can adapt to various production systems, often requiring minimal inputs (Joy *et al.,* 2020); with some production challenges. When animals graze, they consume infective larvae from grass and other forages. These larvae mature into adult parasites that feed on blood in the abomasum and lay eggs, which are then excreted with faeces (Nolinda *et al.,* 2024).

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The cycle continues as the eggs hatch, and the larvae develop on the pasture, where they are ingested by grazing animals. Parasites adversely affect animal health by diminishing productivity and increasing treatment costs (Charlier *et al.*, 2020). The consequences include higher treatment expenses, weight loss, delayed maturity, and even death. Other health impacts involve organ damage and increased costs associated with inspecting dead animals.

Key groups of gastrointestinal parasites affecting ruminants include coccidian parasites, nematodes, cestodes, and trematodes (Maurizio *et al.,* 2021). Livestock are exposed to these pathogenic parasites early in natural grazing conditions, and the impact of infections is shaped by the environment, nutrition, immune system, climate, and management practices. Environmental contamination levels are influenced by factors such as the biotic potential of gastrointestinal helminths and the host's immune status. Parasitic infections are typically most severe in warm, humid conditions. Conversely, excessively hot or dry conditions can kill most larvae on the pasture (Hildreth and McKenzie, 2020).

Gastrointestinal parasites (GIP) are regarded as one of the most significant and overlooked challenges that impede sheep productivity (Hatam-Nahavandi *et al.*, 2023). In many regions, GIPs are the primary contributors to reduced productivity and are often linked to significant economic losses, particularly in resource-limited areas of the world. The impact of GIP infestations varies depending on the specific parasite, the severity of the infestation, and other risk factors such as species, age, sex, settings, and the intensity of worm (Mpofu *et al.*, 2022).

Some surveys have conclusively determined that among GIP, such as nematodes have a significant impact on the survival and productivity of ruminants in various environments (Mpofu *et al.*, 2022; Ahmed *et al.,* 2023;). Among flukes, liver flukes, particularly *Fasciola* species, posed the greatest threat to sheep and goat production (Isah, 2019; Inegbenosun *et al.,* 2023;). Additionally, small liver flukes like *Dicrocoelium* species and rumen flukes (*Paramphistomum* species) were comparatively less significant for livestock, as they have only caused a few isolated losses (Luka *et al.*, 2019; Oyebamiji *et al.,* 2021). Studies have also indicated that the prevalence of gastrointestinal helminths in sheep across Africa revealed that Strongyle-type worms were commonly reported in various ecozones (Luka *et al.*, 2019) while *Eimeria* spp. forms major GIP of sheep resulting in devastating effects (Oyewusi *et al.*, 2017; Eke *et al.*, 2019; El-Alfy *et al.*, 2020).

There are several epidemiological studies that document the prevalence of gastrointestinal helminths in sheep across different regions of the country (Oyewusi *et al.*, 2017; Eke *et al.,* 2019; Luka *et al.,* 2019; Inegbenosun *et al.,* 2023). However, the status of sheep consumed by the populace needs to be determined, as there is limited information or reporting on the prevalence of GIP infections in sheep within the study area. Therefore, we investigated the prevalence of gastrointestinal infections in sheep across different locations in Kwara State, North Central Nigeria. Understanding the distribution of infections by different predictors can help in designing targeted interventions for better animal health management.

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MATERIALS AND METHODS

Ethical consideration

Ethical approval was granted by the Ethical Review Committee of Kwara State University, Malete, Nigeria (MOH/KS/RERC/563/78). We engaged with the general market leader and informed the sectional heads about the project. Verbal consent was obtained from the leaders overseeing each respective zone.

Study Area

Ilorin is located approximately on latitude 8º30' and 8º50' north of the equator and longitude 4º20' and 4º35'east of the Greenwich meridian (Moji and Ebune, 2015). The state capital, Ilorin, experiences a tropical climate, with an average annual temperature of 28.73°C, a relative humidity of 81%, and a yearly rainfall of 170 mm. The vegetation in Ilorin is representative of the Guinea savanna zone. Our study focused on four specific locations within Ilorin: Mandate, Ipata, Eyenkorin, and GSS.

Sample and Data Collection

This cross-sectional survey involved the random selection of 156 sheep (Yankasa-52, Uda-39, Balami-65) from abattoirs in major markets in Ilorin. Sheep were categorized into age groups based on their months as follows: 6–12 months, 13–24 months, 25–36 months, and 37–46 months. Breed identification was conducted using the guidelines outlined by Blench (1999) for traditional livestock breeds in West Africa. The sexes of the sheep were determined by examining their external genitalia. Faecal samples from various sheep breeds were collected early in the morning. Using gloves, samples were taken directly from the rectums of the animals and placed into sterilized containers. These samples were then stored in a cool box at 4°C and transported to the laboratory for parasitological analysis (Cheesbrough, 2004).

Laboratory Examinations

The Baermann technique and flotation method were used to analyse the faecal samples for gastrointestinal parasites. For Baermann technique, a small faecal sample (5-10 grams) was prepared and placed in fine mesh to prevent large particles from clogging the funnel. The funnel was set up upright, with the faecal sample placed in the top and the narrow end positioned above a container to collect water and larvae. Warm water was added to cover the sample, encouraging larvae to migrate into the water, where they collected at the bottom. After 30-60 minutes of incubation, the water was drained into a collecting jar, with debris filtered out. The collected water was examined under a microscope for motile larvae, which were identified based morphological features (Onzima et al., 2017). For floatation method, the samples were first finely crushed and then mixed with saturated normal saline in a beaker. The mixture was subsequently filtered through a fine sieve to eliminate large particles and debris. The filtrate was poured into a sample bottle, with a cover slip placed on top for 10 to 15 minutes. Finally, the samples were examined under a microscope to identify the morphological characteristics of the parasite ova (Cheesbrough, 2004).

Data analysis

The collected data were analysed using the chi-square (χ^2) test and Fisher's exact test, both performed using the R software. Logistic regression analysis was carried out to identify

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significant predictors. This analysis aimed to predict the likelihood of gastrointestinal infection in sheep, considering factors such as location, sex, age, and breed. A p-value of less than 0.05 was regarded as indicating statistical significance.

RESULTS

The examination of sheep from selected markets in Ilorin for gastrointestinal parasites revealed the presence of multiple parasite species. The most prevalent parasite identified was *Eimeria* spp. in 131 sheep (84.0%). *Fasciola hepatica* was detected in 43 sheep, representing 27.6% of the sampled population. *Strongyloides* spp. were found in 36 sheep (23.1%), while *Protostrongylus* spp. and *Moniezia* spp. were each detected in 13 sheep (8.3% each) (Table I).

The prevalence of gastrointestinal parasites among sheep varied across the different markets in Kwara State. *Eimeria* spp. was the most commonly observed parasite, with infection rates ranging from 80% to 91.9% in all the markets. Specifically, in Ipata market, nearly all sheep (approximately 9/10) were infected with *Eimeria* spp., while Mandate, Eyenkorin, and GSS markets exhibited lower but still significant infection rates, with 4/5 of the sheep affected. *Moniezia* spp. infections were less frequent, with the highest occurrence in Eyenkorin (14.5%), and only a few cases in Mandate (7.5%) and Ipata (2.7%) (Table II).

TABLE I: Prevalence of helminth parasites

Parasite species (larvae/ova)	Positive	Negative
***Eimeria* spp.**	131 (84.0)	25 (16.0)
Fasciola hepatica	43 (27.6)	113 (72.4)
***Strongyloides* spp.**	36 (23.1)	120 (76.9)
***Protostrongylus* spp.**	13 (8.3)	143 (91.7)
***Moniezia* spp.**	13 (8.3)	142 (91.0)
Strongyle eggs	11 (7.1)	145 (92.9)
***Paramphistomum* spp.**	12 (7.7)	144 (92.3)
***Nematodirus* spp.**	5 (3.2)	151 (96.8)
***Didrocoelium* spp.**	3 (1.9)	153 (98.1)
***Dictyocaulus* spp.**	1 (0.6)	155 (99.4)
***Muellerius* spp.**	1 (0.6)	155 (99.4)

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TABLE II: Distribution of Gastrointestinal Parasites in Relation to location

Parasite species (larvae/ova)	Mandate No. Infected (%) n=53	Ipata No. Infected (%) n=37	Eyenkorin No. Infected (%) n=55	GSS No. Infected (%) n=11
***Eimeria* spp.**	43 (81.1)	34 (91.9)	44 (80)	10 (90.9)
Fasciola hepatica	12 (22.6)	13 (35.1)	15 (27.3)	3 (27.3)
***Moniezia* spp.**	4 (7.5)	1 (2.7)	8 (14.5)	-
***Strongyle* eggs**	3 (5.7)	4 (10.8)	4 (7.3)	-
***Paramphistomu*m spp.**	-	6 (16.2)	5 (9.1)	1 (9.1)
***Didrocoelium* spp.**	-	2 (5.4)	1 (1.8)	-
***Protostrongylus* spp.**	6 (11.3)	5 (13.5)	2 (3.6)	-
***Muellerius* spp.**	1 (1.9)	-	-	-
***Strongyloides* spp.**	11 (20.8)	9 (24.3)	14 (25.5)	2 (18.2)
***Dictyocaulus* spp.**	3 (5.7)	-	1 (1.8)	-
***Nematodirus* spp.**	2 (3.8)	1 (2.7)	2 (3.6)	-

prevalence of gastrointestinal parasite infection among sheep showed variations among the Yankasa, Uda, and Balami breeds. *Eimeria* spp. infection was most prevalent in the Balami breed, with 90.8% of sheep infected, followed by Uda (87.2%) and Yankasa (73.1%). *Fasciola hepatica* infection also showed a higher prevalence in Balami (32.3%), compared to 25% in Yankasa and 23.1% in Uda breeds (Table III). Gastrointestinal parasite infections prevalence among sheep according to age showed different patterns. *Eimeria* spp. was the most prevalent parasite across all age groups, with the highest infection rate in the 25-36 months age group (94.1%). *Fasciola hepatica* was more commonly found in older sheep, particularly those aged 25-36 months (41.2%). *Strongyle* eggs showed a varied pattern, being more prevalent in the youngest (6-12 months) and oldest (37-46 months) age groups (Table IV).

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TABLE III: Distribution of Gastrointestinal Parasites in Relation to breed

Parasite species (larvae/ova)	Yankasa No. Infected (%) n=52	Uda No. Infected (%) n=39	Balami No. Infected (%) n=65
Eimeria spp.	38 (73.1)	34 (87.2)	59 (90.8)
Fasciola hepatica	13 (25)	9 (23.1)	21 (32.3)
*Moniezia s*pp.	5 (9.6)	5 (12.8)	3 (4.6)
Strongyle eggs	4 (7.7)	1 (2.6)	6 (9.2)
*Paramphistomu*m spp.	4 (7.7)	1 (2.6)	7 (10.8)
Didrocoelium spp.	-	1 (2.6)	2 (3.1)
Protostrongylus spp.	4 (7.7)	4 (10.3)	5 (7.7)
Muellerius spp.	-	-	1 (1.5)
Strongyloides spp.	10 (19.2)	9 (23.1)	17 (26.2)
Dictyocaulus spp.	4 (7.7)	-	-
Nematodirus spp.	1 (1.9)	2 (5.1)	2 (3.1)

TABLE IV: Distribution of Gastrointestinal Parasites in Relation to age

Parasite species (larvae/ova)	6-12 months No. Infected (%)	13-24 (months) No. Infected (%)	25-36 (months) No. Infected (%)	37-46 (months) No. Infected (%)
Eimeria spp.	79 (81.4)	33 (86.8)	16 (94.1)	3 (75)
Fasciola hepatica	25 (25.8)	10 (26.3)	7 (41.2)	1 (25)
*Moniezia s*pp.	10 (10.3)	3 (7.9)	-	-
Strongyle eggs	8 (8.2)	-	2 (11.8)	1 (25)
*Paramphistomu*m spp.	7 (7.2)	4 (10.5)	1 (5.9)	-
Didrocoelium spp.	2 (2.1)	-	1 (5.90	-
Protostrongylus spp.	8 (8.2)	3 (7.9)	1 (5.9)	1 (25)
Muellerius spp.	1 (1.0)	-	-	-
Strongyloides spp.	21 (21.6)	11 (28.9)	4 (23.5)	-
Dictyocaulus spp.	2 (2.1)	-	-	2 (50)
Nematodirus spp.	2 (2.1)	2 (5.3)	-	1 (25)

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The distribution of gastrointestinal parasite infections among male and female sheep reveals distinct patterns. *Eimeria* spp. was the most prevalent parasite, infecting 88.0% of male and 79.5% of female sheep. *Fasciola hepatica* was observed in 31.3% of males and 23.3% of females *Strongyloides* spp. also showed a notable gender difference, infecting 18.1% of males and 28.8% of females, highlighting a higher infection rate in females. (Table V).

TABLE V: Distribution of Gastrointestinal Parasites in Relation to sex

Parasite species (larvae/ova)	Male	No. Infected (%)	Female No. Infected (%)
Eimeria spp.	73 (88)		58 (779.5)
Fasciola hepatica	26 (31.3)		17 (23.3)
*Moniezia s*pp.	6 (7.2)		7 (9.6)
Strongyle eggs	8 (9.6)		3 (4.1)
*Paramphistomu*m spp.	11 (13.3)		1(1.4)
Didrocoelium spp.	2 (2.4)		1 (1.4)
Protostrongylus spp.	7 (8.4)		6 (8.2)
Muellerius spp.	-		1 (1.4)
Strongyloides spp.	15 (18.1)		21 (28.8)
Dictyocaulus spp.	-		4 (5.5)
Nematodirus spp.	2 (2.4)		3 (4.1)

Among 156 sheep, 140 (89.7%) were infected with helminths. The infection rates varied among the different markets, with Ipata exhibiting a 100% infection rate. In contrast, the infection rates were slightly lower in Mandete (84.6%), Eyekorin (87.3%), and GSS (90.9%). The association between market location and infection status was tested using Fisher's exact test (p=0.047). This indicates a statistically significant difference in infection rates across the markets. The Yankasa breed had 43 out of 52 sheep (82.7%) infected, while the Uda breed had 36 out of 39 sheep (92.3%) infected. There was no statistically significant association between breed and infection status, ($\chi^2(2)=4.28$, p=0.118).

In all, the youngest age group (6-12 months) had the highest number of infected sheep, with 85 out of 97 (87.6%) being infected. There was no statistically significant association between age group and infection status, ($\chi^2=2.87$, p=0.411). The chi-square test for independence indicated that there was no statistically significant association between sex and infection status, ($\chi^2=0.0736$, p=0.786) (Table VI). The multivariate logistic analysis in Table VII, were 1.07 (95%CI =0.6-1.9), 1.25 (95%CI = 0.4-3.9), 2.09 (96%CI = 0.8-5.5), 1.55 (95%CI = 0.99-2.4) for location, sex, age, and breed respectively.

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TABLE VI: Association between of gastrointestinal infection and predictors

Predictors	Infected	Uninfected	χ^2 (p-value)/Fisher's exact test
Location			
Mandate	44 (84.6)	8 (15.4)	0.047
Ipata	38 (100)	-	
Eyekorin	48 (87.3)	7 (12.7)	
GSS	10 (90.9)	1 (9.1)	
Breed			
Yankasa	43 (82.7)	9 (17.3)	4.28 (0.118)
Uda	36 (92.3)	3 (7.7)	
Balami	61 (93.8)	4 (6.2)	
Age (months)			
6-12	85 (87.6%)	12 (12.4)	2.87 (0.511)
13-24	24 (89.5%)	4 (10.5)	
25-36	17 (100%)	-	
37-46	4 (100%)	-	
Sex			
Male	75 (90.4)	8 (9.6)	0.0736 (0.786)
Female	65 (89.0)	8 (11.0)	

TABLE VII: Logistic regression for predictors

Variables	Odd ratio	Standard error	p-value	95% CI
Market/location	1.070918	0.308732	0.812	0.6086469 - 1.884285
Sex	1.247598	0.7262302	0.704	0.3986465 - 3.904464
Age	2.089499	1.032341	0.136	0.7934072 - 5.502854
Breed	1.550177	0.3576943	0.057	0.9862143 - 2.436638

DISCUSSION

The overall prevalence of gastrointestinal parasite (GIP) infection among sheep was reported at 89.7%. This high rate of GIP infection likely reflects the significant level of pasture contamination with infective stages of these parasites. The traditional husbandry practices (i.e pasture) used in raising the sheep may be a contributing factor to this contamination. Reports from various regions of Nigeria have also indicated the prevalence of GIP (Oyewusi *et al.*, 2017; Eke *et al.*, 2019). In the present study, we identified several gastrointestinal parasites in

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sheep, including *Eimeria* spp., *Fasciola hepatica*, *Strongyloides* spp., *Protostrongylus* spp., *Moniezia* spp., *Strongyle eggs*, *Paramphistomum* spp., *Nematodirus* spp., *Dicrocoelium* spp., *Dictyocaulus* spp., and *Muellerius* spp. (Oyewusi *et al.*, 2017; Eke *et al.*, 2019; Luka *et al.*, 2019; Inegbenosun *et al.*, 2023;). These parasites were detected at varying prevalence levels, indicating a broad spectrum of infection among the sheep population.

Overall, *Eimeria* spp. were identified in 84.0% of the sheep sampled, making them the most prevalent gastrointestinal parasite in this study. These protozoan parasites, commonly referred to as coccidia, are the causative agents of coccidiosis—a disease of considerable concern in ruminants. Ruminant coccidiosis can result in severe clinical symptoms such as diarrhea, significant weight loss, and reduced overall productivity (Bangoura and Bardsley, 2020), particularly in young or immunocompromised animals. Regarding location, the most striking result is the high prevalence of *Eimeria* spp., with infection rates ranging from 80% to 91.9%. This consistently high prevalence shows the widespread nature of *Eimeria* spp. infections in the region, indicating that coccidiosis is a major concern for sheep health. The nearly ubiquitous presence of this parasite, particularly in Ipata market where almost all sheep were infected, suggests that the environmental conditions in these markets/source—such as overcrowding and poor hygiene—are highly conducive to the transmission of *Eimeria* spp. (Samuel *et al.*, 2015). The increased susceptibility in the 25-36 months age group could be linked to the physiological changes associated with this age, such as peak reproductive activity or stress, which may compromise the immune system and increase susceptibility to coccidiosis (Bangoura and Bardsley, 2020). The markedly high prevalence of *Eimeria* spp. in the Balami breed (90.8%) compared to Uda (87.2%) and Yankasa (73.1%) suggests a potential breed-specific susceptibility to coccidiosis. The Balami breed higher infection rate, with nearly 9 out of 10 sheep affected, may be indicative of a genetic predisposition or environmental factors (i.e contaminated water sources, wet and humid conditions) that make this breed more vulnerable to *Eimeria* infections (Passafaro *et al.*, 2015; Bangoura and Bardsley, 2020).

The relatively high prevalence of *F. hepatica* (27.6%) highlights liver fluke infections as a significant health concern within the sheep population. The liver fluke was the second most prevalent parasite, with a notable infection rate of 35.1% in Ipata market, which is significantly higher than the rates observed in Mandate (22.6%), Eyenkorin (27.3%), and GSS (27.3%). The higher prevalence in Ipata or from the source of the sheep may be due to presence of wet, marshy grazing areas that facilitate the life cycle of *F. hepatica* by supporting the intermediate snail hosts (Morley, 2015). The higher prevalence of *F. hepatica* in older sheep, particularly those aged 25-36 months (41.2%), aligns with the known epidemiology of liver fluke infections (Isah, 2019; Pinilla *et al.*, 2020). Liver fluke infection showed a higher prevalence in the Balami breed (32.3%), compared to 25% in Yankasa and 23.1% in Uda breeds. The elevated prevalence in Balami suggests that this breed may be more exposed to environments conducive to liver fluke transmission or may have a reduced resistance to *Fasciola* infections. Liver fluke infection was more common in males (31.3%) compared to females (23.3%), indicating a higher susceptibility

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among male sheep (Abdulkarim and Abdulazeez, 2019; Benisheikh *et al.,* 2020). This disparity could be attributed to behavioural or physiological differences between sexes, such as grazing habits or hormonal influences that might affect the immune response (Iyaji *et al.,* 2018). The low prevalence of *Dicrocoelium* spp., is in deviance to a similar study where more than half of the sheep had *Dicrocoelium* spp. (Scala *et al.,* 2019) in Italy.

The presence of Strongyle eggs, found in 7.1% of the sheep sampled, indicates infections by various strongyle nematodes, which are prevalent gastrointestinal parasites in ruminants. Although their occurrence in this study is relatively low compared to other parasites, the detection of Strongyle eggs signals ongoing infestations that could compromise the health and productivity of the sheep if not effectively managed. The varied prevalence of Strongyle eggs, with higher rates in the youngest (8.2% in 6-12 months) and oldest (25% in 37-46 months) age groups, suggests different exposure levels or immune responses at these life stages (Cruz-Tamayo *et al.,* 2021).

Strongyloides spp., another significant parasite was found in 23.1% of the sheep surveyed, indicating a moderate prevalence of these nematodes. *Strongyloides* are known to cause a range of gastrointestinal problems, most notably diarrhea and weight loss (Thamsborg *et al.,* 2017), which can significantly impact the health and productivity of infected animals. *Strongyloides* spp., showed substantial variation in infection rates, with the highest prevalence in Eyenkorin (25.5%) and Ipata (24.3%) markets, and a lower rate in Mandate market (20.8%). The higher infection rates of *Strongyloides* spp. in younger sheep (21.6% in 6-12 months and 28.9% in 13-24 months) may be linked to the parasite's life cycle (Page *et al.,* 2018), which can lead to rapid infections in environments with high contamination.

Moniezia spp., detected in 8.3% of the sheep examined, are cestodes that inhabit the intestinal tract (Rahman *et al.,* 2017). The moderate prevalence of *Moniezia* spp. in the studied population suggests that tapeworm infections are a common concern within the flock. The presence of *Moniezia* spp. was relatively low across all breeds, with infection rates of 9.6% in Yankasa, 12.8% in Uda, and 4.6% in Balami. These rates indicate that while *Moniezia* spp. is present, it does not pose a significant threat across these breeds. However, the slightly higher prevalence in Uda sheep suggests that this breed may have more exposure to the intermediate hosts (Cai *et al.,* 2023), that facilitate *Moniezia* transmission.

Paramphistomum spp., or rumen flukes, were also prevalent in the Balami breed (10.8%) compared to Yankasa (7.7%) and Uda (2.6%). The higher infection rates in Balami may be due to their grazing patterns, which might involve more frequent contact with water sources that harbour the intermediate snail hosts of these flukes (Tehrani *et al.,* 2015). *Dictyocaulus* spp. can cause respiratory distress and affect lung function, while *Muellerius* spp., similarly impacts the lungs. Although both types of lungworms were found in only 0.6% of the sheep but is lower than 5.6% and 2% recorded in Türkiye (Ercan and Mustafa, 2023). Their presence in this study highlights the importance of maintaining vigilance for respiratory parasites. Other GIPs, such as *Protostrongylus* spp., *Nematodirus* spp. had relatively low prevalence, which suggest that they are less common compared to other gastrointestinal parasites. The parasite has also been reported in Brazil and India (Tariq, 2015; Macedo *et al.,* 2022).

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CONCLUSION

The high overall prevalence and the varied infection rates across different locations indicate the need for targeted, market-specific interventions and further research to better understand breed-specific vulnerabilities. Improving hygiene practices, implementing regular deworming protocols, and considering breed-specific susceptibilities are crucial steps in mitigating the impact of gastrointestinal parasites and enhancing sheep health and productivity.

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