SHORT COMMUNICATION

Epidemiology of *Schistosoma* and Gastrointestinal Parasites in Goats: A Slaughterhouse-Based Study from Malwa Region, Madhya Pradesh, India

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Abstract

Gastrointestinal (GI) parasitic infections, including those caused by *Schistosoma* species, represent a major constraint to goat health and productivity. This research aimed to elucidate the prevalence and epidemiological dynamics of *Schistosoma* and other GI parasites in goats slaughtered in the Malwa region of Madhya Pradesh, India. A total of 312 fecal and mesenteric tissue samples were systematically collected from goats at the Mhow Cantonment Slaughterhouse during the summer and monsoon seasons of 2024. Diagnostic assessments were performed using flotation, sedimentation, and McMaster techniques, supplemented by morphological identification of *Schistosoma* worms and eggs. The findings revealed a significantly higher prevalence of GI parasites during the monsoon season ($p<0.05$), with *Eimeria* spp. (63.14%) and strongyles (59.29%) predominating. *Schistosoma indicum* was detected in 1.60% of the sampled goats. Males demonstrated a markedly higher prevalence of parasitism (70.08%) compared to females (53.84%, $p<0.05$), while adults (66.66%) exhibited a higher infection rate than kids (37.5%, $p<0.01$). Breed-specific differences were also observed, with Jamunapari goats exhibiting the highest prevalence (71.60%), followed by Sirohi, Barbari, and Beetal breeds. The highest parasite intensities were recorded for *Eimeria* spp. (2377 ± 226 EPG) and strongyles (2329 ± 230 EPG), with comparatively lower counts for *Trichuris*, *Fasciola*, and *Schistosoma* spp. The study highlights the significant burden of GI parasitism in goats and underscores the need for targeted and season-specific control strategies to enhance animal health and productivity in the Malwa region.

Key words: Epidemiological dynamics, Gastrointestinal parasites, Goat, Parasitic burden, *Schistosoma* spp.

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Introduction

Goats hold a pivotal position in livestock production, particularly in regions where they are reared for milk, meat, and other by-products. Their remarkable adaptability to diverse environmental conditions and efficient conversion of low-quality fodder into high-value animal products make them a vital resource in sustainable agriculture. With the rising global demand for goat-derived protein, ensuring their health and productivity has become increasingly important. Among the major challenges to goat farming is the burden of gastrointestinal (GI) parasites, which cause significant health issues such as anorexia, weakness, diarrhea, anaemia, and reduced productivity. These infections, often caused by single or mixed-species infestations, are particularly prevalent in tropical and subtropical climates (Rahman, 1994). Schistosomosis, a chronic parasitic disease caused by *Schistosoma* spp., is one of the most economically and clinically significant infections in goats. The disease leads to inflammation and tissue damage due to the presence of spined eggs in host tissues, causing considerable economic losses and impairing animal welfare.

Traditional diagnostic methods, such as direct smear, flotation, and sedimentation, are often inadequate for detecting eggs due to their hatching in water and potential retention in host tissues (Agrawal, 1999). Postmortem studies, especially those conducted in slaughterhouses, provide a more reliable assessment of parasitic infections. Such investigations allow for direct observation of parasites in tissues, yielding accurate insights into the prevalence and intensity of infections (Kouadio *et al.,* 2020; Ravindran *et al.,*

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2007). In India, schistosomosis is the fifth most significant helminthic disease in livestock, contributing to chronic morbidity and economic losses (Cherian and D'Souza, 2009). The zoonotic potential of *Schistosoma* spp., including hybridization between animal and human-infecting species, poses an additional threat to public health (Angora *et al.,* 2019). Despite numerous reports of schistosomosis from various parts of India (Jeyathilakan *et al.,* 2008), there remains a dearth of data on its prevalence in goats from the Malwa region of Madhya Pradesh (Agrawal *et al.,* 2013). The absence of baseline data necessitates a comprehensive investigation to formulate targeted and efficacious control strategies for the region. The present study bridges this gap by investigating the prevalence of GI parasites with a focus on schistosomosis in goats slaughtered in the Malwa region.

Materials and Methods

The study was aimed to determine the prevalence of gastrointestinal parasites in goats at the Mhow Cantonment Slaughterhouse in the Malwa region of Madhya Pradesh, India. A total of 312 fecal samples were collected from goats, along with mesenteric tissues for identifying gastrointestinal parasites and *Schistosoma* species in particular. Samples were preserved in 10% neutral buffer formalin and transported to the laboratory for further analysis. The study was conducted during the summer and monsoon seasons (April to September 2024). Approximately 3-5 fecal pellets were collected using gloved fingers via the lay or rectal method and placed in disposable plastic zip-lock bags containing 10% formalin. Each bag was labeled with a serial number corresponding to the data collection sheet for accurate tracking.

In the laboratory, fecal samples were analyzed using qualitative methods, including flotation and sedimentation techniques (Soulsby, 1982), and quantitative analysis through the McMaster method. Mesenteric tissues from slaughtered goats were cut into small pieces, submerged in normal saline, and allowed to sit undisturbed for 5-6 h to recover worms, which were visible to the unaided eye. The procedures for recovering *Schistosoma* species from mesenteric tissues followed the method described by Sumanth *et al.* (2004). The association between the prevalence of gastrointestinal parasites and factors such as season, sex, age, and breed was analyzed statistically using the Chi-square test to validate their significance.

Results and Discussion

A statistically significant variation in the prevalence of gastrointestinal (GI) parasites was observed between summer and monsoon seasons, with a higher prevalence recorded during the monsoon (66.66 vs 53.20: $p<0.05$, Table 1). This aligned with prior studies (Sorathiya *et al.,* 2017; Jas *et al.,* 2017) and underscored the influence of environmental factors, such as increased moisture and favorable conditions during the monsoon, on parasite survival and transmission. The dominance of *Eimeria* spp., Strongyles and *Trichuris* spp. during the monsoon indicates their affinity for humid environments conducive to larval development and fecal contamination. Conversely, the drier summer conditions appear less favorable, resulting in a reduced overall prevalence. However, the persistence of Amphistomes and *Eimeria* spp. across seasons highlights their adaptability to varying environmental stressors.

The cumulative count of individual parasite species (e.g., Strongyle: 38; Strongyloides: 3; Trichuris: 9; Moniezia: 2; Amphistomes: 25; Fasciola: 2; Schistosoma: 0; Eimeria: 34) exceeds the total number of positive samples (n=83) due to the occurrence of mixed parasitic infections. Several animals were concurrently infected with more than one genus of parasites. Therefore, while the total number of positive animals remains 83, the summation of parasite-specific counts is higher because it reflects the total number of occurrences across all detected parasite types.

Sex-based differences in parasitism were statistically significant ($p<0.05$), with males exhibiting a higher overall prevalence (70.08%) compared to females (53.84%). Strongyles and *Eimeria* spp. were the most prevalent parasites in both sexes, with males showing a notably higher prevalence (34.18% and 27.35%, respectively) than females (25.12% and 22.56%, respectively, Table 2). These findings were consistent with prior studies (Sorathiya *et al.,* 2017; Jas *et al.,* 2017) and underscore the influence of environmental factors, such as increased moisture and favorable conditions during the monsoon, on parasite survival and transmission. While significant differences were evident for Strongyles and *Eimeria* spp., other parasites such as Amphistomes, *Trichuris* spp., and *Fasciola* spp. showed no significant sex-based variations, emphasizing the need for tailored control strategies that address male susceptibility.

Age-wise analysis revealed a highly significant difference ($p<0.01$) in parasite prevalence, with adult goats showing a higher prevalence (66.66%) compared to kids (37.50%). This corroborated with the findings of Singh *et al.* (2017) and Pal *et al.* (2017), suggesting that prolonged exposure to contaminated environments and grazing practices increases the likelihood of parasitism in adults. Strongyles, *Eimeria* spp. and Amphistomes contributed most to this disparity, while other parasites, such as *Trichuris* spp. and *Strongyloides* spp., showed no significant differences between age groups ($p>0.05$) (Table 2).

Breed-wise analysis also revealed significant differences ($p<0.01$) in parasite prevalence, with Jamunapari goats exhibiting the highest prevalence (71.60%), followed by Sirohi (68.65%) and Barberi and Beetal (51.16%, 50.00%). This aligned with Akther (2015), highlighting potential breed-specific susceptibility and management factors contributing to the variation. Despite this, individual parasite species such as *Strongyloides, Trichuris* spp., *Fasciola* spp., *Schistosoma* spp. and *Moniezia* exhibited no significant variation among breeds ($p>0.05$) (Table 3).

Table 1: Season-wise prevalence of gastrointestinal parasites in goats

Season	Exami-ned (n)	Positive (%)	Strongyle (%)	*Strongyloides* (%)	*Trichuris* (%)	*Moniezia* (%)	Amphi-stomes (%)	*Fasciola* (%)	*Schisto-soma* (%)	*Eimeria* (%)	p-value
Summer	156	83 (53.20)	38 (24.35)	3 (1.92)	9 (5.76)	2 (1.28)	25 (16.02)	2 (1.28)	0 (0.00)	34 (21.79)	0.02*
Monsoon	156	104 (66.66)	51 (32.69)	7 (4.48)	17 (10.89)	5 (3.20)	29 (18.58)	2 (1.28)	5 (3.20)	42 (26.92)	

Table 2: Prevalence of gastrointestinal parasites by sex and age

Factor	Group	Exami-ned (n)	Positive (%)	Strongyle (%)	*Strongy-loides* (%)	*Trichuris* (%)	*Moniezia* (%)	Amphi-stomes (%)	*Fasciola* (%)	*Schisto-soma* (%)	*Eimeria* (%)	p-value
Sex	Female	195	105 (53.84)	49 (25.12)	6 (3.07)	12 (6.15)	4 (2.05)	32 (16.41)	2 (1.02)	2 (1.02)	44 (22.56)	0.006 **
	Male	117	82 (70.08)	40 (34.18)	4 (3.41)	14 (11.96)	3 (2.56)	22 (18.80)	2 (1.70)	3 (2.56)	32 (27.35)	
Age	Adult	240	160 (66.66)	80 (33.33)	8 (3.33)	21 (8.75)	4 (1.66)	44 (18.33)	4 (1.66)	5 (2.08)	62 (25.83)	<0.000 **
	Kid (≤6M)	72	27 (37.50)	9 (12.5)	2 (2.77)	5 (6.94)	3 (4.16)	10 (13.88)	0 (0.00)	0 (0.00)	14 (19.44)	

able 3: Prevalence of gastrointestinal parasites by breed

Breed	Exami-ned (n)	Positive (%)	Strongyle (%)	*Strongy-loides* (%)	*Trichuris* (%)	*Moniezia* (%)	Amphi-stomes (%)	*Fasciola* (%)	*Schisto-soma* (%)	*Eimeria* (%)	p-value
Beetal	78	39 (50.00)	20 (25.64)	1 (1.28)	8 (10.25)	3 (3.84)	13 (16.66)	0 (0.00)	0 (0.00)	16 (20.51)	0.005 **
Barbari	86	44 (51.16)	18 (20.93)	2 (2.32)	2 (2.32)	2 (2.32)	13 (15.11)	0 (0.00)	0 (0.00)	20 (23.25)	
Sirohi	67	46 (68.65)	23 (34.32)	2 (2.98)	8 (11.94)	0 (0.00)	11 (16.41)	2 (2.98)	2 (2.98)	20 (29.85)	
Jamunapari	81	58 (71.60)	28 (34.56)	5 (6.17)	8 (9.87)	2 (2.46)	17 (20.98)	2 (2.46)	3 (3.70)	20 (24.69)	

The intensity of GI parasites, expressed as egg/cyst counts (mean ± SE), revealed *Eimeria* spp. (2377 ± 226) and strongyles (2329 ± 230) as the most prevalent, followed by Strongyloides (446 ± 44) and amphistomes (420 ± 90). Lower counts were observed for Trichuris (275 ± 72), Fasciola (150 ± 50), Moniezia (100 ± 50), and Schistosoma (75 ± 25). These results corroborated with the earlier reports (Singh *et al.,* 2017), emphasizing the dominance of *Eimeria* spp. and Strongyles in the parasitic burden of goats.

Finally, *Schistosoma indicum* was identified in 1.60% (5/312) of the goats through detailed morphological examination. Adult worms and eggs were distinguished by characteristic features, including terminal spines on eggs and integumentary tuberculation in adult worms. These findings provide valuable insights into the prevalence and characteristics of *S. indicum*, contributing to a more comprehensive understanding of GI parasitism in goats.

Overall, the study delineates the epidemiological profile of *Schistosoma indicum* and other gastrointestinal parasites in goats from the Malwa region, highlighting significant seasonal, sex-based, age-specific, and breed-associated variations in prevalence and intensity. The high prevalence of *Eimeria* spp. and Strongyles during the monsoon season underscores the critical role of environmental moisture in enhancing parasite transmission dynamics. The detection of *Schistosoma indicum* in 1.60% (5/312) of goats, along with its pathological implications, indicates an underappreciated parasitic burden requiring advanced diagnostic approaches for accurate surveillance. The significantly higher parasitism in male and adult goats, particularly in Jamunapari breeds, necessitates tailored control measures integrating breed-specific and life-stage management strategies. These findings underscore the importance of seasonally adaptive and regionally targeted parasitic control programs to safeguard goat health and productivity while minimizing economic losses in semi-arid regions like Malwa.

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