



Prevalence of Gastrointestinal Parasitism in Goat Population of District Una (Himachal Pradesh)

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Abstract

The present study was conducted with an aim to assess the prevalence of common gastrointestinal parasites (GIP's) in goats and associated risk factors. The faecal samples analyzed for the present study were collected from goats (n=207) of different age groups and sex presented to Veterinary Polyclinic Lalhri from different regions of Una district of Himachal Pradesh during January 2018 to March 2020. The overall prevalence of GIPs in the present study was 78.26%, with a mean prevalence of 27.53, 42.02 and 8.69% for single, dual and mixed parasitic infection respectively. Prevalence of GIT parasites showed that females (81.28%) were significantly more susceptible than males (63.88%). A significant (p<0.05) association between age and prevalence was observed. The results of the present study indicates that periodical monitoring of GIT parasitism and well planned control measures to check the parasitic load among goats population is needed to prevent economic losses to the owners through morbidity and mortality.

Keywords: Economy, Eimeria, Gastrointestinal Parasitism, Goats, Himachal Pradesh, Prevalence, Strongyle, Strongylloides, Trichuris spp.

Introduction

Small ruminants especially sheep and goats hold an important niche in sustainable agriculture in developing countries and support a variety of socio-economic functions (Singh *et al.*, 2017). Their existence in rural households serves as a cushion in the event of crop failures due to various reasons, including climatic vagaries, especially in arid and semi-arid environments. Goats are considered one of the most essential species of livestock worldwide especially in tropical and dry zones (Di Cerbo *et al.*, 2010). Goats serve as multi-purpose animal and play a significant role in the economy and nutrition of landless and marginal farmers. India has an estimated sheep and goat population of 74.26 million and 148.88 million, respectively, whereas the North-Western Himalayan state of Himachal Pradesh has 0.79 million sheep and 1.1 million goats as per 20th livestock census (20th livestock census, 2019).

Goat farming is a fundamental sector in Himachal Pradesh. Many native prolific breeds are reared for meat and milk production (Di Cerbo *et al.*, 2010). This high potential component of small ruminant sector has not been efficiently exploited due to several constraints including malnutrition, inefficient management and parasitic diseases (Di Cerbo *et al.*, 2010). Gastrointestinal parasitic diseases remain an issue in the productivity of goat industry in India and worldwide (Pathak and Pal 2008). Gastrointestinal parasitic diseases are one of the important factors, which hamper the productivity of small ruminants and result in weight losses of 6-12 kg per animal per year and 40% mortality rates in goat herd (Sutherland and Scott, 2010). Gastrointestinal (GI) parasites cause considerable global economic losses as a consequence of reduced weight gain, digestive disturbance, lowered production, impaired reproductive performance, condemnation of affected organs and mortality in infected animals. GIT parasitism in goats is of paramount importance because small ruminants' rearing has been a major source of income especially to the marginal and landless farmers of the country (Singla, 1995).

Infections of gastrointestinal helminthes and enteric protozoan parasites among goats are implicated in serious economic losses including morbidity and mortality, mostly in young animals (Waller, 1999; Badran *et al.*, 2012; Majeed *et al.*, 2015). Among the gastrointestinal parasites, *Strongyle* nematodes are considered as one of the extremely pathogenic and economically significant parasites affecting small ruminants (Perry *et al.*, 2002; Jurasek *et al.*, 2010). Coccidiosis caused by genus *Eimeria* is another widely spread parasitic diseases either clinically or sub-clinically among small ruminants (Agyei *et al.*, 2004; Gadelhaq *et al.*, 2015; Majeed *et al.*, 2015). Coccidian parasites contribute to enteric disease particularly in young animals under stress in poor farm conditions, which lead to high mortality rate among kids (Ratanapob *et al.*, 2012). Goats act as an intermediate host for *Taenia hydatigena* which is considered clinically more important than the adult tape worm infection (Oryan *et al.*, 2012; Mhoma *et al.*, 2011; Elmawdy and Diab 2017). Several studies revealed that *Balantidium coli* and *Entamoeba spp.* infections are of public health significance and could cause zoonotic transmission to the human being (Mhoma *et al.*, 2011; Elmawdy and Diab 2017). Studying the intensity of parasitic prevalence remains paramount for adopting proper control measures. Monitoring of helminthic and protozoal infections among goats is supposed to be imperative to reduce the economic losses in goat industry (Soliman and Zalat 2003; El-Shahawy 2016; Sultan *et al.*, 2016; Elmawdy and Diab 2017; Mohamaden *et al.*, 2018).

Goats are owned by the poor, landless and marginal farmers in the district whose livelihoods depend solely on goat husbandry. Most of the animals are procured through government subsidies and loans. GIP affects the economics of production through losses resulting from parasitic morbidity and mortality. The agro-climatic condition in the study area differs from rest of the state as hot and humid climate is suitable for parasitic growth. Moreover, the marshy grazing areas are frequently denuded by flash floods aids in parasitism. Studies dealing with the prevalence of various GIT parasites among goats reared by small landless marginal farmers in the Himachal Pradesh particularly in district Una are very limited. Keeping in view, the importance of parasitic diseases among goats, present study was aimed to identify the prevalence and risk factors associated with caprine GIT parasites. This is vital for future holistic therapeutics, prevention and control strategies in the study area.

Materials and Methods

Ethical Approval

The study was based on the routine fecal sample collection only hence the ethical approval was not required. The fecal samples were directly collected from the animals without any harm or freshly voided samples with the prior

consent of the owners.

Sample Collection and Fecal Analysis

A total of 207 fecal samples from goats of different age group and sex kept by small animal holders were randomly collected during the period of January 2018 to March 2020 in each season uniformly from different regions of district Una (Himachal Pradesh). Animals were divided into three different age groups, viz., young (<6 months), yearling (6-12 months) and adults (>1 year). All the animals were examined clinically also. The fecal samples were collected from the rectum of each animal using examination glove and placed in a plastic container. A questionnaire was prepared to elicit information about age, sex and treatment given based on the history taken at the time of sampling for each animal. Samples were labeled accordingly and stored in ice chilled container to slow down the process of nematode eggs development. The collected faecal samples were grossly examined for color, consistency, presence of mucus/blood, undigested food, odor, and presence of adult worms or developmental stages, if any. The samples were processed and examined using direct microscopy employing sedimentation and floatation methods as per Soulsby (1986) for evaluating the incidence of infections. The GIP's were identified under a light microscope (10x and 40x magnification) based on the morphological appearance and size of helminth eggs, protozoa cysts and trophozoites as per standard method described by Soulsby (1986). A sample was considered positive when a minimum of one GIP egg was detected under the microscope. Distinguishable nematode (*Trichuris*), trematode and cestode eggs were identified directly. *Eimeria* species were identified based on morphological characteristics of oocysts (size, shape, color, and presence or absence of a micropyle and its cap).

Statistical Analysis

Data analysis was performed using SPSS-25 Analysis System (SPSS-25 for Windows, Version 9.4). Association between the prevalence of GIT helminths infections and various factors was carried out by Chi-square test (χ^2 -test).

Results and Discussion

In the present study, out of 207 fecal samples examined, 162 were found positive with an overall prevalence of 78.26% for GIP's as presented in Table 1.

Table 1: Number of positive goats based on single, dual and mixed parasitic infection

Species	No. of samples examined	Positive samples (%)			Total positive samples (%)
		SPI	DPI	MPI	
Goat	207	57 (35.19%)	87 (53.70%)	18 (11.11%)	162 (78.26%)
	χ^2	*9.583 (b/w SPI & DPI)	*24.767 (b/w SPI & MPI)	*60.751 (b/w DPI & MPI)	

*indicates values varying significantly at $p < 0.01$; SPI= Single parasitic infection; DPI= Dual parasitic infection; MPI= Mixed parasitic infection (more than two species parasitic eggs)

In the present study, parasitic eggs of different species viz. *Eimeria*, *Strongyle*, *Amphistomes*, *Trichuris*, *Fasciola*, *Moniezia*, *Strongylloides* and *Ogmocotyle* were detected in the tested fecal samples. The species wise parasite distribution showed mean prevalence of 17.9, 14.8 and 2.4% for single parasitic infection caused by *Eimeria* (Fig. 1), *Strongyle* (Fig. 2) and *Amphistome* spp. respectively (Table 2). The overall prevalence of coccidian oocyst (*Eimeria* spp.) was significantly high (17.9%) followed by *Strongyle* spp. (14.8%) and *Amphistome* (2.4%). Dual parasitic infection was reported with an overall prevalence of 53.70%. The overall species wise prevalence of dual parasitic infection was 41.3, 5.6, 4.32, 1.85 and 0.61% for *Eimeria* + *Strongyle* (Fig. 1 & 2), *Strongyle* + *Amphistome*, *Strongyle* + *Trichuris* (Fig. 2 & 3), *Strongyle* + *Moniezia* and *Strongyle* + *Strongylloides* (Fig. 2 & 4) respectively. The overall prevalence of mixed parasitic infection (more than two parasitic species) was 11.11% (Table 2).

Table 2: Comparative species wise copro-prevalence of GIT parasitic infections in goats from different regions of district Una (Himachal Pradesh)

Species	Total samples examined	Total positive (%)	Single parasitic infection (%)			Dual parasitic infection (%)					Mixed infection (> two species)
			<i>Eim.</i>	<i>Str.</i>	<i>Amp.</i>	<i>Eim. + Str.</i>	<i>Str. + Strg.</i>	<i>Str. + Amp.</i>	<i>Str. + Tri.</i>	<i>Str. + Mon.</i>	
Goat	207	162 (78.26%)	29 (17.90%)	24 (14.80%)	4 (2.40%)	67 (41.30%)	1 (0.61%)	9 (5.60%)	7 (4.32%)	3 (1.85%)	18 (11.11%)

Mixed infections: *Eimeria* + *Strongyle* + *Trichuris*=09; *Strongyle* + *Eimeria* + *Amphistome*=03; *Strongyle* + *Eimeria* + *Ogmocotyle*=01; *Strongyle* + *Moniezia* + *Eimeria* + *Trichuris*= 02; *Eimeria* + *Strongyle* + *Fasciola* + *Strongyloides* =03; *Eim.* = *Eimeria*, *Str.* = *Strongyle*, *Amp.* = *Amphistomes*, *Fasc.* = *Fasciola*, *Mon.* = *Moniezia*, *Strg.* = *Strongyloides*, *Tri.* = *Trichuris*; GIT = Gastrointestinal tract

A significant difference was observed between GIT parasites (GIP's) between male and female goats (Table 3). Sex wise an overall copro-prevalence of GIP's showed that females (81.28%) were significantly ($p < 0.01$) more susceptible than males (63.88%).

Table 3: Sex based copro-prevalence of GIT parasitic infections in goats from different regions of district Una (Himachal Pradesh)

Parasitic infection	Total no. of males examined (n=36)		Total no. of females examined (n=171)		Total number
	Positive (23)	Prevalence %	Positive (139)	Prevalence %	
<i>Eimeria</i> spp.	4	17.39%	25	17.98%	29
<i>Strongyle</i> spp.	2	8.69%	22	15.82%	24
<i>Amphistome</i> spp.	-	-	4	2.87%	4
Coc. + Str.	13	56.52%	54	38.84%	67
Str. + Strg.	-	-	1	0.71%	1
Str. + Amp.	1	4.34%	8	5.75%	9
Str. + Tri.	1	4.34%	6	4.32%	7
Str. + Mon.	-	-	3	2.15%	3
Mixed infection	2	8.69%	16	11.51%	18
Grand Total	23	63.88%	139	81.28%	162
χ^2			*5.291		

A significant ($p < 0.05$) association between goat age and prevalence of GIP's was observed, where the prevalence was higher in adult goats (88.38%), followed by yearling (56.25%) and young goats (35%) (Table 4).

Gastrointestinal parasitism is a major health issue affecting the productivity of goat farming worldwide (Sissay *et al.*, 2006; Sutherland and Scott 2010; McRae *et al.*, 2014). The overall GIP's prevalence of 78.26% observed in the present study, however, is lower than the prevalence of GIP's in goats reported earlier (Ntonifor *et al.*, 2013; Islam *et al.*, 2017). Lower prevalence rate in younger goats may be attributed to the fact that most of the animals examined were kept in confinement and managed on intensive system management. They had restricted access to outer infection sources and dewormed regularly as suggested by the owners. In contrast, the highest prevalence in adult goats may be due to the fact that the field flocks of goats encountered during the study were mainly from the nomadic pastoralists that were mobile and kept on changing the pastures. Species wise, the single parasitic infection prevalence was 27.53%, while the dual infection was 42.52% and multiple infections having more than three parasites was 8.69%, respectively. Similar to the present findings, higher rates of infection throughout the year in goats were reported earlier (Pandey *et al.*, 1994; Saha *et al.*, 1996). This slight variation in prevalence might depend on the difference in agro-climatic condition and availability of susceptible host.

Table 4: Age wise copro-prevalence of GIT parasitic infections in goats from different regions of district Una (Himachal Pradesh)

Parasitic infection	< 6 months (n=20)		6-12 months (n=32)		>1 year (n=155)		Grand total
	Positive	Prevalence %	Positive	Prevalence %	Positive	Prevalence %	
<i>Eimeria</i> spp.	4	20%	5	15.63%	22	14.19%	31
<i>Strongyle</i> spp.	2	10%	3	9.38%	17	10.96%	22
<i>Amphistome</i> spp.	-	-	1	3.12%	3	1.94%	4
<i>Coc. + Str.</i>	1	5%	6	18.75%	60	38.70%	67
<i>Str. + Strg.</i>	-	-	-	-	1	0.65%	1
<i>Str. + Amp.</i>	-	-	1	3.12%	8	5.16%	9
<i>Str. + Tri.</i>	-	-	-	-	7	4.52%	7
<i>Str. + Mon.</i>	-	-	-	-	3	1.94%	3
Mixed infection (> two species)	-	-	2	6.25%	16	10.32%	18
Grand total	7	35%	18	56.25%	137	88.38%	162
χ^2	*17.877		*20.810		* 1.629		

n = Total number of samples examined in each category; *indicates values varying significantly at $p < 0.01$

The current study revealed that the females (81.28%) were significantly more prone to parasitic infection than males (63.88%). On the contrary, the prevalence of GIP's was previously reported to occur more frequently in males than females (Dappawar *et al.*, 2018). However, some workers (Emiru *et al.*, 2013; Kheirandish *et al.*, 2014; Ishlam *et al.*, 2017) reported more GIT parasitism in females in comparison to males similar to findings of the present study. Contrary to the findings of Dappawar *et al.*, (2018) the percentage of *Eimeria*, *Strongyle* and *Trichuris* infections between the two sexes was marginally higher in females as compared to males in the present study.



Figure 1: Microscopic view of *Eimerian* oocyst (40x)

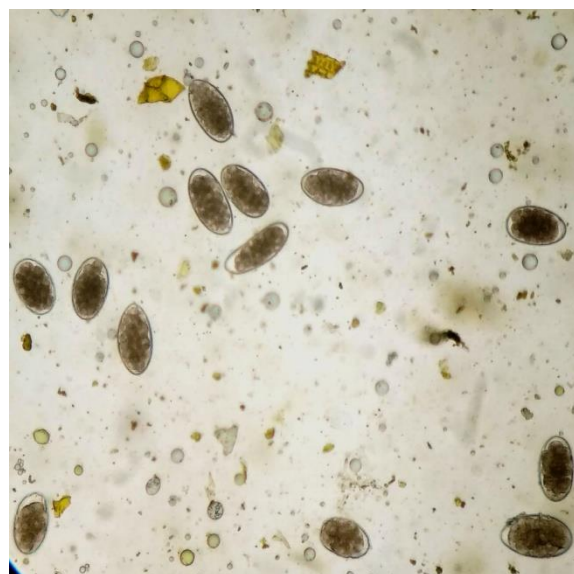


Figure 2: Microscopic view of *Strongyle* eggs (10x)



Figure 3: Microscopic view of *Trichuris* egg (40x)



Figure 4: Microscopic view of *Strongyloides* eggs (10x)

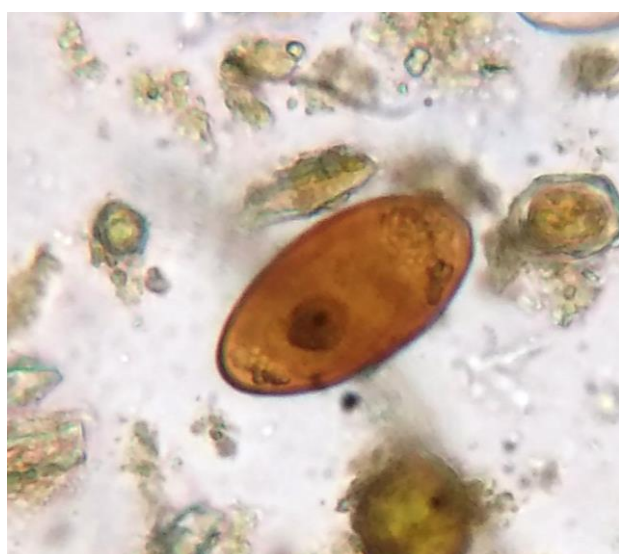


Figure 5: Microscopic view of *Fasciola* egg (40x)



Figure 6: Microscopic view of *Ogmocotyle* egg (40x)

The influence of sex on the susceptibility of animals to infections could be attributed to genetic predisposition and differential susceptibility owing to hormonal control (Blood and Radostitis, 2000). The physiological peculiarities of the female animal, usually constitute stress factors thus reducing their immunity to infections and lactation stress induces weakness and malnourishment, resulting in more susceptibility to the infections (Mir *et al.*, 2013).

The interactions between host factors and parasite factors determine the potential for disease/infection to occur and the pattern of infection, whereas host-environment and parasite-environment interactions influence disease transmission (Roeber *et al.*, 2013). The current study revealed that the adults were significantly more prone to parasitic infection with the prevalence of 88.38% than the young ones (35%). The present findings are contrary with findings from several other studies (Ndamukong 1985; Zvinorva *et al.*, 2016; Ishlam *et al.*, 2017) in which young goats showed a higher incidence of parasitic infection than adult goats. However, similar to present study some researchers have noticed a higher prevalence in adults than in young goats (Uddin *et al.*, 2006; Hassan *et al.*, 2011; Admasu and Nurlign 2014). Several workers (Emiru *et al.*, 2013; Kheirandish *et al.*, 2014; Dappawar *et al.*, 2018) observed that the age of the animals was not significantly associated with the prevalence of the GIP's. Furthermore, in contrast to the findings of the present study, Verma *et al.*, (2018) reported that suckling goats were more heavily infected with *Eimeria* and *Moniezia* spp. than adult goats. The overall prevalence of GIP's in young goats found in this study (35%), however, lower than the prevalence observed by Radfar *et al.*, (2011) and Dappawar *et al.*, (2018) who reported a prevalence of 91.42 and 45.0%, respectively, in young goats. The overall GIP's prevalence in adult

goats in the present study was higher than the findings of previous workers (Radfar *et al.*, 2011; Verma *et al.*, 2018). It could be explained that higher GIT's prevalence in adults might be due to grazing on larger area of pastures being contaminated with various flocks and different stress conditions such as climate extremes, long daily traveling, and gestation (Badran *et al.*, 2012). The young animals are less susceptible to parasitic infections due to less exposure for grazing as they mainly depend upon milk feeding and remained confined in the barns. Our findings were in concordance with Nye and Moore *et al.* (2004), Emiru *et al.* (2013) who recorded a higher prevalence of infection in adults than young ones.

In the present study, dual parasitic infection caused by *Eimeria* +*Strongyle* was the most commonly observed gastrointestinal parasitic infection followed by single parasitic infection caused by *Eimeria* and *Strongyle* spp. infection. Our observations were similar to other studies (Fikru *et al.*, 2006) who reported *Eimeria* and *Strongyle* spp. infection as a major problem in small ruminants. Similar to present study several authors have previously reported that *Eimeria* spp. infection is the most prevalent among GIP's in goats (Githigia *et al.*, 2001; Jatau *et al.*, 2011; Singh *et al.*, 2015; Verma *et al.*, 2018). In the present study overall prevalence of dual and mixed infection was 42.02% and 8.69%, respectively, differs from the findings of Ntonifor *et al.* (2013) who reported a prevalence of 13.9 and 48.9%, respectively. This difference may be attributed to different sampling sites, size, goat breed, and agro-climatic conditions. The significant association observed between the prevalence of *Eimeria*, *Strongyle* and *Trichuris* spp. might be due to geographical and climatic variability and locally adopted management practices. The higher prevalence of *Eimeria*, *Strongyle*, *Trichuris*, *Eimeria*+*Strongyle* followed by *Strongyle*+*Trichuris* spp. in the study area may be attributed to the fact that this area has higher humidity, high temperatures which are therefore suitable for fecundity and epidemiology of the GIP's. Another contributing factor may be poor farm management practices generally unhygienic farming conditions and improper use of anthelmintics.

Conclusion

On the basis of the present study findings, it can be concluded that in light of the high prevalence rate of gastrointestinal parasitism in the study area, routine monitoring of GIP through faecal analysis is needed. This will inform strategies for preventive veterinary care of goat husbandry through appropriate use of specific anthelmintics. Control of gastrointestinal parasitic infections in goats requires a comprehensive knowledge of the disease epidemiology, understanding of the pasture management, farm management practices, level of host susceptibility, the health status of the animal and immunological status. Further, effective and well-planned control measures to check the parasitic population should be implemented by conducting extension programs to educate the farmers regarding control of GIP.

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Conflict of Interests

There is no conflict of interest.

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