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Prevalence of Gastrointestinal Nematodes in Small Ruminants in Boloso Sore District, Wolaita Zone, Southern Ethiopia

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Abstract

A cross-sectional study was conducted to determine the prevalence of gastrointestinal nematodes in small ruminants in Boloso Sore District, Wolaita Zone, Southern Ethiopia during November, 2019 to June, 2020. A total of small ruminants 276 (177 sheep, and 99 goats) were included in the study by using simple random sampling. The study showed that the overall prevalence of gastrointestinal nematodes in small ruminants in study area was 64.1%. Among the positive animals in study area, 62.7% and 37.3% were sheep and goats respectively. Among affected animals in study area, 22% (39/177) of male and 78% (138/177) female were infested gastrointestinal nematodes. Based on simple fecal floatation, different types of nematode eggs were identified including 45.3% (125) were positive for *Strongyl*e type, 14.1% (39) were positive for *Strongyloide,* 2.2% (6) were positive for *Nematodirus fillicollis* and 2.5% (7) were positive for *Trichuris*. *Strongyle* type eggs dominated infections, where by 26.8 % (74) sheep and 18.5% (51) goats were positive for *Strongyle* infection. Among considered risk factors, sex, body condition had statistical association ($P < 0.05$) with prevalence of nematode parasites. The study showed that GIT nematodes are major problems of small ruminants in the study area. The gastrointestinal nematode parasites are found livestock health problems including for small ruminants and are responsible for economic losses due to reduced production, morbidity and mortality. Therefore, Strategic treatment of small ruminants with anthlmentics, parasitic control and prevention should be practiced in the study area to minimize the impact of gastrointestinal nematodes on the health of animals.

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Introduction

Ethiopia has the largest livestock inventories in Africa, including more than 38,749,320 cattle, 18,075,580 sheep, 14, 858,650 goats, 456,910 camels, 5,765,170 equines and 30,868,540 chickens with livestock ownership currently contributing to the livelihoods of an estimated 80 percent of the rural population [1]. Among this livestock population, small ruminants constitute a major part [2]. There are about 25.5 million sheep and 24.06 million goats in the country playing an important role in the livelihood of poor farmer's resource [3].

Livestock production in Ethiopia's agricultural economy is an important sector providing a significant contribution to gross domestic, export products and raw materials for industries [4]. Small ruminants are important source of income for agricultural community and are one of Ethiopia's major sources of foreign currency through exportation of live animals, meat and skin [5].

Despite their physiological adaptation and ability to thrive under harsh environmental conditions, the full exploitation of these resources is hindered in the tropical environment and particularly in Africa due to a combination of factors such as drought, poor genetic potential of the animals, traditional system of husbandry and the presence of numerous diseases. Among prevalent diseases, GI helminthes, particularly nematodes have been recognized as one of the major factors that limit production [6].

Internal parasites are an important cause of disease and lose of production in small ruminants [7]. Gastrointestinal nematodes are recognized as a major constraint to both small and large-scale small ruminant production in developing countries [8]. These could be harmful to the health of infected animals in different regions and causes economic losses due to mortalities, reduce weight gain and other production losses.

In developed world, the greatest component of impact by nematode parasites is probably found in the cost of control. But their impact is greater in the SubSaharan Africa in general and Ethiopia is particular due to ecological factors suitable for diversified hosts and parasite species. The epidemiology of gastrointestinal (GIT) parasites in livestock varied depending on the local climatic condition, such as humidity, temperature, rainfall, vegetation and management practices. These factors largely determine the incidence and severity of various parasitic diseases in a region [9].

Small ruminants are the host to different species of gastrointestinal nematodes. The epidemiology of nematodosis is determined by several factors governed by parasite host-environment interactions. The major risk factors can therefore be broadly classified as parasite factors, host factors and environmental factors [10]. *Haemonchus*, *Trichostrongylus*, *Bunostomum* are highly prevalent in small ruminants of warmer climates, whereas *Teladorsagia*, *Nematodirus* and *Cooperia* are responsible for severe diseases in small ruminants of temperate areas. This is, because of the fact that the free-living stages of these parasites are strongly affected by moisture conditions of the soil and the climate [11].

Gastrointestinal nematode infection is one of the major problems of the disease that difficult to easily detected and prevented by smallholder farmers and pastoralists because of subclinical nature of the infection. Thus subclinical nematode infections are responsible for serious economic losses due to reduce production, suppress immunity, morbidity and mortality [12].

Objectives

- ✓ To determine the prevalence of gastrointestinal nematode in small ruminants in Bolo Sore District, Wolaita Zone, Southern Ethiopia.
- ✓ To assess the influence of host related risk factors such as age, sex, species and body condition on the occurrence of gastrointestinal nematode in study area.

Materials and methods

Study area

The study was conducted from November, 2019 to June, 2020 in Boloso Sore District, Southern Ethiopia. Boloso Sore is located in the Wolaita Zone of the Southern Nations, Nationalities, and Peoples' Region, 300 km southwest of the capital city of Ethiopia, Addis Ababa. The area has a latitude and longitude of 7°05'N 37°40'E / 7.083°N 37.667°E and an altitude of 1350-2380 m above sea level. The rainfall pattern is bimodal; a short rainy season runs from March to May and long rainy season runs from June to September with average annual rainfall of 1300 mm and average daily temperature of 20.4°C. The district is bordered by Boloso Bombe in the West, Kembata Tembaro in North West, Sodo Zuria and Damot Sore in South and Damota Gale in the East. Depending on the climatic condition, 80% was Woina Dega (mid altitude), the remaining composed of Kola (Lowland) and small proportion was for Dega (Highland). According to Wolaita Zone Livestock and Fishery Resources office 2016 report, the livestock population of Boloso Sore District was estimated as 84,391 cattle, 57,331 ovine, 8,396 caprine, 7,321 equines and 91,375 poultry (WZLFR, 2016).

Study population

The study animals were ovine and caprine species in study area. 276 animals were taken as a sample in which 177 sheep and 99 goats. The study animals were indigenous breeds kept under traditional semi-intensive management system with different sex and body condition. Those animals were from different randomly 6 selected kebeles of the woreda like Legama, Tadisa, Dubbo, Madalicho, Woyibo and, Yukar.

Study design

The cross-sectional study was conducted from November, 2019 to June, 2020 to determine the overall prevalence of gastrointestinal nematodes in small ruminants in Boloso Sore District. The prevalence was determine in respect to the number of risk factors such as host factors age , sex, species and body condition of the animals, and the environmental factors included origin of the animals. The animals were selected by simple random sampling technique. Fecal sample was collected directly from the rectum of selected animal and stored in vials with preserve ice box and transported for laboratory examination to Wolaita Sodo University Veterinary Parasitology Laboratory. The sample was used for further detection of the presence of parasites and their pathological effects inside the gastrointestinal tract.

Sample size determination

By using simple random sampling methods and 95% confidence interval with required 5% precision, the sample size was

determined by the formula [14]. To calculate the total sample size, the following confidence level (CL), 5% desired level of precision; and parameters was used: 95% confidence interval with the 86% [15] expected prevalence of Gastrointestinal nematode sheep and goats in the study area.

$$n = \frac{1.96^2 \times Pexp\ (1-Pexp)}{d^2}$$

$$n = \frac{1.96^2 \times 0.86(1-0.86)}{(0.05)^2} = 185$$

Where: n= required sample size; Pexp = expected prevalence and d= desired absolute precision.

Hence, by using this formula, the sample size was calculated to be 185. However, total sample size of the study was increased to 276 in order to increase the precision of study. Simple random sampling technique was employed to estimate the prevalence of gastrointestinal nematode in small ruminants.

Data collection

Faecal sample collection

A fresh faecal sample of approximately 10 g was collected directly from the rectum of each animal. The faecal sample was placed in a separate universal plastic bottle, labeled and kept in Ice box before transportation to Wolaita Sodo University Veterinary Parasitology Laboratory for laboratory investigation. That sample which was not examined within 24 h of arrival at laboratory was stored at Refrigerator and examined the next day early in the morning.

Laboratory examination

The collected faecal specimens was processed and examined by simple faecal floatation technique and sodium chloride (NaCL) was used [16,17] for qualitative investigation of the types of gastro-intestinal nematode eggs and the microscopic detection of parasite eggs in host faeces [18]. The collected fecal samples were processed and examined under the 10x magnification.

Data analysis

The data which was collected from the study area result obtained from fecal examination was recorded in the format developed for this purpose and was entered in to Microsoft Excel spread sheet. Statistical Package for Social Sciences (SPSS, version 20) was used for analysis of the data. The significant association between the prevalence of gastrointestinal nematode and explanatory variables was determined using Chi-square test (x^2). The explanatory variables included: sex, age, body condition, breed and their associations with the level of prevalence was described. The difference was regarded as significant if P-value was<0.05 at 95% confidence interval.

Results

The out of 276 small ruminants were examined in the study area, 177 were sheep and 99 were goats. An overall prevalence of gastrointestinal nematodes in small ruminants in study area was 64.1% (177/276). Out of the total population sampled in study area (276), 45.3% (125) were positive for *Strongyle* type, 14.1% (39) were positive for *Strongyloide*, 2.5% (7) were positive for *Trichuris* and 2.2% (6) were positive for *Nematodirus fillicollis*. The result revealed that the *Strongyle* type were prevalent in study area than other gastrointestinal nematodes in small ruminants. *Nematodirus fillicollius* was least prevalent in study area when compared with other gastrointestinal parasites in study area. There was statistical association between different parasities found in study area (p=0.000 or p<0.05) as described in Table 1.

Table 1: Prevalence of different gastrointestinal nematodes in small ruminants.

Genera of helminthes	No of positive animals (%)	X^2	*p* value
Strongyle	45.3%	276.00	0.00
Strongyloide	14.1%		
Nematodirus fillicollius	2.2%		
Trichuris	2.5%		

In this area, 26.8 % (74) sheep were positive in *Strongyle* type and 18.5% (51) goats were positive in *Strongyle type*. Therefore, *Strongyle* type was prevalent in sheep than goats in study area. Among the 39 affected small ruminants with *Strongyloide*, 27(9.8%) and 12 (4.34%) were sheep and goats respectively. From total population sampled in study area, only the 6 (2.17%) sheep were affected with *Nematodirus fillicollius*. Therefore, there was no *Nematodirus fillicollius* founded in goats in study area. Out of the 7 affected small ruminants with *Trichuris*, 4 (1.4%) sheep were affected with *Trichuris* and 3 (1.1%) goats were found with *Trichuris*. The study described that five parasitic species which encountered in study area were highly prevalent in sheep than in goats. There was statistic signifance association between egg type in study area (p <0.05) (Table 2).

Table 2: Gastrointestinal nematode genera in infected sheep and goat.

Genera of helminth	Sheep	Goats	P value
Strongyle	26.8% (74)	18.5% (51)	0.00
Strongyloide	9.8% (27)	4.34% (12)	
Nematodirus fillicollus	2.17% (6)	0	
Trichuris	1.4% (4)	1.1% (3)	

Among the 177 positive animals, 62.7% and 37.3% were sheep and goats respectively. The prevalence of gastrointestinal nematodes in sheep was higher than goats. In present study, there was no statistically significant variation between species (p= 0.511) in Table 3.

Table 3: Prevalence of gastrointestinal nematodes with species based risk factors.

Species	No of animal examined	No of animal positive (%)	X2	P value
Ovine	177	111 (62.7%)	.432	0.511
Caprine	99	66 (37.3%)		

Out of 177 positive examined animals in this study area, 22% (39/177) and 78% (138/177) were male and female respectively. Statistical analysis showed that there was significant variation among sex of animals (p=0.04 or p<0.05). Therefore, the prevalence of gastrointestinal nematodes was higher in female (78%) than male (22%) as reported in Table 4 below.

Table 4: Prevalence of gastrointestinal nematodes related with sex based risk factors.

Sex	No of animal examined	No of positive animal	X2 value	P value
Male	72	39 (22.0%)	4.204055	0.040
Female	204	138 (78.0%)		

Of all sheep and goats examined in six selected kebeles in study area, samples from legama, Tadisa, Madalicho, Yukar, Dubbo and Woyibo were taken. This study revealed that Yukar (20.9%) had high prevalence rate than Legama (16.9%), madalicho (16.4), Dubbo (15.8%) and Woyibo (15.8%), Tadisa (14.1%). The prevalence of gastrointestinal nematodes in small ruminants in Legama was recorded as second to yukar. The rate of prevalence in Dubbo had equal proportion with rate of prevalence in Woyibo. The prevalence of gastrointestinal nematodes in small ruminants in Tadisa was low recorded than other five selected sites in study areas. However, there was no statistically significant difference between origin of animals sampled (p value=0.173) as described in Table 5.

Table 5: Prevalence of gastrointestinal nematodes related with origin of animals.

Risk factors		No of examined	NO (%) positive	X^2	P value
Origin	Legama	46	30 (16.9%)	7.702	0.173
	Tadisa	46	25 (14.1%		
	Madalicho	46	29 (16.4%)		
	Yukar	46	37 (20.9%)		
	Dubbo	46	28 (15.8%)		
	Woyibo	46	28(15.8%)		

In this study, the body condition was recorded as good, medium and poor. The study described that the good body conditioned animals 49 (27.7%) were least susceptible than that had medium 76 (42.9%) and poor body condition 52 (29.4%). In addition to that the gastrointestinal nematode infestation was highly prevalent in the medium body condition animals than in good and poor body condition animals. There was statistically variation among body condition animals (p value =0.00) in Table 6 below.

Table 6: Prevalence of gastrointestinal nematodes in small ruminants related with body condition based risk factors.

Body condition	No of animal examined	No of animal positive	X^2	P value
Good	104	49 (27.7%)	21.048	0.00
Medium	103	76 (42.9%)		
Poor	69	52 (29.4%)		

The seven age groups of animals were recorded in this study area. Relatively high prevalence of nematodes was found in animals of age under age one year 34 (19.2%) and 39 (22%) four year than other age groups of the animals. The group of animals under age seven (2.8%) was least prevalent of gastrointestinal nematodes in study area. There was no statistically significant variation between age of the study animals (P =0.275) in Table 7.

Table 7: Prevalence of gastrointestinal nematodes in small ruminants related with body condition based risk factors.

Age	No of animal examined	No of animal positive	X^2 value	P value
1	55	34 (19.2%)	7.326	0.275
2	46	27 (15.3%)		
3	33	26 (14.7%)		
4	66	39 (22.0%)		
5	45	30 (16.9%)		
6	26	16 (9..0)		
7	5	5 (2.8%)		

Discussion

The present study revealed that overall prevalence of gastrointestinal nematodes in small ruminants was 64.1%. This result coincides with the result of Tsegaye et al [19] (61.0%) at Gimbo district, Kaffa Zone, South West Ethiopia. This result is in disagreement with the result of Samuel *et al.,* [20] (88.6%) in and around Dire Dawa, Eastern Ethiopia. The difference of findings could be occurred due to difference in sample size taken and, ecological and climate diversity as well as the existing host range [7].

Based on the egg type in the present study, the proportion of *Strongyle* is significantly higher (P <0.05) in sheep than goats. This observation is in agreement with Lemma and Birhanu [21], in and around Asella South Eastern Ethiopia. Present study disagreed with reported that the previous study Tigist et al., [22] in three districts of Kaffa and Bench Maji Zones, Southwest Ethiopia in that the prevalence of *Strongyle* infection in sheep and goats showed no significant (*P* >0.05) variation. Both sheep and goats have equal chance to acquire the infective larvae of Strongyle. This might be due to similarities in agroecology and in management of both sheep and goats.

The higher prevalence rate in sheep compared with prevalence rate in goats. In this study, there was no statistically significant difference (p=0.511) in prevalence between species of animals. This study agreed with reported from Anteneh and Sagni, [23] in Guto Gida District, East Wollega, Ethiopia, but there was statisticifically difference between species (P<0.05) due to different habit of grazing in this previous study. However, it contradicts with reported from Golo *et al.,* [24] prevalence between species of animals as goats were 2.821 times more likely to be positive for GIT parasite than sheep and contradicts with reported from Fikru *et al.,* [25] in Eastern Ethiopia that higher parasite prevalence is more common in goats than in sheep due to most of the goats were from lowland and mid altitude areas, which are thought to be suitable for survival of the larval stage of the parasite.

The high prevalence rate of gastrointestinal nematodes in female compared with male. In the present study, there was statistical association between sexes of animals. This study agreed with reported from Kemal and Minda, [26] in Sinana and Dinsho Districts of Bale Zone, South Eastern Ethiopia; Dagnachew *et al.,* [27] in selected sites of North Gondar Zone, Northwest Ethiopia. This might be due to females are more prone to parasitism during pregnancy and per-parturient period due to stress and decreased immune status (p<0.05). This finding disagreed with previous reported from Jiregna *et al.,* [28]; Abebe *et al,* [29];

Samuel *et al.,* [20] in that gastrointestinal nematodes affecting both sex groups equally due to having similar ecology and management system.

During this study, it was observed that the body condition had significant effects on the prevalence of gastrointestinal nematodes ($p<0.05$). Prevalence was relatively higher in goats and sheep with medium body condition 76 (42.9%) followed by the animals with poor 52(29.4%) and good body condition 49 (27.7%). The present study coincides with reported from Tigist *et al.,* [22] in three districts of Kaffa and Bench Maji Zones. This study disagreed with reported from Getachew *et al.,* [30] in Tullo District, Western Harerghe, Ethiopia in that good body conditioned animals were less affected than medium body conditioned animals and poor body conditioned animals due to a better immunity in animals with good body conditions. In addition to that the present finding disagreed with the reported from Rahmeto *et al.,* [31] in Tangil Bangladesh that animals with poor body condition had higher gastrointestinal nematodes due to compromised immune response to infection in poor body condition animals than medium body conditioned animals.

The higher prevalence rate was recorded in younger and medium age than enough old age groups of animals. This study showed no statistically significant difference ($P>0.05$) between age. This finding is in agreement with reports from Getachew *et al.,* [30], Tullo Districts, Western Harerghe, Ethiopia indicated GIT nematodes affect both ages equally and there are instances where younger animals were reported with high rate of parasitic infection. This finding is disagree with finding of Gedefaw *et al.,* [32] in Andabet District of North West Ethiopia, in that the prevalence of gastrointestinal nematodes was higher in young age than adult due to young animals ($p<0.05$) are highly susceptible due to immunological immaturity and unresponsiveness. However, with present study I ascribed the absence of significant difference in parasites infection between ages of animals. This might be as a result of equal chance of exposure for all age groups to the infective stage of the parasite as all are allowed to graze under semi-intensive management system.

In the present study, there was no statistically association between location and prevalence of gastrointestinal nematodes in small ruminants. This result coincides with result of Temesgen A. and Walanso I. [16] in and around Ambo town of Central Oromia, Ethiopia. This might be due to relative similarity in agro-ecology between study locations. This finding disagreed with reported from Jemal *et al.,* [33] in Haramaya District, Eastern Ethiopia. This might be due to owner's awareness to deworm their animals among selected sites of the study area.

Conclusion and recommendations

The gastrointestinal nematode parasites are livestock health problems including for small ruminants and are responsible for economic losses due to reduced production, morbidity and mortality. Parasitological laboratory examination for analyzing of gastrointestinal nematode eggs in small ruminants of present study showed that the animals harbored high prevalence of nematode parasites. However, the prevalence rate in present study was lower than previous study in the study area. Among considered risk factors, sex, body condition had significance difference with prevalence of nematode parasites. The infection was found higher in animals with medium body conditions than poor and good body conditioned small ruminants. In addition to that present study indicated that the parasitic infections in was highly prevalent in female than male. Thus, based on above conclusion, the following recommendations were suggested:-

- Community awareness creation should be practices regarding to control and prevention approaches on gastrointestinal nematodes in small ruminants.
- Strategic treatment of small ruminants with anthlmentics should be practiced to minimize the impact of gastrointestinal nematodes on the health of animals.
- Parasitic control and prevention should be implemented in the area.
- The attention should be given to animals with medium and poor body condition in order to control nematode infections.
- The control approaches should be used in female small ruminants by great care.

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