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# Prevalence and Associated Risk Factors of Gastrointestinal Parasites in Small Ruminants in Three Agro-Ecological Districts of Arsi and East Shoa Zones, Central Ethiopia

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**Abstract:** Small ruminants represent the most important part of Ethiopian livestock system A cossectional study was conducted from November to May 2018 in the two zones of Oromia regional state namely Arsi and east Shoa zones of central Ethiopia. The association with risk factors such as agro-climate, species, sex, age and body weight was determined in the current study. Coprological examination was conducted on 601 small ruminants (386 sheep and 215 goats) selected from Guna, Abomsa and Lume districts. Out of the total 601 shoats (386 sheep and 215 goats) examined, 302 sheep and goats (50.25%) were harboring one or more GIT parasites. The predominant GIT parasites identified in sheep and goats in the study areas were strongyle, strongyloides, coccidia, monesia, paraphistomum, fasciola and trichuris with the prevalence of 34.28%, 18.30%., 14.81%, 7.34%, 3.33%, 2.00% and 1.8%, respectively. This study revealed that statistically significant variation in prevalence of GIT parasites was only seen between body weight in which those with poor body weight were 2.1 times more likely to be affected by gastrointestinal parasites than those with good body weight (*OR*: 2.09973; CI=1.491961 - 2.955082, *P* = 0.000). Preliminary prevalence study has indicated that control strategy against these parasites could be scheduled. Therefore, on these bases of this study it is recommended that further studies should be conducted on seasonal importance of GIT parasites in shoats in the study areas for the successful implementation of GIT parasites control.

**Key words:** Sheep · Goats · GIT Parasites · Prevalence · Central Ethiopia

## INTRODUCTION

The livestock subsector has an enormous contribution to Ethiopia's national economy and livelihoods of the citizens. The subsector contributes about 16.5% of the national Gross Domestic Product (GDP) and 35.6% of the agricultural GDP [1]. It also contributes 15% of export earnings and 30% of agricultural employment. The livestock subsector currently support and sustain livelihoods for 80% of all rural population of which small ruminants account for about 22% [2]. Small ruminants represent the most important part of the Ethiopian livestock system, about 24.2 million sheep and 22.6 million of goats reported in the country. In this country small ruminants are reared in all agro climatic zones. The highland area comprises 75% of the sheep and 27% of the goat population, while the lowland pastoral and agro pastoral areas have 25% of the sheep and 73 % of the goats' population [3].

Small ruminants are very important for resource-poor smallholder systems of rural Ethiopia due to their ease of management, short generation cycles and high reproductive rates which lead to high production efficiency and significant role in provision of food and generation of cash income. Sheep and goats are serving as a living bank for many farmers, closely linked to the social and cultural life of the resource poor farmers and provide security in bad crop years [4]. The annual national mutton and goat meat production is 77 and 62 thousand metric tons, respectively.

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Sheep and goats contribute 13.9% and 11.2% of the total meat production respectively. The share of small ruminants of the total milk output is estimated to 16.4% and Ethiopia exports 155, 000 heads of livestock particularly the small ruminants annually [5]. Small ruminants are important component of livestock sector of Ethiopia and valued for a variety of fundamental contributions in lives of pastoral and farmers' households. Thus, they reared by farming community with several objectives to meet the socio-economic and cultural need. Small ruminants play a crucial role in financial security, women's empowerment and insurance. They are also important in a diversification strategy that aims to reduce market and climatic risks and optimize the use of available resources.

However, their potential contribution is constrained by animal health problems such as endoparasitic infections [6]. Among the diseases that constrain the survival and productivity of sheep, gastrointestinal parasites infection ranks highest on a global index [7]. Gastrointestinal parasite infections have greater impact in Ethiopia due to the availability of a wide range of agro-ecological factors suitable for diversified hosts and parasite species [8]. Endoparasites are responsible for the death of one-third of lamb's considerable losses of parts of carcasses condemned during meat inspection [9]. Even though, Ethiopia endowed with large number of sheep and goats population, little attempts has been made in the past to study the health aspect of these animals. Lack of well sound data on the magnitude, distribution and predisposing factors of small ruminant GIT helminthes in the study areas initiated this study project. Therefore, the main objectives of this study were to identify the major GIT parasites of small ruminants and to compare the prevalence of those parasites in the study areas in relation to different risk factors.

## MATERIALS AND METHODS

**Study Areas:** The study was conducted in two zone of Oromia regional state namely Arsi and east Shoa zones of central Ethiopia. Guna and Abomsa districts were selected from Arsi zone and these two districts are located in central part of Ethiopia 230 km and 200 km far from Addis Ababa at an elevation of 2786 to 2800 and 1274 to 1503 meters above sea levels respectively. From east Shoa zone Lume district was selected for study. Lume district is located in central part of Ethiopia 75 km far from Addis Ababa and at an altitude 1624 meters above sea levels. From each district three peasant associations (PAs) were randomly selected with various proportions of samples from each nine PAs.

**Study Animals and Sampling Methods:** Coprological examination was conducted on 601 small ruminants (386 sheep and 215 goats) selected from Guna, Abomsa and Lume districts from October 2018 to May 2018. The study animals were kept under extensive traditional management system by rural households in which animals were allowed to graze on natural pasture freely during daytime and kept in open enclosure or house during the night.

**Sample Size Determination and Sampling Technique:** The desired sample size for the study was calculated using the formula given by Thrusfield (10) with 95% confidential interval and 5 % absolute precision.

$N = 1.962 * P \exp (1-Pexp) / d^2$,

where; n = sample size, Pexp = expected prevalence, $d^2$ = absolute precision (5%).

There was no previously published and documented prevalence in the study area. Therefore, sample size was calculated using expected prevalence of 50% by substituting the value, the required sample size was calculated to be 384 but to increase the precision 601 samples were collected. Simple random sampling technique was employed for selection of animal in study areas in the zone.

**Faecal Sample Collection and Examination:** Approximately 10 g of faecal samples were collected directly from the rectum of selected animal and kept in screw capped universal bottles. The bottles were then labeled with unique identification number of animals and labeled and fecal samples was preserved by potassium dichromate and transported it to Asella regional veterinary laboratory for coprological investigation. During faecal sample collection, information regarding the sex, age, species and body condition of individual animal was recorded using recording formats. Age of each animal was determined by dentition as described by Girma and Alemu [10] and categorized as young (less than 1 year old) and adult (greater than 1year old). Body condition of each sampled animal was carried out according to the method described by Girma and Alemu [11] and categorized in to two scores as poor and good.

The collected faecal specimens were processed and examined by direct faecal floatation technique for qualitative investigation of the types of gastro-intestinal nematode eggs and coccidian oocysts.

**Statistical Analysis:** The data were analyzed by using STATA software, version 11. Descriptive statistics was used to determine the prevalence of the parasites and Chi-square test $\chi^2$ was used to assess the association of the potential risk factors with the prevalence of the parasites and logistic regression was also used to assess the strength of association.

## RESULTS

**Overall Prevalence:** Out of 601 animals (386 sheep and 215 goats) examined, 302 (50.25%) were harboring one or more GIT parasites.

**Prevalence of Helminth Parasites by Agro-Ecology:** Among the three agro-ecological zones; insignificant difference (P>0.05) was found in the distribution of gastrointestinal helminth infections of the examined animals between highland, midland and lowland areas. The highest prevalence of helminthiasis was found in Guna (highland) then Abomsa (midland) and followed by Abomsa (lowland).

**Prevalence of Helminth Parasites by Host and Genera of Parasites:** The prevalence of gastrointestinal helminthes was higher in sheep than goats but not significantly different as shown in Table 3. The predominant GIT parasites identified in sheep and goats in the study area were strongyle, strongyloides, coccidia, monesia, paraphistomum, fasciola and trichuris with prevalence of 34.28%, 18.30%., 14.81%, 7.34%, 3.33%, 2.00% and 1.8% respectively (Table 2).

Table 1: Summary of the prevalence of gastro intestinal parasites in districts of Arsi and East Shoa zones

| District (agro-ecology) | No. of animals examined | Total no of animals affected | Overall prevalence (%) |
|---|---|---|---|
| Guna (highland) | 200 | 116 | 58 |
| Lume (midland) | 199 | 102 | 51.26 |
| Abomsa (lowland) | 202 | 84 | 41.58 |
| Total | 601 | 302 | 50.25 |

Table 2: Over all gastrointestinal parasite species isolated from Arsi and East Shoa zones

| Parasite species | Total no. of isolated parasites | Prevalence (%) |
|---|---|---|
| Strongyle | 206 | 34.28 |
| Strongyloides | 110 | 18.30 |
| Ascaris | 18 | 3.00 |
| Trichuris | 11 | 1.83 |
| Fasciola | 12 | 2.00 |
| Paraphistomum | 20 | 3.33 |
| Monesia | 44 | 7.32 |
| Coccidia | 89 | 14.81 |

Table 3: Risk factors associated with prevalence of gastro intestinal parasites

| Risk factors | Category | No. of examined | No. positive | Prevalence (%) | P-value |
|---|---|---|---|---|---|
| Districts | Guna | 200 | 116 | 58 | - |
| | Lume | 199 | 102 | 51.26 | 0.996 |
| | Abomsa | 202 | 84 | 41.58 | 0.245 |
| Species | Ovine | 386 | 212 | 54.92 | - |
| | Caprine | 215 | 90 | 41.86 | 0.568 |
| Sex | Female | 444 | 217 | 48.88 | - |
| | Male | 157 | 85 | 54.14 | 0.391 |
| Age | Young | 162 | 84 | 51.85 | - |
| | Adult | 439 | 218 | 49.66 | 0.794 |
| Body condition | Good | 318 | 132 | 41.51 | - |
| | Poor | 283 | 170 | 60.07 | <0.001 |

Table 4: Multivariable logistic regression model of risk factors for gastrointestinal parasites

| Risk Factor | Category | Odds Ratio | [95% Conf. Interval] | P-value |
|---|---|---|---|---|
| District | Guna | | | |
| | Lume | 1.001202 | .6529094 1.53529 | 0.996 |
| | Abomsa | .660829 | 328821 1.328063 | 0.245 |
| Spp. | Ovine | | | |
| | Caprine | .8340758 | .4473543 1.555104 | 0.568 |
| Sex | Female | | | |
| | Male | 1.183332 | .8055648 1.738251 | 0.391 |
| Age | Young | | | |
| | Adult | .9509015 | .6521578 1.386495 | 0.794 |
| Bcs | Good | | | |
| | Poor | 2.09973 | 1.491961 2.955082 | <0.001 |

**Prevalence of Helminth Parasites in Male and Female Small Ruminants:** Relatively higher prevalence of helminthiasis was observed in male animals (54.14%) compared to female (48.88%) but the difference was not significant (P>0.05) as indicated in Table 3.

**Prevalence of Helminth Parasites by Age of Animals:** Younger animals tend to be more susceptible to helminthiasis as compared to adults. However, these differences were not significant (P>0.05). In general during the study period prevalence was assessed between the risk factors. By chi square ($X^2$) and logistic regression analysis there was statistically significant difference (P<0.05) with body condition to GIT parasites infection, but in the case of study area, species, sex and age there was no significant difference (P>0.05) (Table 3).

The study revealed statistically significant variation in prevalence of GIT parasite between body condition in which those with poor body weight were 2.1 times more likely to be affected by gastrointestinal parasites than those with good body weight (*OR*: 2.09973; CI=1.491961 - 2.955082, *P* = 0.000) (Table 4).

## DISCUSSION

The present study revealed an overall prevalence of GIT nematode parasites in the small ruminants to be 50.25%, with 54.92% and 41.86% in sheep and goats, respectively. This finding is in line with the findings of Ahmed, *et al*. [12] in Haramaya district, Eastern Hararege, 2017 (57%); Tigist, *et al*. [13] in Benchi Maji district, South west Ethiopia, 2018 (54.1%) and Bifaw, *et al*., 2018 (56.8%) in Humbo District, Wolaita Zone, Ethiopia, who reported the prevalence of gastrointestinal nematode in small ruminants [14]. This study is significantly higher than the previous study of Muluneh, *et al.* [15], at Dembia district, North West, Ethiopia (43.2%); Petros, *et al*. [16], in Kuarit district, North West Ethiopia (44.90%) and Andualem, *et al.* [17] in North East Ethiopia (42.2%), who reported the prevalence of gastrointestinal parasites of small ruminants.

The investigation of different putative risk factors of helminth infection showed that body weight was found to be important in determining levels of infection of gastrointestinal parasite in the study areas. In the current study significant higher prevalence of shoats gastrointestinal parasites were recorded in poor body condition than good body condition. This finding agrees with Temesgen [18], Keyyu, *et al.* [19], Sissay [20]. In addition, Radiostits, *et al.* and Odoi, *et al.* [21, 22] indicated that animals with poor condition are highly susceptible to infection and may be clinically affected by worm burdens too small to harm and otherwise well-fed healthy animal. Moreover, Kumba, *et al.* [23] observed that a well-fed animal was not in trouble with worms and usually a poor diet resulted in more helminth infections. Furthermore, helminthes also led to a loss of appetite and poor utilization of food, which results in a loss of body weight. Well-fed animals develop good immunity that suppresses the fecundity of the parasites and animals with good body condition had lower prevalence of gastrointestinal parasites than those with poor body condition [24]. But animals with poor body condition have weak immunity compared to others and might be resulted from malnutrition or other concurrent disease that suppress the immunity [25].

Gastrointestinal helminthiasis was found prevalent in the three agro-ecological areas but with variable levels of infection and with insignificant association (P>0.05). The probable reasons of decreased infection of gastrointestinal helminthes in the present study may be due to the unfavorable environmental factors for the development and growth of most helminth species [26, 27]. Most of the helminth species are susceptible to desiccation in dry climatic conditions that results from the high temperature at which even eggs fail to develop

into L3 [28, 29, 30] as a result, in this study comparatively that might be the reason for high prevalence of gastrointestinal parasite in the highland and midland than lowland (moisture stressed area) agro-climate. This study revealed that there was a higher prevalence of GIT parasite in sheep than in goats, however statically there was no significant association ($p>0.05$) between species of the host animals. This observation is consistent with the assumption of earlier works in the other parts of Ethiopia [31, 32] which shows GIT- parasites prevalence is more common in sheep than in goats due to the grazing habit of sheep. In reality sheep have exposure to communal grazing lands that have been contaminated by feces of infected animals [33]. Unlike this finding the prevalence of helminthiasis both in sheep and goat is comparable but relatively higher in goats which varied from other reports [34, 35]. This variation might be associated to the practice of grazing sheep and goat together in the same area so that goats may acquire more susceptibility for the same species of parasite infection.

Prevalence of GIT parasites in s mall ruminants with regard to sex group in the current study was 48.88% in female and 54.14% in male, however there was no statistically significant difference of GIT parasite infections between sex group of animals ($P>0.05$). This finding was in agreement with the reports of Tefera, *et al*. [36] and Fikru, *et al*. [8] which showed sex of animals did not show significant association with the prevalence of GIT parasites in small ruminants. However, this observation disagrees with the work of Thrusfield [10], Bashir, *et al*. [37] and Mihreteab and Aman [36] who reported higher prevalence of GIT- nematodes in females than in males.

Prevalence of GIT parasites in small ruminants with regard to age in the present study was 51.85% in young and 49.66% in adult without statistically significant difference ($P>0.05$). This finding agrees with other studies carried out in Northern Gondar, Ethiopia in which significant association was not observed in age [38]. This result also coincides with the study conducted on the epidemiology of gastrointestinal nematode in Sheep and Goats in Ghana [39] as young animals are more vulnerable to the infection. This might be due to having weak immunity to resist infection [40, 41].

## CONCLUSIONS AND RECOMMENDATIONS

Arsi and east Shoa zones have large number of small ruminants that are managed under extensive management system in mixed farming system and serves as a source of food and cash income generation for rural society of these areas. But the animals were affected by different helminth parasites such as strongyle, strongyloides, coccidia, monesia, paraphistomum, fasciola and trichuris parasites and sometimes by mixed parasitic infection which causes loss of production, reducing growth rate and death of small ruminants due to lack of proper management like regular deworming and improper feeding. In the current study significant higher prevalence of shoats gastrointestinal parasites were recorded in poor body condition than good body weight.

Based on the above conclusion the following recommendations are forwarded:

- Preliminary prevalence study has indicated that control strategy against these parasites could be scheduled. The most effective strategies to control the parasites are usually those based on a thorough knowledge of the species of parasites present, their seasonal availability and of the weather conditions in a particular area. On these bases, it is recommended that further studies should be conducted on the economic importance of GIT parasites in shoats in the study areas for the successful implementation of GIT parasites control.
- Systematic deworming with appropriate anthelminthics is recommended to reduce the parasitic burden and to minimize pasture contamination with larvae by treating flock rather than individual animal but separately with special consideration to those of poor body condition because such animals are more predisposed to GIT parasitic infections.

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