

Full Length Research Paper

Major gastrointestinal helminth parasites of grazing small ruminants in and around Ambo town of Central Oromia, Ethiopia

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Received 17 September 2014; Accepted 1 December 2014

A cross-sectional survey was conducted to estimate the prevalence of small ruminant helminthosis and associated risk factors in and around Ambo town of central Oromia, Ethiopia between February and May, 2013. A total of 120 small ruminants were examined using standard parasitological procedures. The study showed that 49.2% of the study animals were found to harbor eggs of one or more gastrointestinal helminth parasites. Both sheep and goats have been shown to harbor strongyle species, *Fasciola* and mixed infections. The dominant helminth parasites observed in infected animals were strongyle species (81.4%). In addition, lower infection rate of *Fasciola* of 10.2% and mixed infections of 8.3% were found. The species level prevalence of the parasites was 47.8% (43/90) and 53.3% (16/30) in sheep and goats, respectively. Though the infection rate of gastrointestinal tract (GIT) parasites was higher in goats than sheep, the difference was statistically insignificant ($P>0.05$). Moreover, statistically insignificant association ($P>0.05$) was observed between animal species and infection with strongyles species, *Fasciola* or mixed infections. In this survey, no statistically significant effect ($P>0.05$) of animal sex, age, location and management system on prevalence of the helminth parasites was observed. However, prevalence significantly varied ($\chi^2=15.16$; $P=0.000$) among different body condition scores. Animals with thin (OR=9.24, 95% CI: 2.70-31.57) and moderate (OR=5.10, 95% CI: 1.70-15.26) body condition scores were associated with high relative risk of infection with GIT helminth parasites than fat animals. In conclusion, body condition score was found to be the potential risk factor and should be considered during designing control measures against helminthosis of small ruminants in the study area.

Key words: Helminth parasites, prevalence, coprological examination, small ruminants, Ambo, Oromia.

INTRODUCTION

Small ruminant population of Ethiopia is about 48 million of which 26 million is sheep and 22 million is goat (CSA,

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2008). Small ruminants provide about 46% of the national meat consumption and 58% of the value of hide and skin production (Awgichew et al., 1991). They have many advantages over large ruminants for most smallholder farmers, including among others: less feed costs, quicker turnover, easy management and appropriate size at slaughter (Abegaz, 2002; Donkin, 2005). Nevertheless, small ruminant productivity is still low compared to the population due to poor nutrition, diseases and 'poor' genetic make-up of the indigenous stock (Tibbo et al., 2004).

Among diseases, helminthosis constitutes one of the most important constraints to small ruminant production in Ethiopia (Tibbo et al., 2004; Zeryehun, 2012). Studies conducted on ruminant helminthosis of various regions of Ethiopia have revealed a prevalence range from 47.67 to 84.1% (Demelash et al., 2004; Regassa et al., 2006; Dagnachew et al., 2011). The pervasive occurrence of parasitic infections in grazing animals, the associated loss of production, the cost of anthelmintics, death of infected animals and increasing frequency of drug resistance are all major concerns (Singla, 1995; Tibbo et al., 2004; Odoi et al., 2007).

In Ethiopia, helminthosis is responsible for 25% mortality and 3.8% weight loss in highland sheep and causes an estimated annual loss of about 700 million Ethiopian birr (Ngategize et al., 1993). Helminthosis is associated with enormous losses due to condemnation of affected organs at slaughter (Kumsa and Wossene, 2006). Several previous studies conducted in different parts of Ethiopia have revealed that the most common genera of parasitic helminths of small ruminants are *Haemonchus*, *Trichostrongylus*, *Oesophagostomum*, *Bunostomum*, *Strongyloides*, *Fasciola* and *Trichuris* (Regassa et al., 2006; Kumsa and Wossene, 2006; Kumsa and Bekele, 2008).

The incidence of helminth parasite infections varies greatly area to area depending on the relative importance of many factors like nutrition status, pasture management, climatic condition, animal immunity and host preference (Singla 1995; Radostits et al., 2006). To better identify appropriate control strategies for helminth control of small ruminants in the smallholder systems, it is important to investigate the burden of small ruminant helminthosis and identify specific risk factors that are unique to this area and farming system. To the knowledge of the authors, no information published in refereed scientific journals on the burden of gastrointestinal tract (GIT) helminth infections of small ruminants in and around Ambo town is available. This study was, therefore, designed to investigate the magnitude, and composition of helminths of small ruminants in and around Ambo town in central Oromia Regional State of Ethiopia. In addition, an attempt was made to identify the possible risk factors associated with the occurrence of infections in small ruminants that may help to devise effective control measures against the parasites in the study area.

MATERIALS AND METHODS

Study area

This study was conducted between February and May, 2013 in Ambo town of West Showa zone in Oromia Regional State, Ethiopia. Ambo town is the capital of West Showa administrative zone of the Oromia Regional State. The town is located at 114 km away from Ethiopian capital, Addis Ababa, to the west of the country. The town is located at altitude of 2,185 meter above sea level (masl). The geographical location of Ambo town is approximately between 8°56'30"N and 8°59'30"N latitude and between 37°47'30"E and 37°55'15"E longitude. Based on 20 year meteorological data, the mean annual temperature, the annual maximum and the annual minimum temperatures of the area were about 18.8, 26 and 10.76°C, respectively (Nemomsa, 2013). The mean annual rainfall is about 1,143 mm and the highest rainfall occurs from June to September. The town and its surrounding areas are dominated by Eucalyptus trees. Major soils of the area are vertisols consisting of 67% clay, 18% silt, 15% sand and 1.5% organic matter (Nemomsa, 2013). According to the National Population and Housing census carried out in 2007, the population of the town was 67,514, out of which 34,276 (50.8%) were males and 33,238 (49.2%) were females (CSA, 2007). During the study period, there were approximately 112,236 heads of cattle, 24,966 heads of sheep and 16,399 heads of goats in Ambo district. In the study area, ruminants are managed by communal holding of all species such as cattle, sheep, goats and equines together. The urban agricultural activities are dominated by livestock production like medium (>5 dairy animals) and smallholder (<5 dairy animals) dairy farming (Lemma et al., 2001), animal fattening, and sheep and goat farming.

Study animals and their management

The study animals were two populations of small ruminants managed under extensive smallholder and semi-intensive husbandry systems. On one hand, small ruminants belonging to smallholder farmers found in and around Ambo town that were kept under traditional extensive management system were used. In the study area, ruminants were allowed to graze on communal or private owned pasture land without provision of supplementary feeds except some leftover foods. The major feed resources in the area were natural pasture, hay, crop residues and crop-aftermath and tree/shrub fodders. The major crop residues fed to animals by majority of the farmers were teff, maize, and sorghum. Planting forages was not common. The animals were housed in houses with muddy grounds roofed with either hay or corrugated iron. Strategic de-worming was not practiced by the farmers of the area, but animals were often treated with chemicals when clinical helminthosis was evident.

On the other hand, all small ruminant animals kept at Ambo University farm at the time of the study were also included as study animals. The animals were managed under semi-intensive management system in which they were kept on grazing pasture during the day and housed during the night in sheltered pens. They were vaccinated against ovine pasteurellosis and sheep pox annually and were de-wormed with albendazole bi-annually before and after the main rainy season. The last drenching of the animals was performed in October of the previous year. Individual animals were treated against any infectious diseases. To determine the body conditions of the study animals, body condition scoring system developed by Ethiopian Sheep and Goat Productivity Improvement Program was used (ESGPIP, 2008). Age groups were categorized into young (<1 year), adult (1-4 years) and old (>4 years) based on farmers response and observations made during sampling. The number of goats included in the present study was

Table 1. Prevalence of small ruminant gastrointestinal tract parasites in sheep and goats in Ambo town during the study period.

Species	No. exam	No. positive (%)	Type of parasites		
			Strongyles (%)	<i>Fasciola</i> (%)	Mixed infection (%)
Sheep	90	43 (47.8)	36 (40.0)	4 (4.4)	3(3.3)
Goats	30	16 (53.3)	12 (40.0)	2 (6.7)	2 (6.7)
Total	120	59 (49.2)	48 (40.0)	6 (5.0)	5 (4.2)

low compared to sheep because of the low population of goats reared in the study area.

Study design and sampling

A cross-sectional study design was used to collect random samples from the study animals to address the objectives of the study. Simple random sampling was used to select study locations in and around the town, while Ambo University livestock farm was included purposively. Households owning small ruminants were identified based on data obtained from district office of agriculture and 24 households (farms) who were willing to participate in the survey were selected and every animal in the selected farms were included as study animals. Accordingly, 98 animals were sampled from animal populations owned by smallholder farmers (the average number of small ruminants per farm was 4.0) and the remaining 22 animals were sampled from university farm.

Parasitological examination of specimens

Random fecal samples were collected directly from the rectum of the study animals using disposable plastic gloves and placed in plastic fecal bags that were then labeled. The collected samples were preserved in 10% formalin and dispatched to Veterinary Laboratory of Ambo University for coprological investigations. Parasitological examination was done by direct smear and flotation techniques following the standard procedures for nematode parasites (Hansen and Perry, 1994). In addition, for eggs of liver flukes, coproscopic examination was performed according to the sedimentation technique described by Hansen and Perry (1994). As *in vivo* identification of infections relies on the microscopic detection of parasite eggs in host faeces (Gareth, 2009), the collected fecal samples were processed and examined under the 10x magnification. Parasite eggs were identified using keys given by Soulsby (1982). Speciation of the parasites was not carried out due to laboratory capacity reasons.

Data management and analysis

All the data obtained from the study were entered into MS Excel data sheets and coded. The coded data were imported and analyzed using SPSS version 16.0 (SPSS, Inc. Chicago). Percentages (%) were used to measure prevalence of the parasites as described by Hansen and Perry (1994) and chi-square (χ^2) was used to measure associations between prevalence and the various independent variables including species of the animals, age, sex, location, management system and body condition scores. Fisher's Exact Test was used to measure associations between prevalence and variables that have less than 5 numbers of observations. Univariate logistic regression analysis was conducted to examine the relationship between the outcome variable and the different explanatory variables. Regression coefficients were used to

estimate odds ratios for each of the independent variables. Odds ratios (OR) with 95% confidence intervals (CI) were used to assess the level of association of the dependent variable and independent variables. In all the analyses, a 95% confidence interval and P-value of less than 0.05 ($P < 0.05$) was set for significance of statistical associations between the dependent and independent variables.

RESULTS

Overall prevalence of helminthosis

The present study showed that 49.2% (n=59) were found to harbor one or more GIT parasite eggs. About 81.4% of these infected animals were found to harbor strongyle species and 10.2% were harboring only *Fasciola* species. In addition, 8.5% of the study animals were found to harbor mixed infections of strongyle and *Fasciola* parasites.

Prevalence of helminth parasites by animal host and parasite species

Coprological examination in both sheep and goats have shown the presence of strongyle species, *Fasciola* and mixed infections with the two types of parasites. The species level prevalence of the parasites was 47.8% (43/90) and 53.3% (16/30) in sheep and goats, respectively (Table 1). Though the infection rate of gastrointestinal helminths was higher in goats than sheep; the difference was not statistically significant ($P > 0.05$) between the two species. In addition, no statistical association ($P > 0.05$) was observed between animal species and infection with strongyle species, *Fasciola* and mixed infections.

Prevalence of helminth parasites by animal sex and age groups

Prevalence of helminth parasites of 50.0 and 48.3% were found in male and female animals, respectively. No statistically significant difference ($P > 0.05$) in prevalence was observed between different sexes. In addition, no effect of sex on prevalence of infection was detected within particular species of the study animals. Moreover,

Table 2. Overall and specific helminth parasite prevalence in different age groups of small ruminants in the study area.

Age	No. exam	No. positive (%)	Type of parasites		
			Strongyles (%)	<i>Fasciola</i> (%)	Mixed infections (%)
Young	62	30 (48.4)	26 (41.2)	2 (3.2)	2 (3.2)
Adult	42	17 (40.5)	13 (30.9)	1 (2.4)	3 (7.1)
Old	16	12 (75.0)	9 (56.2)	3 (18.7)	0 (0.0)
Total	120	59 (49.2)	48 (40.0)	6 (5.0)	5 (4.2)

Table 3. Prevalence and risk factors of GIT helminth parasites in small ruminants at Ambo town during the study period.

Factor	Categories	No. exam	No. positive	Prevalence (%)	χ^2	P value	OR	95.0% CI (OR)
Location	Kebele 01	34	18	53.3	0.872	0.832	-	-
	Kebele 02	34	15	44.1				
	AU farm	22	10	45.4				
	Teltele	30	16	53.3				
Body condition score	Thin	26	21	80.7	15.75	0.000	9.24	2.70-31.57
	Moderate	62	28	45.2		-	5.10	1.70-15.26
	Fat	32	10	31.2		-	-	-
Management type	Extensive	98	49	50.0	0.149	0.700	-	-
	Semi-intensive	22	10	45.4		-		

*AU: Ambo University.

though the overall prevalence of helminth infection was found to be higher in old animals (75.0%) compared to adult (40.5%) and young (48.4%) animals; no statistically significant differences ($P>0.05$) were observed between the age categories (Table 2). Besides, the present study did not find statistically significant association ($P>0.05$) between the different age groups and prevalence of the different parasites considered.

Prevalence of helminth parasites by body condition, location and management type

Concerning the prevalence of helminth infections in different body conditioned animals, higher prevalence was observed in thin (80.7%) than moderate (45.2%) and fat (31.2%) animals. Thus, a significant association ($\chi^2=15.75$; $P=0.000$) in prevalence was shown among animals with different body condition scores. Consequently, animals with thin and moderate body condition scores were associated with a high relative risk of being infected with GIT helminth parasites than fat animals. On the other hand, no statistically significant association was observed between parasite infection rate and different locations ($P>0.05$). Moreover, in the present

study, type of management system did not significantly influence ($P>0.05$) the prevalence of infections in study animals (Table 3).

DISCUSSION

The present study revealed the overall prevalence of GIT helminth parasites of small ruminants to be 49.2%. The overall prevalence found in the current study is consistent with the findings of Kumsa and Wossene (2006) and Dagnachew et al. (2011) who reported similar prevalence of small ruminant helminthosis from East and North Ethiopia, respectively. Nevertheless, the overall prevalence in the present study is lower than reports of Regassa et al. (2006), Fufa et al. (2009), Bitew et al. (2011), Kumsa et al. (2011), Zeryehun (2012) and Ibrahim et al. (2014) from different regions of Ethiopia. The difference, among others, could be due to differences in agro-ecology, management of the animals, and breed of the animals.

Coprological examination in both sheep and goats have shown the presence of strongyle species, *Fasciola* and mixed infections in both species of animals. The dominant helminth parasites found during the study

period were strongyle species (81.4%). This finding is consistent with other reports from different parts of Ethiopia (Regassa et al., 2006; Dagnachew et al., 2011; Kumsa et al., 2011; Ibrahim et al., 2014) and elsewhere (Agyei, 2003; Waruiru et al., 2005; Githigi et al., 2005; Odoi et al., 2007; Ntonifor et al., 2013). The high prevalence of strongyles may be due to the suitability of the climatic condition of Ambo for survival and transmission of the parasites. In addition, the poor management practices including the poor hygienic practices employed by the farmers may be the other contributing factor as the epidemiology of nematodosis is determined by environmental factors (Thamsborg et al., 1996; Ng'ang'a et al., 2004). The aggregate prevalence of *Fasciola* spp. for sheep and goats was 10.2%. The low coprological prevalence of fasciolosis could be due to the low number of metacercariae intake by the animals owing to low ambient temperature which is not favorable for the snail intermediate host (Andrews, 1999). In addition, 8.5% of the study animals were found to harbor mixed infections of strongyle and *Fasciola* species. Mixed infections characterized by the presence of two or more helminth genera in both sheep and goats in this study is in agreement with the findings of other researchers in the country (Abebe et al., 2010; Regassa et al., 2006; Tefera et al., 2011; Kumsa et al., 2011; Ibrahim et al., 2014) and elsewhere (Asif et al., 2008; Agyei, 2003; Githigia et al., 2005; Waruiru et al., 2005). Polyparasitism has been suggested to be an important cause of morbidity and loss of production in small ruminants (Kumsa et al., 2010; Ibrahim et al., 2014). Moreover, the presence of interaction and compromise of the immune system of the host by polyparasitism has been described to increase their susceptibility to other diseases or parasites (Wang et al., 2006).

On the other hand, the present study has shown the prevalence of GIT parasites to be 47.8% (43/90) and 53.3% (16/30) in sheep and goats, respectively. A relatively similar prevalence was reported by Abebe et al., 2010; Kumsa and Wossene (2006) and Dagnachew et al. (2011) from different areas of Ethiopia. Even though the infection rate was higher in goats than sheep, the difference was not statistically significant ($P > 0.05$). While some studies have reported that goats are more susceptible than sheep to a similar challenge (Ntonifor et al., 2013), others have reported that sheep usually suffer heavier worm burdens because of the difference in their grazing habits (Baxendell, 1984; Tembely and Hansen, 1996). Nevertheless, in the present study, though sheep and goats differ in their feeding habits, both species were kept together on common grazing land. Mixed crop livestock production predominates in the area where farm animals including small ruminants are kept together on confined grazing land which may expose goats to acquire more susceptibility for the same species of parasite infection. In consequence, the condition could be due to less or slow

development of immunity in goats to GIT parasites compared with the situation in sheep. Goats do not build up an effective immune response against helminth infections and so remain susceptible to disease throughout their lives. The risk is enhanced if they are forced to graze rather than browse (Urquhart et al., 1996; Radostits et al., 2006). Sheep faced prolonged challenge over generations and had developed good resistance (Urquhart et al., 1996).

In our study, male and female animals were found to be equally susceptible to infection with gastrointestinal helminth parasites. The absence of statistical association between sex and prevalence of GIT parasites is in agreement with that of Keyyu et al. (2003) and Regassa et al. (2006). Nevertheless, it is in disagreement with other reports including Maqsood et al. (1996) and Urquhart et al. (1996) who found higher infections in female animals than males with a significant difference between them. It is assumed that sex is a determinant factor influencing prevalence of parasitism (Maqsood et al., 1996) and females are more prone to parasitism during pregnancy and per-parturient period due to stress and decreased immune status (Urquhart et al., 1996). In addition, Dagnachew et al. (2011) reported a higher prevalence of helminth infection in female animals. In the present study, both species of small ruminants recruited from different locations were infected with GIT parasites, though no statistically significant association ($P > 0.05$) was observed between prevalence and locations. Previous studies indicate that different climatic conditions in different locations are important factors for development, multiplication and survival of nematode parasites (Woldemariam, 2005) and these could be translated to differences in the risk of acquiring the parasites between animals managed under different locations. In our study, absence of association between location and prevalence in small ruminants could be due to relative similarity in agro-ecology between study locations and a relatively similar management systems practiced by farming communities. Likewise, in this study, old animals were found to have higher prevalence of GIT parasites than young and adult animals though it was statistically insignificant. The higher prevalence of GIT parasite infections in older animals is in agreement with Garedaghi et al. (2013). This finding is in contrast with the hypothesis that older animals can acquire immunity against GIT parasites which has been supported experimentally by different studies (Gamble and Zajac 1992; Knox, 2000). Similarly, a number of authors have demonstrated an increased prevalence in young age than old age (Gupta et al., 1976; Raza et al., 2007). The higher prevalence in old animals may be due to the waning of immunity as animals get older coupled with the poor management of the animals (Radostits et al. 2006).

In this study, a significant difference was observed in prevalence of helminth infection in relation to body condition score where a higher prevalence of

gastrointestinal parasites were recorded in thin and moderate body conditioned animals compared to other animals. This finding agrees with Keyyu et al. (2006), Negasi et al. (2012), and Gonfa et al. (2013). In addition, Radostits et al. (2006) and Odoi et al. (2007) indicated that animals with poor condition are highly susceptible to infection and may be clinically affected by worm burdens too small to harm an otherwise well-fed healthy animal. Moreover, Knox et al. (2006) observed that a well-fed animal was not in trouble with worms, and usually a poor diet resulted in more helminth infections. Furthermore, helminths also led to a loss of appetite and poor utilization of food, which results in a loss of body weight. Hawkins and Morris (1978) demonstrated that weekly growth rates of wool and live weight decreased with increasing fluke burdens in sheep.

Conclusions

This study revealed the importance of helminthosis in small ruminant populations in the study area. Among the potential risk factors, body condition score was found to be the important potential risk factor for infection of small ruminants with gastrointestinal helminth parasites. Therefore, body condition score should be considered during designing control measures against helminthosis of small ruminants in the study area. In addition, further studies with large sample size, and wide geographical coverage should be conducted in different seasons of the year so as to establish the epidemiology of the infections and to implement holistic helminthosis control in the study area.

ACKNOWLEDGEMENTS

The authors would like to thank the Department of Veterinary Laboratory Technology of Ambo University for allowing them to use laboratory facilities for this research purpose.

Conflict of interest

The authors have no conflict of interest.

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