Epidemiology of Gastrointestinal Parasites of Ruminants in Western Oromia, Ethiopia

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ABSTRACT

A study was conducted to determine the prevalence and risk factors associated with gastrointestinal parasitism in western Oromia during 2003–2004. A total of 757 ruminants (257 cattle, 255 sheep, and 245 goats) were included in the study using standard coprologic parasitological procedure. The study showed that the overall prevalence of gastrointestinal parasites was 69.6% with 50.2%, 75.3%, and 84.1% in cattle, sheep, and goats, respectively. Strongyles and Eimeria were the most prevalent parasites encountered in the area. A statistically significant difference was found in prevalence and egg output (eggs per gram; EPG) among species of animals considered. A higher rate was recovered in small ruminants than in cattle, and a greater proportion of study animals (77.3%) had low EPG compared with study animals with moderate to severe EPG (22.7%). Agro-ecology was found to be associated with prevalence rate and EPG. Season and age were shown to have association with prevalence but not with EPG while no association was revealed between prevalence and EPG with sex and body condition of the animals. Hence, in this study, species of the animals, agro-ecology, season, and age are important risk factors associated with gastrointestinal parasites in the study area.

INTRODUCTION

Gastrointestinal parasite infections are a world-wide problem for both small- and large-scale farmers, but their impact is greater in sub-Saharan Africa in general and Ethiopia in particular due to the availability of a wide range of agro-ecological factors suitable for diversified hosts and parasite species. Economic losses are caused by gastrointestinal parasites in a variety of ways: they cause losses through lowered fertility, reduced work capacity, involuntary culling, a reduction in food intake and lower weight gains, lower milk production, treatment costs, and mortality in heavily parasitized animals.[1]

Despite the immense progress made to control parasitosis, farmers in Ethiopia con-

tinue to incur significant losses due to insufficient availability of information on the epidemiology of the parasites. Furthermore, parasitosis appears to be a major factor for lowered productivity of Ethiopian livestock sector.[2] The prevalence of gastrointestinal parasites, the genera of helminth parasites involved, species, and the severity of infection also vary considerably depending on local environmental conditions, such as humidity, temperature, rainfall, vegetation, and management practices.[2] Therefore, the distribution and prevalence of the disease should be presented by geographical areas that could roughly correspond to climatic conditions.

In some parts of Ethiopia, surveys have been carried out on prevalence of helminth parasites[2–8] of which most of the information obtained is from abattoir survey and animals managed in stations. Moreover, there is no sufficient information on epidemiology of the gastrointestinal parasites of ruminant farm animals in the western part of the country where mixed crop-livestock production system is the main form of agriculture. Therefore, the current study was performed to determine the prevalence of gastrointestinal parasite in ruminants in western Oromia to obtain baseline data so as to design effective control options. In this study, an attempt was made to identify agro-ecological factors; species of ruminants affected in that production systems; and management practices that are assumed to be associated with parasitosis.

MATERIALS AND METHOD

Study Area

The study was carried out during 2003–2004 in 6 selected districts of western Oromia, 2 from each agro-ecologies (Chaliya and Arjo highland, Bako and Abay Chomen mid altitude, and Arjo-Gudetu and Wama-Boneya lowland districts). The study sites were in the altitude range of less than 1500 masl (lowland), 1500-2000 masl (mid altitude), and 2000-3000 masl (highland), with mean minimum and maximum temperature of 23.8°C and 23.5°C, 11.6°C and 22.5°C, and 11.5°C and 11.9°C, respectively.

Study Design

Multi-stage random sampling procedure was used to select peasant associations (PAs), households (farmers), and the animals. From each district, 5 PAs were randomly selected, and random fecal samples were collected directly from the rectum of a total of 757 ruminants (257 cattle, 255 sheep, and 245 goats). The collected feces were preserved in 10% formalin and dispatched to Bako Agricultural Research Center laboratory for coprological investigation. Parasitological examination was done by direct smear, sedimentation, and flotation techniques following the standard procedures.[9–11] Those fecal samples that were positive for strongyles were subjected to egg output (eggs per gram; EPG) of feces count using Mc Master egg counting technique,[10,12] and the degree of infestation was categorized based on literature.[12,13]

The samples were collected in 2 seasons—dry (Oct–April) and wet (May–Sept)—from both sexes and all age groups. Body condition was recorded as poor or good, and age groups were determined as respective of the species based on farmers' response and observations made during the survey.

Data Analysis

The prevalence was calculated by dividing the number of animals harboring a given parasite by the total number of animals examined. In addition to this, the number of worm EPG of feces was categorized and the result thus obtained was analyzed to determine prevalence using SPSS version 11.1 (SPSS, Inc. Chicago, Ill). Percentages (%) to measure prevalence and chi-square (χ^2) to measure association between prevalence of the parasite and species of the animals, age, sex, agro-ecology, and season were the statistical tools applied. In all the analyses, confidence level was held at 95% and $P < 0.05$ was set for significance.

RESULTS

Of the 757 ruminants examined, 69.6 % (n = 527) were found to harbor 1 or more parasite species. Similarly, the prevalence of gastrointestinal parasites was 50.2%, 75.3%, and 84.1% in cattle sheep and goats, respectively. The greater proportions of study animals (77.3%) were with low EPG while fewer (22.7%) were with moderate to severe infection rates (Table 1).

and goats (47.8%) were infected by single parasite while the remaining 5.8%, 30.2%, and 35.3%, respectively, were infected by 2 and more than 2 types of parasites, where most of the combinations were strongyles and Eimeria.

Significant differences in prevalence and EPG were shown among different study districts (Table 3). A higher prevalence rate was encountered in Wama Boneya and Arjo

Table 1. Overall Prevalence of Gastrointestinal Parasite and Degree of EPG.

		EPG Category (%)			
Species	**Prevalence (%)**	**Low**	**Moderate**	**Severe**	**Total**
Cattle	129 (50.2)	209 (81.3)	34 (13.2)	14 (5.4)	257
Sheep	192 (75.3)	200 (78.4)	20 (7.8)	35 (13.7)	255
Goat	206 (84.1)	176 (71.8)	23 (9.4)	46 (18.8)	245
Total	527 (69.6)	585 (77.3)	77 (10.2)	95 (12.5)	757

Table 2. Prevalence of Gastrointestinal Parasites in Study Ruminants.

	Type of Parasite (%)						
Species	**Ascaris**	**Eimeria**	**Strongyle**	**Lungworm**	**Trichuris**	**Tapeworm**	**Total**
Cattle	7(2.8)	10(3.9)	121 (47)	1 (0.4)	4 (1.6)	1 (0.4)	257
Sheep	4(1.6)	68 (26.7)	179 (70.2)	11 (4.3)	14 (4.5)	0 (0)	255
Goat	6 (2.5)	84 (34.3)	192 (78.4)	3 (1.2)	24 (9.8)	0 (0)	245

There was statistically significant differences in parasite prevalence and presence of more than 1 type of parasite among species of ruminants and where mostly small ruminants share the greater proportion than cattle. Moreover, statistically significant difference in degree of EPG was observed among different species of animals studied. Higher fecal EPG was recorded in small ruminants than in cattle.

The gastrointestinal parasites identified were Ascaris, Eimeria, strongyles, lungworms, trichuris, and tapeworms with the prevalence of each of the parasites presented in Table 2. Strongyles and Eimeria were the most prevalent parasites encountered. Most of the cattle (44.4%), sheep (45.1%),

Gudetu lowland districts followed by Bako mid altitude districts. Likewise, highest EPG was recorded in Wama Boneya (lowland) followed by Bako and Abay Chomen (mid altitude).

No significant difference was observed in prevalence of the parasite and degree of EPG between male and female subjects (Table 4). Likewise, degree of EPG and prevalence of the parasites did not show significant association with body condition of the animals (Table 5).

A significantly higher prevalence rate was encountered during the wet season than the drier ones while no significant difference were found in degree of EPG between the seasons (Table 6). Similarly, there was

Table 3. Prevalence and Degree of EPG at Each Study Districts.

Districts	Prevalence (%)	EPG Category (%)			Total
		Low	Moderate	Severe	
Arjo	48 (64.9)	61 (82.4)	6 (8.1)	7 (9.5)	74
Chaliya	66 (52.0)	111 (87.4)	10 (7.9)	6 (4.7)	127
Abay Chomen	74 (56.1)	119 (90.2)	3 (2.3)	10 (7.6)	132
Bako	191 (78.6)	158 (65.0)	44 (18.1)	41 (16.9)	243
Arjo Gudetu	83 (81.4)	76 (74.5)	10 (9.8)	16 (15.7)	102
Wama Boneya	65 (82.3)	60 (75.9)	4 (5.1)	15 (19.0)	79
Total	527 (69.6)	585 (77.3)	77 (10.2)	95 (12.5)	757

Table 4. Prevalence and Degree of EPG of the Sex Groups.

Sex	Prevalence (%)	EPG Category (%)			Total
		Low	Moderate	Severe	
Female	344 (70.1)	386 (78.6)	48 (9.8)	57 (11.6)	491
Male	183 (68.8)	199 (74.8)	29 (10.9)	38 (14.3)	266
Total	527 (69.6)	585 (77.3)	77 (10.2)	95 (12.5)	757

Table 5. Prevalence and Degree of EPG Across Body Condition.

Body Condition	Prevalence (%)	EPG Category (%)			Total
		Low	Moderate	Severe	
Good	318 (74.0)	327 (76.0)	44 (10.2)	59 (13.7)	430
Poor	209 (63.9)	258 (78.9)	33 (10.1)	36 (11.0)	327
Total	527 (69.6)	585 (77.3)	77 (10.2)	95 (12.5)	757

Table 6. Prevalence and Degree of EPG Across Seasons.

Season	Prevalence (%)	EPG Category (%)			Total
		Low	Moderate	Severe	
Dry	121 (59.9)	159 (78.7)	20 (9.9)	23 (11.4)	202
Wet	406 (73.2)	426 (76.8)	57 (10.3)	72 (13.0)	555
Total	527 (69.6)	585 (77.3)	77 (10.2)	95 (12.5)	757

Table 7. Prevalence and Degree of EPG at Different Agro-Ecology.

Agro-Ecology	Prevalence (%)	EPG Category (%)			Total
		Low	Moderate	Severe	
Highland	114 (56.7)	172 (85.6)	16 (8.0)	13 (6.5)	201
Mid altitude	265 (70.7)	277 (73.9)	47 (12.5)	51 (13.6)	375
Lowland	148 (81.8)	136 (75.1)	14 (7.7)	31 (17.1)	181
Total	527 (69.6)	585 (77.3)	77 (10.2)	95 (12.5)	757

association between prevalence rates and EPG with agro-ecology where higher values were recorded for lowland areas followed by mid altitude areas with lowest values in highland areas (Table 7).

Higher prevalence rates were shown in younger of all the ruminants while no association was recognized between degree of EPG and age for all the species of the study animals.

DISCUSSION

This study revealed that the overall prevalence of gastrointestinal parasites of ruminants to be 69.6% with 50.2%, 75.3%, and 84.1% in cattle, sheep and goats, respectively. It also disclosed that regardless of the species of ruminants, the animals are infected with variety of parasites of which strongyle and Eimeria oocysts are the most abundant. Similar prevalence rate was reported in other parts of Ethiopia[7] and Kenya[14] but slightly lower than prevalence in sheep and goats from eastern part of Ethiopia[8] and in sheep at Bako[3] and Zimbabwe.[15] The higher prevalence rate observed in sheep and goats of eastern Ethiopia could be due to difference in management system of the animals and breeds of these animals. In eastern Ethiopia, animals are managed under extensive pastoralism in which large numbers of the animals are kept together. This could increase the degree of pasture contamination leading to higher prevalence rate, whereas in western Ethiopia, mixed crop-livestock production predominates, where few numbers of various species of livestock are kept together. The higher prevalence rate recorded in small ruminants as a whole agrees with most of the reports,[5,14] but the higher prevalence rate in goats compared with sheep is in agreement with report a from eastern Ethiopia.[8] However, it contradicts the assumption of earlier works in other part of Ethiopia[2] and Kenya[16] that higher parasite prevalence is more common in sheep than in goats due to the grazing habit of sheep. The result in this study could be because most of the goats in this study were from lowland and mid altitude areas, which are thought to be suitable for survival of the larval stage of the parasites. Likewise, in the lowland areas of the country where goats are mostly reared, there is poor veterinary infrastructure and medication to goats. More importantly, the condition could be due to less or slow development of immunity in goats to gastrointestinal parasites compared with the situation in sheep and cattle. The latter 2 faced prolonged challenge over generations, but in goats, the declining of sufficient browsing area and expansion of crop agriculture forced them to graze with the other 2 species that had good resistance.

The degree of EPG in most of the study animals was low, agreeing with various works[5,14] indicating the sub-clinical cases of gastrointestinal parasites with subsequent subsistent low degree of pasture contamination. But it is inconsistent with reports from eastern Ethiopia[8] that could be explained by the difference in management and breed of the respective animals.

The study also indicated higher prevalence and degree of EPG in lowlands and mid altitude areas in all the study animals in consent with reports in many parts of sub-Saharan Africa as reported by Teklye.[2] These agro-ecologic zones are characterized by a hot-humid environmental situation that is favorable for the survival of the infective larval stage of most of the parasites.

The study further revealed that sex and body conditions of the animal did not show significant association with the prevalence of the parasites and degree of EPG. The absence of association between sex and prevalence of EPG is in agreement with that of Keyyu et al.[17] However, that of body condition disagrees with previous reports.[17] This could be explained by the fact that loss of body condition in the study animals could be due to other factors, such as seasonal change of forageable feed staff and the presence of other concurrent disease conditions, mainly high prevalence of trypanosomiasis in most of the lowland districts.

Significantly higher prevalence and, though not significant, higher degree of EPG were recorded in wet season than in drier ones. This finding is in consent with many reports around the world.[4,6,15,18–24] This is due to the existence of a direct relationship between prevalence with the humidity and temperature. In this study, the presence of sufficient moisture during the rainy season favored the survival of infective larvae in the pasture and higher probability of uptake of the infective larvae leading to higher prevalence rate. In western parts of the Ethiopia, under local production systems, the animals that are completely managed on pasture grazing throughout the year succumb to seasonal variation of availability of forgeable feed and then difference in plane of nutrition. Thus, the presence of sufficient feed during rainy seasons could in turn increase the nutritional status, and these well-fed animals developed good immunity that suppressed the fecundity of the parasites. This situation was reported in Bisset et al[25] that increased plane of nutrition increases the immunity and reduces the fecundity of the worms to the contrary of the higher prevalence rate observed during the rainy season. This is in agreement with works in Burkina Faso where comparable worm counts were obtained during both seasons.[26]

Similarly, a significantly higher prevalence rate was recorded in younger animals (calves and lambs) and was also higher in kids. This finding is in agreement with most literatures[9,12,17,20,23,24] from different corner of the world. This could be due to the fact that younger animals are more susceptible than adult counter parts. Adult animals may acquire immunity to the parasites through frequent challenge and expel the ingested parasite before they establish infection,[9,12] But the findings of this study are inconsistent with reports from Gambia where adults and older animals bear high worm burden.[18] There was no significant difference in EPG among different age group though higher proportions of severe cases were recorded in younger study animals. This observation is in consent with previous works in Ethiopia and Kenya[24] that stated no association of degree of EPG and age of the animals. But it is to the contrary from semi-arid parts of Kenya that reported higher prevalence and intensity of EPG in older sheep and goats.[16]

Therefore, this study identified the potential risk factors associated with high prevalence rate and high degree of EPG enabling to design feasible and strategic control of helminth parasites of ruminants in areas of similar ecological features.

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