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Prevalence of lungworm infection in small ruminants in North Gondar zone, Amhara National Regional State, Ethiopia

Yitagele Terefe[1], Ketema Tafess[2], Getasew Fekadie[1] and Nigatu Kebede[3]*

[1]Faculty of Veterinary Medicine, Haramaya University, Ethiopia.
[2]Faculty of Veterinary Medicine, Gondar University, Gondar, Ethiopia.
[3]Aklilu Lemma Institute of Pathobiology, Addis Ababa University, Addis Ababa, Ethiopia.

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The study was conducted to determine the prevalence, associated risk factors and identification of the species of lungworms of small ruminants in four districts of Northwestern Amhara National Regional State. A total of 632 small ruminants were included in the study using coprologic procedures (565 animals) and post-mortem examination (87 animals). The study showed that the overall prevalence of lungworm infection was 46.0 and 56.3% based on coprological and postmortem examination, respectively. Significant difference (P < 0.05) in prevalence of lungworm was found between animals under semi-intensive and extensive management systems. The prevalence of lungworm infection was significantly different (P < 0.05) between seasons, the highest being during the rainy season (57.1%) and the lowest in the dry season months (35.0%). The prevalence of *Muelleris capillaris* infection was highest (50.4%) during the study period based on postmortem examination. The prevalence of lungworm infection showed significant association (P < 0.05) with different age groups of animals, where *Dictiocaulus fillaria* was highly prevalent in young age group while *M. capillaris* and *Protstrongylus rufescens* were highly prevalent in adult age groups of study animals. In the current study, three respiratory helminthes of small ruminants were identified and management system, age and season are important risk factors associated with lungworm infection in the study area. Due to its impact on production, emphasis should be given for the prevention and control of lungworm infection in the study area.

Key words: *Dictiocaulus fillaria, Muelleris capillaries, Protostrongylus rufescens*, lungworm, small ruminant, helminthes.

INTRODUCTION

Sheep and goats are the most numerous of man's domestic livestock and are especially important in the more extreme climates. Of the worlds' 1,614 million sheep and 475 million goats, 65 and 95%, respectively, are located in developing countries. Small ruminants in Africa are noted for their ability to convert low cost feed into high value products, namely: meat, milk, fiber, manure and hides (Wilsmore, 2006; Food and Agriculture Organization (FAO), 1986).

The current sheep and goat populations of Ethiopia are approximately 23 and 17 million, respectively (ILRL, 2000). Small ruminants are important contributors to food

*Corresponding author. E-mail: nigatukebede@yahoo.com. Tel: +251112763091. Fax: 251-11-2755296.

production in Ethiopia, providing 33% of meat consumption and 14% of milk consumption (Asfaw, 1997). In the central highlands of Ethiopia where mixed crop-livestock production system is practiced, small ruminants account for 40% of cash income and 19% of the house hold meat consumption (Zelalem and Fletcher, 1993). Owing to their high fertility, short generation interval and adaptation even in harsh environments, sheep and goats are considered as investments and insurance to provide income to purchase food during seasons of crop failure and to meet seasonal purchases such as improved seed, fertilizer and medicine for rural households (Asfaw, 1997).

Even though small ruminants are important components of the Ethiopian farming system, their contribution to food production, rural income and export revenue are far below than their expected potential. This is because small ruminant production is constrained by the compound effects of disease, poor feeding and poor management (Getachew, 1995). Studies in the central highland of Ethiopia have shown that lungworm parasites are a major problem in small ruminants and cause disease, increase mortality and production losses (Bekele et al., 1992). Up to half of all sheep deaths and morbidity on farms in Ethiopian highlands are caused by parasitic pneumonia and endoparasites (ILCA, 1990).

The incidence of lungworm infection varies geographically. Only a few limited studies have been completed on respiratory helminthes of small ruminants in the Amhara National Regional State, northwestern Ethiopia. Therefore, the aims of the present study are (i) to determine the prevalence of lungworm infection in small ruminants; (ii) to identify the species of lungworms and (iii) to identify associated risk factors for lungworm infection in north Gondar zone, Amhara National Regional State, northwestern Ethiopia.

MATERIALS AND METHODS

Study area

The study was conducted in four districts of northwest Amhara region including Abaintonios, Anchew, Belagig and Gondar town districts. The study areas are about 710 km North West of Addis Ababa at an altitude ranging from 1500 to 3500 meters above sea level. Numerous mountains, plateaus, sloped areas, rivers, streams and lakes mark the topography of the area. The climate of the study area is divided into subhumid ("wurch and Dega"), semiarid ("Woynadega") and arid ("Kola"). The average maximum and minimum daily temperature of the area varies between 22 to 30.7°C and 12.3°C, respectively.

The region receives a bimodal rainfall, the average annual precipitation rate being 1000 mm. The short rains occur during the months of March to May while the long rains extend from June to September. The production system observed in the area combines cereal-based agriculture and livestock farming. The study area has a livestock population of 2.03 million cattle, 0.6 million sheep, 0.54 million goats, 0.25 million equine species of which 62.5% are donkeys, 5% are mules, and 32.5% are horses, and 1.9 million poultry (CSA, 2003).

Study animals and sampling

Small ruminants in the study area are kept mainly under an extensive traditional management system, involving small household flocks of mixed age. The sample size was determined according to Thrusfield (1995) for an infinite population. Since there has been no previous work done in the study area, an estimated prevalence of 50% was used for sample size determination. A total of 652 small ruminants (412 sheep and 153 goats from study districts, and 58 sheep and 29 goats from Gondar ELFORA abattoir) were used in this study. Four representative districts were purposely selected; Abaintoniose, Anchew, Blagig and Gondar town. Sampling animals was conducted at random from study districts and small ruminants slaughtered in ELFORA abattoir. Animals from Gondar town were managed under a semi-intensive system while the rest were under an extensive production system.

Study design

Coprological examination

Faecal samples were collected directly from the rectum of all selected animals and stored in vials containing 10% formalin and transported to the Gondar veterinary clinic for laboratory examination. In the laboratory, the collected fecal samples were processed according to conventional methods for lungworm larvae (Baermanization) (Hansen and Perry, 1994). During sample collection, the species of the animal, sex, age, date of sampling and the area were recorded. In the laboratory, 25 g of faeces was weighed from each sample for the extraction of larvae using modified Baermann technique (Hansen and Perry, 1994). The faeces were enclosed in a gauze fixed on the string rod and submerged in a clean glass tube filled with warm water. The whole apparatus was left for 2 to 3 h. The larva leaves the faeces and migrates through the gauze and settles at the bottom of the glass. After siphoning off the supernatant, the sediment was examined under the low power of the microscope (Fraser, 1991; Urquhart et al., 1996). All the area under the cover slip was thoroughly and uniformly searched for the presence of lungworm larvae (Hendrix, 1998).

Abattoir survey

Small ruminants slaughtered at Gondar ELFORA abattoir were examined during the study period. The lungs were palpated for the presence of protostrogylidea nodules. These are brood nodules and worm nodules. Brood nodules are cone shaped granuloma-like areas of the affected lung tissue varying in size and color, which contains active worm and caused by parenchyma-dwelling small lungworms (Protostrongylidae). The worm nodules are pin head shaped mostly subpleural, grey (*Mullerius*) cyst which contain adult worms. If the nodules are present, they are trimmed off and worms extracted from the tissue by gentle pressing of a small non-calcified nodule or part of large nodule between two glass slides and then carefully teasing the worm away from the tissue. The air passages were opened starting from the trachea down to the small bronchi with fine blunt pointed scissors, to detect parasites (Kassai, 1999; Schneider, 2000).

Data analysis

Prevalence was determined by the percentage (%) positive and chi-square (x^2). To measure association were

Table 1. Prevalence of lungworm infection in different districts of the study area.

District	Number examined	Number positive (%)
Abaintonios	176	77 (43.7)
Anchew	88	50 (56.8)
Belagig	56	24 (42.8)
Gondar town	245	109 (44.4)
Total	565	260 (46.0)

P > 0.05.

the statistical tools applied and determined using statistical package for social sciences (SPSS) V 17.0. In all the analysis, confidence level was held at 95% and 5% level of significance (Thursfield, 1995).

RESULT

Coprological examination

Out of 565 (412 sheep and 153 goats) fecal sample examined, 260 (46.0%) were positive for lungworm infection. No statistically significant difference was observed in the prevalence of the lungworm infection of small ruminants in different district (x^2 = 28.22 P > 0.05). The higher prevalence rate was encountered in Anchew (56.8%) while the lowest was in Belagig (42.8%) (Table1).

The prevalence rate of lungworm infection was found to be higher in extensive management system (51.8%) than in semi-intensive management system (24.5%). Comparison between sheep and goats showed statically significant difference between the two species (x^2 = 33.2, P < 0.05). Similarly, there was association between the prevalence rate of lungworm infection with management system, and months where x^2 = 36.71, P < 0.0 and x^2 = 47.55 P < 0.05, respectively. The prevalence rate of lungworm infection did not show statistically significant association with sex of the animals (x^2 = 4.55, P > 0.05). Lungworm infection in small ruminants and associated risk factors in the study area are shown in Table 2.

In comparison of age groups, significant difference (x^2 = 33.22, P < 0.05) in the prevalence rate of lungworm infection was observed. Among lungworms identified, high prevalence rate of *Muelleris capillaries* (50.4%) followed by *Dictiocaulus fillaria* (26.5%) was recorded. The prevalence of *M. capillaris* and *Protostrongylus rufescens* increases with age of the animal, whereas the prevalence of *D. filaria* was high in young age groups of the animals. Mixed infection was common in old age group of the animals (Table 3).

Abattoir survey

Of the 87 animals (58 sheep and 29 goats) examined in the ELFORA abattoir, 49 (56.3%) were positive for lungworm infection. There was a significant difference in prevalence of lung worn infection between the two species (x^2 = 3.95, P < 0.05), the prevalence being higher in sheep (63.8%) than goats (41.3%). The distribution of lungworm species detected in the lung during postmortem examination of positive animals is shown in Table 4. Higher prevalence of *M. capillaris* (51.0%) was observed than *P. rufescens* (28.6%) and *D. fillaria* (20.4%). The relative percentage of adult lungworms recovered during postmortem examination is described in Table 4.

DISCUSSION

This study revealed the overall prevalence of lungworm infection of small ruminants to be 46.0%, with 42.3% in sheep and 46.7% in goats. It also disclosed that animals are infected with three nematode species parasitizing the respiratory tract of small ruminants of which *Mullerius* and *Dictyocaulus* species are the most abundant. This finding is in agreement with Regassa et al. (2010) and Sissay (1996) who have reported 40.4 and 44% in small ruminants in Dessie and Kombolcha districts, north-eastern Ethiopia and Bahir Dar, respectively. The present finding is lower than reports of Alemu et al. (2006) in northeast Ethiopia and Bekele and Abu (2011) in Tiyo District, South-East Ethiopia, with an observed prevalence of 53.6 and 57.1%, respectively. However, it is higher than that of Addis et al. (2011) and Weldesenebet and Mohamed (2012), with 33.83% prevalence at Gondar and 26.7% at Jimma, respectively. These differences might be due to the method used for the detection of the larvae or difference in the study area of topography which has a conducive environment for the survival of larvae and intermediate hosts, slug or snails and also the nutritional detection.

In this study, small ruminants under extensive management system had more infection than those kept under semi-intensive management system. The reason for this could be increased cultivation of land which restricts animals on communal grazing land so that large numbers of the animals are kept together. This could increase the degree of pasture contamination leading to higher prevalence rate. Management practice such as provision of ample nutrition increases the resistance of the host under the semi-intensive system, contrary to this malnutrition which reduces the host-parasite response and favors the fecundity of the parasites that allows the animals for continuous larvae exposure under extensive system (Soulsby, 1986).

The reason for this high prevalence of *Mullerius* compared with *Dictyocaulus* could be partly attributable to its wide range of intermediate host and the ability of larvae to over winter in the mulluscs. Additional factors which play a part in ensuring the endemicity of the worm are, first, the ability of L1 (First stage larva) to survive for months in faecal pellets and secondly, the persistence of

Table 2. Lungworm infection in small ruminants and associated risk factors in the study area.

Variable	Number examined	Number positive (%)
Species		
Ovine	412	164(39.8)
Caprine	153	96(62.7)
Sex		
Female	329	158(48.0)
Male	236	102(43.2)
Management system		
Extensive	444	230(51.8)
Semi-intensive	121	30(24.5)
Season		
Dry	285	100(35.0)
Rainy	280	160(57.1)

Table 3. Prevalence of the species of lungworm in small ruminants of different age groups.

Age (years)	Prevalence (%)	Positive							Total
		Single infection			Mixed infection				
		D (%)	M (%)	P (%)	DM (%)	DP (%)	MP (%)	DMP (%)	
≤1/2	29(11.6)	14(20.3)	12(9.2)	2(4.9)	-	-	1(14.3)	-	81
1/2-2	80(30.8)	24(34.9)	41(31.3)	10(24.4)	2(33.3)	1(25.0)	2(28.6)	-	193
2-4	69.(26.5)	12(17.4)	41(31.3)	11(26.8)	3(50.0)	1(25.0)	1(14.3)	-	146
>4	82(31.5)	19(27.4)	37(28.2)	18(43.9)	1(16.7)	2(50.0)	3(42.9)	2(100.0)	145
Total	260(46.01)	69(26.5)	69(26.5)	41(15.8)	6(2.3)	4(1.5)	7(2.7)	2(0.8)	565

D:*Dictyocalus filaria*, M*: Muellerius capillaries*, P: *Protostrongylus rufescens;* $x^2 = 33.72$, $P < 0.05$.

Table 4. Relative percentage of adult lungworm recovered from postmortem examination.

Species of lung worm	Number of positive	Percentage (%)
D. filarial	10	20.4
M. capilaris	25	51.0
P. rufescens	14	28.6
Total	49	100.0

$x^2 = 87.0$, $P < 0.05$.

the L3 (third stage larva) in the intermediate host for the life time of the mollusks (Taylor et al., 2007). On the other hand, the longevity and development of free larvae of *Dictyocaulus* are known to be dependent on humidity and temperature condition. Dry seasons are characterized by high mortality of larvae in the pasture (Gallia and Nunns, 1976), where dry, hot summer and cold winter is the climatic condition of the study area. The prevalence of *D. filaria* is higher in infants than adults. However, the prevalence of *M. capillaris* and *P. rufescens* is higher in adult animals than younger ones. This might be due to the long period of potency and the apparent inability of the final host to develop acquired immunity, so that adult sheep have the heaviest infection, highest infection and the highest prevalence (Taylor et al., 2007). The study further revealed that goats were found to be more susceptible to lungworm infection than sheep. This 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 parasite. Likewise, in the lowland areas of the country where goats are mostly reared, there is poor veterinary infrastructure and medication.

More importantly, the condition could be due to less or slow development of immunity in goats compared to sheep (Wilsmore, 2006).

The higher prevalence of lungworm infection during the rainy season of the months might be the presence of sufficient moisture during the rainy season which favored the survival of infective larvae and stimulated the activity of mollusks in the pasture resulting in higher probability of up take of the infective larvae, leading to higher prevalence rate. In northwestern part of Ethiopia, under local production system, 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 in rainy season could in turn increase the nutritional status, and these well fed animals develop good immunity that suppressed the fecundity of the parasites. This situation was reported by Bisset et al. (1996) that increased plane of nutrition increased the immunity and reduced the fecundity of the worm, contrary to the higher prevalence rate observed during the rainy season.

The prevalence of lungworm infection obtained by postmortem examination was higher (56.3%) than the result obtained by coproscopic examination (46.0%). This difference might be related to worm nodes of Protostronglidae. Worm nodules contain immature parasite in general (Schneider, 2000). Higher infection rate observed on postmortem examination may be related to these worm nodules detected. In addition, in the prepatent or postpatent phase or during hypobiosis, it is impossible to detect this parasite by fecal examination (Fraser, 1991). Furthermore, egg laying adult female parasites might be inhibited by the immune reaction of the host (Hansen and Perry, 1994).

Conclusion

The study revealed that lungworm infection in small ruminant is highly prevalent in North Gondar zone. *D. filaria, M. capillaris* and *P. rufescens* were the lungworms identified during the study. Young animals are mostly affected by most pathogenic species of lungworm, *D. filarial*, than adults on the contrary which are highly affected by *M. capillaris* and *P. rufacens*. Animals under semi-intensive management system have been found less affected than those under extensive management system. Therefore, avoidance of overstocking and grazing in watery and damp areas of arid pastures, treatment of potential worm carriers and separate grazing of young stocks are recommended.

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