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Ovine Lungworms in Tiyo District, South-East Ethiopia: Prevalence, Effect of Altitude and Major Host Related Risk Factors

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Abstract: A cross-sectional study was conducted from November 2009 up to March 2010 to determine the prevalence and the predominant species of lung worms and to evaluate the effect of altitude and major host related risk factors on the occurrence of these parasites in sheep of Tiyo district, south east Ethiopia. Samples were randomly collected from 382 animals and examined using a Modified Baermann technique. Consequently, the overall prevalence was 57.1%. *Dictyocaulus filaria* was the predominant species. There was a significant difference ($P<0.05$) in the infection among the various altitudes, age group and body condition of sheep as well as between male and female animals. Logistic regression analysis revealed that highland sheep are virtually three times and midland sheep are almost twice more likely to be infected with lungworms than sheep from lowland. Female sheep are nearly three times more likely to be infected than male ones. A decrease in one-year of age has a 44.0% (95% CI; 22.9%, 84.3%) increase in the chances of being infected with lungworms. Lastly, the odds of sheep with poor body conditions and medium body conditions to be infected with lungworms as compared to sheep with good body conditions is 27.8% (95% CI; 15.5%, 49.6%) and 7.2% (95% CI; 3.8%, 13.7%) respectively. In conclusion, our work revealed that lungworms belong to the major parasites that affect the health and productivity of sheep in the area; hence, due attention should be given to the sector to mitigate the setback.

Key words: Altitude % Lungworms % Ovine % Prevalence % Risk Factors

INTRODUCTION

Ethiopia is a home for diverse indigenous sheep and ranks second in Africa and sixth in the world in terms of sheep population; 25,017,218 [1]. According to FAO [2], sheep with its variation in agro-climatic zones and productions systems, contribute 25% of the total annual meat production. They are important components of the livestock sub sector and play a vital role as sources of meat, milk, wool and cash income for smallholder keepers in different farming systems and agro-ecological zones of the country [3, 4]. Moreover, they are also sources of foreign currency [5].

Despite this huge potential, the country at the moment fails to get the expected benefit as the productivity of this sector is low due to various factors [3, 6]. Among the plethora of factors, diseases, particularly parasites take a lion share; respiratory nematodes known as lung worms being one of them.

Lung worms are commonly found in sheep and they are an important problem for sheep breeders throughout the world [7]. These parasites cause reduced weight gain, respiratory problems such as bronchopneumonia and high mortality as well as reduced reproductive and growth performances [8-10]. Thus, appropriate disease prevention and control is required to be undertaken to significantly reduce the impact of these parasites on sheep. To this end, studying the magnitude as well as the association of altitude and major host related risk factors with lungworm infection is of paramount importance in providing input to such endeavors.

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Therefore, the objectives of present study were to determine the prevalence and the predominant species of lung worms and to evaluate the effect of altitude and major host related risk factors on the occurrence of these parasites in Tiyo district, south east Ethiopia.

MATERIALS AND METHODS

Study Area: Tiyo district is situated at 6°59'-8°49N altitudes and 38°41'-40°44'E longitude in central Ethiopia, 175km south-east of Addis Ababa, the capital city of Ethiopia. The altitude of the area ranges from 1750-3100 m.a.s.l and is characterized by mid sub-tropical temperature ranging from 10°C-28°C. The area has bimodal rainfall with the short rainy season occurring during the months of January up to March; whereas the long rainy season occurs from June up to September. The average annual rainfall is 2100mm. According to CSA [1], the number of sheep population in Arsi zone is 1,623,352.

Study Population: The study population comprises of indigenous Arsi-Bale sheep breed from three agro-ecological areas (highland, midland and lowland) that have been kept under similar traditional productive system (extensive management system).

Study Design: A cross-sectional survey was conducted from November 2009 up to March 2010 to determine the magnitude of ovine lungworm infection and to assess the effect of altitude and major host related risk factors on the occurrence of these parasites in sheep of Tiyo district, south east Ethiopia.

Sample Size Determination: The sample size was determined according to the formula given by Thrusfield [11] as follows:

$$n = \frac{1.96^2 . P_{exp} (1-P_{exp})}{d^2}$$

Where: n = required sample size
p_{exp} = expected prevalence
d^2 = desired absolute precision

With a 53% expected prevalence (considering the previous study recorded by Assela Regional Veterinary Laboratory), 95% confidence level and 5% precision, sample size was calculated to be 382.

Sampling Technique: Out of 18 villages of Tiyo district, three, namely: Konicha, Dosha and Lalocheka were purposively selected considering their representation of the highland, midland and lowland agro ecological zones of the district respectively. Konicha is located at a distance of 20km from Assela town with an altitude of greater than 2700 m.a.s.l.; Dosha is situated in the south-eastern part of Assela town, at a distance of 10km with an altitude of 2100m.a.s.l. and Lalocheka is located at a distance of 28km south-west of Assela town with an altitude of less than 1750m.a.s.l. [12]. The households and individual animals were selected using simple random sampling technique. Accordingly, equal proportion of animals, i.e. 127 sheep from Dosha and Lalocheka villages each and 128 sheep from Konicha village were selected for the study. During sampling, age, sex and body conditions of the animals were recorded.

Body Condition Scoring: Body condition of each animal was determined based on the criteria set by Thompson and Meyer [13] using the 5 point scale (1=very thin to 5=obese). Animals were visually assessed followed by palpation of the area around the lumbar vertebrae between the back of the ribs and the front of the pelvic bones.

Determination of Age: Since most smallholder farmers do not usually keep records, it was difficult to obtain information on the age of animals from the owners; hence, age of every sampled sheep was determined based on dentition as indicated by Vatta *et al*., [14].

Sample Collection and Laboratory Diagnosis: Fresh fecal samples collected from the rectum of the animals were immediately transported to Assela Regional Veterinary Laboratory for processing. Ten grams of feces were weighed from each sample for extraction of larvae using Modified Baermann techniques according to Anne and Gary [15]. The feces were fully enclosed in cheesecloth fixed with two applicator sticks that pass through the rubber band and rest on the edges of the funnel glass. The glass was filled with clean lukewarm water until the sample became submerged making sure that the corners of the cheesecloth did not hang over the edge of the funnel. The sample was allowed to sit overnight. Larvae were collected and morphologically identified as described by previous studies [2, 15, 16].

Data Management and Statistical Analysis: Raw data and the results of parasitological examination were entered in to a Microsoft Excel spread sheets program and then were transferred to SPSS version 16 for analysis. The prevalence of lungworm infection was calculated as the number of positive samples divided by the total number of samples examined. Logistic regression analysis, odds ratio and 95% confidence interval were computed to see the degree of association of altitude and major host related risk factors with ovine lungworm infection. Pearson's chi-square (P^2) was used to evaluate the association of different variables with the prevalence of lungworm. P-value less than 0.05 (at 5% level of significance) were considered significant in all analysis.

RESULTS

The examination of samples collected from 382 randomly selected animals using a Modified Baermann technique revealed an overall lungworm prevalence of 57.1%.*D. filaria* (*Dictyocaulus filaria*) was the predominant species in the study area followed by *P. rufescens* (*Protostrongylus rufescens*), whereas *M. capillaris* (*Muellerius capillaris*) was the least prevalent. Certain proportion of the investigated animals was also suffering from mixed infection (Figure 1).

There was a significant variation (P<0.05) in the infection rate among the various altitudes (Table 1). The highest prevalence was recorded in the village with high altitude (Konicha) and the lowest in low altitude (Lalocheka). Furthermore, logistic regression analysis showed statistically significant (P<0.05) difference in the odds of sheep from various altitudes to be infected with lungworms. Accordingly, highland sheep are virtually three times and midland sheep are almost twice more likely to be infected with lungworms than sheep from lowland (Table 3).

A significant (P<0.05) difference was also observed in the infection rate between male and female animals. The infection was higher in female animals than in males (Table 2). According to the logistic regression analysis, statistically significant (P<0.05) variation was observed in the likelihoods of both sexes to be infected with lungworms. Thus, female sheep are nearly three times more likely to be infected than male ones (Table 3).

Taking age of the animals as one of the host related risk factors, lungworm infection was significantly higher (P<0.05) in younger sheep as compared to older ones (Table2). A decrease in one-year of age has a 44.0% (95% CI; 22.9%, 84.3%) increase in the chances of being infected with lungworms (Table 3). In relation to the body condition of the animals, the prevalence was significantly the highest (P<0.05) in those sheep with poor body conditions than in those with medium or good body conditions (Table 2). The odds of sheep with poor body conditions and medium body conditions to be infected with lungworms as compared to sheep with good body conditions is 27.8% (95% CI; 15.5%, 49.6%) and 7.2% (95% CI; 3.8%, 13.7%) respectively (Table 3).

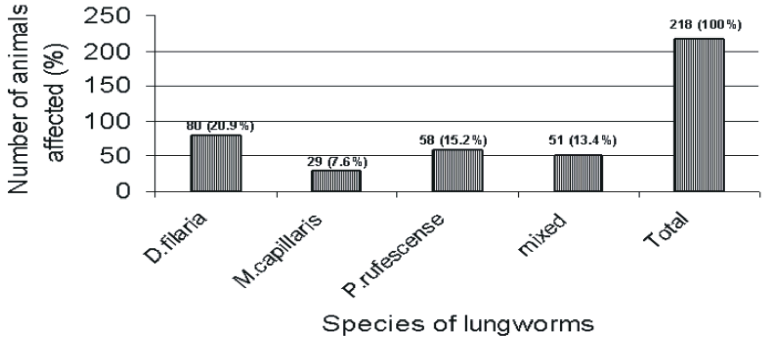

Fig. 1: Prevalence of lungworms in Tiyo district based on the species of the parasite

Table 1: Prevalence of lungworms based on the villages with various altitudes

Villages of various altitudes	No examined	No of positives (% out of examined)	[95% confidence interval (CI)]	df	P^2(p-value)
Konicha (Highland)	128	85 (66.4%)	58.2-74.6	2	9.567[a] (0.008)
Dosha (Midland)	127	73 (57.5%)	48.9-66.1		
Lalocheka (Lowland)	127	60 (47.2%)	38.6-55.9		
Total	382	218 (57.1%)	52.1-62.0		

P^2=3.820E2[a], df=4, P-value= 0.000

Table 2: Prevalence of lungworms based on major host related risk factors

Major host related risk factors	No examined	No of positives (% out of examined)	[95% CI]	df	P^2(p-value)
Sex					
Female	275	177 (64.4%)	58.7-70.0	1	21.328[a]
Male	107	41 (38.3%)	29.1-47.5		(0.000)
Total	382	218 (57.1%)	52.1-62.0		
Age, years					
<1.5	86	61(70.9%)	26.5-45.9	3	26.147[a]
1.5-2	90	59 (65.6%)	48.0-66.3		(0.000)
2-3	112	64 (57.1%)	55.7-75.4		
>3	94	34 (36.2%)	61.3-80.5		
Total	382	218 (57.1%)	52.1-62.0		
Body conditions					
Poor	137	113 (82.5%)	76.1-88.9	2	75.896[a]
Medium	121	69 (57.0%)	48.2-65.8		(0.000)
Good	124	36 (29.0%)	21.0-37.0		
Total	382	218 (57.1%)	52.1-62.0		

Table 3: Multivariate logistic regression analysis of the association of altitude and major host related risk factors with occurrence of ovine lungworm infection

Parameters (Risk factors)	Odds ratio (OR)	95% CI for OR	P^2	df	P-value
Altitude					
Highland (Konicha)	2.970	1.592-5.544			
Midland (Dosha)	1.883	1.030-3.443	11.784	2	0.003
Lowland (Lalocheka)					
Sex					
Female	2.947	1.694-5.127	14.631	1	0.000
Male					
Age, years					
<1.5	0.440	0.229-0.843			
1.5-2	0.325	0.157-0.672	13.737	3	0.003
2-3	0.298	0.144-0.617			
>3					
Body conditions					
Poor	0.278	0.155-0.496			
Medium	0.072	0.038-0.137	64.055	2	0.000
Good					

DISCUSSION

Our study revealed the presence of *D. filaria*, *P. rufescens* and *M. capillaris* as major respiratory nematodes of sheep in the study area with an overall infection rate of 57.1%. This result is almost in close agreement with the work of Alemu *et al*., [17] in northwestern Ethiopia who reported the prevalence of 53.6%. The result of the current work is higher than Alemayehu *et al*., [18] in Dessie and Kombolcha districts, northeastern Ethiopia and Mekonnen *et al*., [19] at Gondar who reported prevalence of 40.4% and 32.7% respectively. However, the present finding is lower than prevalence reported by Netsanet [20] in Debrebrihan who reported 73.3%. These differences in the prevalence might be associated with the variations in agro-ecology of the study areas which favor the survival of parasites larvae in general and/or the snail intermediate host in case of *P. rufescens* in particular. Moreover, according to Bradford [21] and Soulsby, [8], the occurrence of lungworms is associated with nutritional status, level of immunity, management practice of the animal, rain fall, humidity and temperature differences and season of examination on the respective study areas.

With regard to the species of lungworms, it was observed that *D. filaria* was the predominant species in the area followed by *P. rufescens*, whereas *M. capillaris* was the least prevalent. This finding is supported by Alemu *et al*., [17], Netsanet [20] and Nemat and Moghadam [22] who reported *D. filaria* to be the most prevalent in their survey. In contrast to our findings, Sissay [23] in Bahirdar and Mezgebu [24] in Addis Ababa reported that *M. capilaris* is the most prevalent. The possible explanation for the predominance of *D. filaria* in

the study area might be attributed to the difference in the life cycles of the parasites. Thus, *D. filaria* has a direct life cycle and requires shorter time to develop to an infective stage. According to Soulsby [8], after ingestion, the larvae of these parasites can be shed with feces within 5 weeks. Compared with *D. filaria*, the transmission of *P. rufescens* and *M. capillaris* is epidemiologically complex event involving host, parasite and intermediate host. In addition to this, the low prevalence of both *M. capilaris* and *P. rufescens* in the study area might be attributed to the fact that the study was done in dry season which does not favor the development of the snail intermediate hosts. *M. capillaris* and *P. rufescens* in sheep require slugs or snails as intermediate hosts, which must be eaten for infection to occur [25]. Mixed infection was observed in the current study as in many previous studies [26-28].

On the attempt to assess the influence of altitude on lungworm infection of sheep, a significant effect ($P<0.05$) was observed on the prevalence of lungworm infection among the various altitudes. Thus, the prevalence was seen to increase with altitude. This result is in accord with the report of Alemu *et al*., [17], Wondowossen [26], Hassen [28] and Uqbazghi [29] where significant difference ($P< 0.05$) was observed in the prevalence of lungworm infection among the areas of different altitudes. In an abattoir study done in Egypt, lungworms were not identified in any of the sheep examined, probably supporting the effect of altitude on the distribution of these parasites [30]. The results of logistic regression analysis of the association of the prevalence of lungworms with altitude where highland sheep are virtually three times and midland sheep are almost twice more likely to be infected with lungworms than sheep from lowland commands special consideration to be given to highland sheep in the endeavors to undertake prevention and control of lungworm infections in these animals.

It was observed that the prevalence was higher in female animals compared to male animals. Female animals are almost three times more likely to be infected than male animals and this variation was statistically significant ($P<0.05$). In support of our findings, Alemu *et al*. [17] and Sissay [23] showed that female animals are more susceptible to lungworms infection than males. On the other hand, Nemat and Moghadam [22] reported that the lungworm infestation rate of male sheep was higher than that of the female ones. The difference in prevalence between female and male animals in this study could be attributed to the fact that resistance to infection decreases at the time of parturition and during early lactation. This per parturient relaxation of resistance may result in the females' inability to expel adult worms which cause higher level of larvae detection [31].

In relation to the age of the animals, younger sheep were found to be significantly affected ($P<0.05$) by the infection of lungworm than older ones. This finding is in agreement with Uqbazghi [29] and Wondowossen [26] who reported that young sheep were found to harbor as many lungworms as compared with adult sheep. This has been partly explained by the acquired immunity developed in older animals due to previous exposure and sheep that recovered from the infection have better immunity against re-infection [16, 32].

While assessing the influence of body condition score on the prevalence of lungworm infection, the prevalence was significantly the highest ($P<0.05$) in those sheep with poor body conditions than in those with medium or good body conditions. The odds of sheep with poor body conditions and medium body conditions to be infected with lungworms as compared to sheep with good body conditions were higher. This is in accord with the report of Thomson and Orita [33]. The possible explanation for this observation could be due to immuno-suppression in sheep with poor body conditions, concurrent infection by other parasites including GIT helminthes and/or malnutrition [34]. Poorly nourished sheep appear to be less competent in getting rid of lungworm infection [27, 35]. Evidently, the infestation with a parasite by itself might results in progressive emaciation of the animals.

CONCLUSION AND RECOMMENDATIONS

The overall prevalence of ovine lungworms recorded in the study area was high. *D. filaria*, *P. rufescens* and *M. capillaris* were the species of respiratory nematodes identified in the study area while *D. filaria* being the predominant one, although mixed infections was also observed. The prevalence of lungworm infection increased with altitude. Female animals are more susceptible to lungworms infection than males. Younger sheep were found to be more affected by the infection of lungworms than older ones. The prevalence of lungworm infection was the highest in those sheep with poor body conditions than in those with medium or good body conditions. Finally, the result of current study revealed that lungworms are major parasites that affect the health and productivity of sheep in the area; hence, due attention should be given to the sector to mitigate the setback.

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