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Study on Lungworm and Associated Risk Factors of Small Ruminants in Hitosa Woreda, Ethiopia

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Abstract: A cross-sectional study was carried out from November, 2015 to April, 2016 in selected villages of Hitosaworeda, Oromia region, Ethiopia to determine prevalence, risk factors and identifying species of lungworm in small ruminants. Coproscopical examination was conducted on 400 (322 sheep and 78 goats). Simple random sampling technique was followed to select sampling units. Fecal samples from sheep and goats of all age groups and both sexes were examined by modified Baermann technique for the extraction of L1 larvae. The overall prevalence of lungworm infection was 45% in coproscopic examination. The prevalence of lungworm at sex level was 35.9% and 49.3% in male and female, respectively. The prevalence at species level was 43.8% and 50.0% in ovine and caprine, respectively. There was no statistical significance difference in the prevalence of lungworm infection between species of animals during coprological examination ($p>0.05$). However, there was statistical significant difference in the prevalence of lungworm infection on body condition ($p<0.05$). Identified species of lungworm were *Muellerius capillaris*, *Dictyocaulus filaria*, *Protostrongylus rufescens* and mixed in rate of 20.8%, 10.5, 2.8, 11% in coproscopic examination respectively. *Mulerius capilaris* had the highest prevalence in the study area than other species of lungworms. Due to its impact on production, emphasis should be given for the control and prevention of lungworm infection in this area.

Key words: Bearman technique · Hitosa · Lungworm · Prevalence · Small Ruminants

INTRODUCTION

Ethiopia has a population of about 44 million cattle, 23 million sheep and 23 million goats; however, the economic gains from these animals remain insignificant when it is compared to their huge number. This low productivity is a reflection of disease, limited genetic potential and husbandry standard. The morbidity of animals generally estimated to be in the range of 8-10% of national cattle herd per annum and 14-16%, 11-13% of national sheep and goat flock per annum, respectively with average live weight loss of 70kg for cattle and 6kg for sheep and goat. The national value of this direct loss estimated to be of 550 million Ethiopian birr [1].

Small ruminants are important domestic animals in tropical livestock production systems. They play a great role in food supply, a source of income and foreign currency small ruminants provide as much as 30% of meat and milk consumed in sub-Saharan Africa and is found on small holdings throughout the continent. They are especially important in the more extreme climates of the world [2].

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. Sheep and goats contribute a quarter of the domestic meat consumption; about half of the domestic wool requirement; 40% of fresh skins and 92% of the value of semi-proceed skin and hide export trade. It is estimated that 1, 078, 000 sheep and 1, 128, 000 goats are used in Ethiopia for domestic consumption annually. There is also a growing export market for sheep and goats meat in the Middle Eastern Gulf States and some African countries. At optimum off take rates, Ethiopia can export 700, 000 sheep and 2 million goats annually and at the same time supply, 1, 078, 000 sheep and 1, 128, 000 goats for the domestic market [3].

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Lungworms can result in infection of thelower respiratory tract, usually resulting in verminous bronchitis or verminous pneumonia. The common causes of verminous pneumonia in sheep andgoats are *Dictyocaulus filaria*, *Protostrongylus rufescens* and *Muellerius capillaris*. *D. filaria* belongs to the super family Trichostrongyloidea while the latter two belong to Metastrongyloidea, which have direct and indirect life cycles, respectively. Although mixed infection may occur, *D. filaria* predominates in most outbreaks [2].

Up to half of all sheep deaths and morbidity on farms in Ethiopian highlands are caused by pneumonia and endoparasites. Endoparasites, including *Dictyocaulus filaria*, are major causes of death and morbidity [4]. Very few and limited studies were done so far pertaining to respiratory helminthes of small ruminants in the study area. Therefore, the objectives of the study were (i) to determine the prevalence of lungworm infection in small ruminants through coproscopic examination, (ii) to identify some of the determinant risk factors involve in infection and identify the involved lungworms species.

MATERIALS AND METHODS

Description of Study Area: The study was carried out from November, 2015 to April, 2016 in five randomly selected villages of Hitosa woreda, Oromia region of Ethiopia. The study area has a latitude and longitude of 08°08'N 39°14'E / 8.133°N 39.233°E coordinates, 08°08'N 39°14'E / 8.133°N 39.233°E with an elevation ranges from 1500 to 4170 meters above sea level. Hitosa woreda covers 937km^2 area and 170 km Southeast of Addis Ababa. The area has a biomodal rainfall occurring from March to April (a short rainy season) and from July to October (long rainy season). The annual temperature range is 10-22.6°C. It has a daily maximum temperature that can reach up to 28°C and minimum temperature of 10°C. There is mixed farming of crop production and animal breeding. A survey of the land in this woreda shows that 52.8% is arable or cultivable (46.5% was planted in cereals), 16.3% pasture, 28.1% forest and the remaining 2.8% is considered swampy, mountainous or otherwise unusable [5]. The geographical map of the study area (Hitosa) showed below in Figure 1.

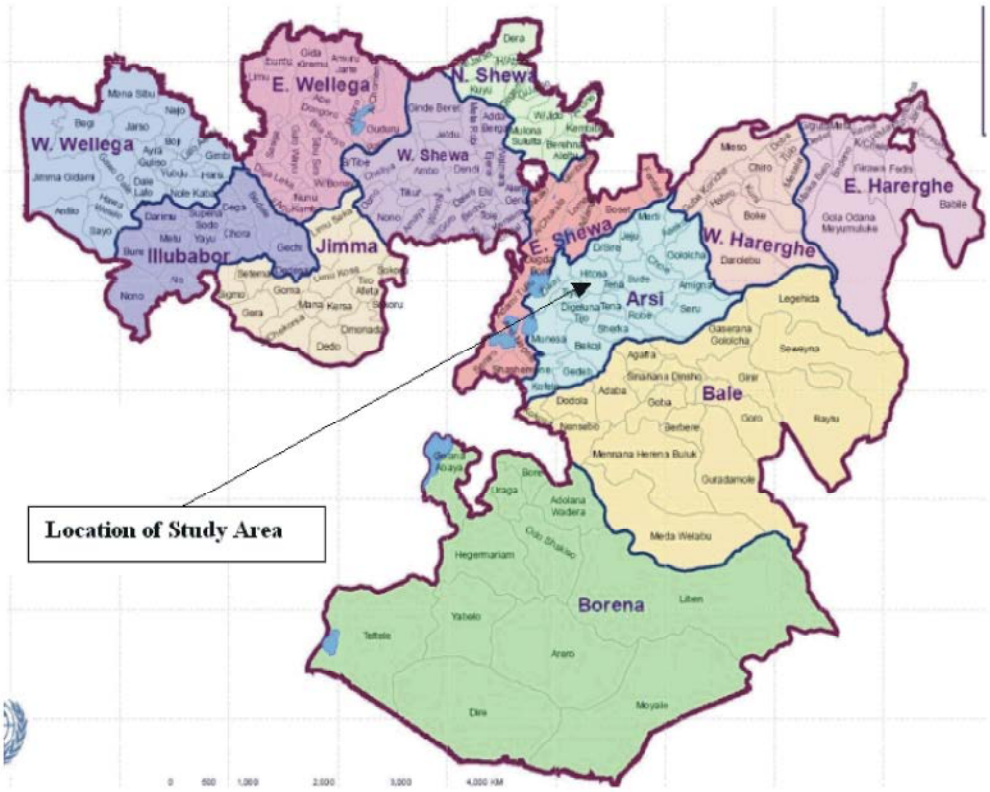

Fig. 1: Map showing study area
Source [6]

Study Animals: The study animals were sheep and goats of mixed age groups, sexes and various body conditions in selected villages in Hitosa woreda. Small ruminants in the study area were kept under extensive traditional management system. The study animals were local (indigenous) breed. These animals were maintained in small house hold flocks of mixed age for subsistence and small scale private farms for sale. In the study area the number of goats was low compared to sheep population. Animals of greater than one year of age form the largest proportion. Generally, the proportion of male to female was very small in any flock of sheep and goats. Animals were categorized into three age groups, group one (= 1year), group two (> 1year- = 3year) and group three (> 3 year) [7].

Study Design: A cross-sectional study design was carried out to determine the prevalence of lungworms in small ruminant in selected five villages ofHitosa woreda, Oromia region, Ethiopia. The variables of interest considered as an input variable versus risk factors during the study were fecal status for larvae. Age, sex, body condition and species of the animals studied were considered as explanatory variables.

Study Methodology

Sample Size Determination and Sampling Method: Sample size required for this study was determined depending on the formula given by (Thrusfield, 1995) [8] considering expected prevalence 50%, 95% confidence interval and 5% desired absolute precision. Adding few more samples to improve accuracy, a total of 400 samples were considered for coprological examination. Simple random sampling technique was employed to select sample units. Proportional samples were taken from five villages (Boru Chilalo, Debeya Adare, OdaJila, Gora Jawi and Ada Shaki) of Hitosaworeda.

$$N = \frac{1.96^2 P_{exp}(1 - P_{exp})}{D^2}$$

where;

N = Required sample size
P_{exp} = Expected prevalence
D = Desired absolute precision

Sample Collection and Transportation: After wearing plastic disposable gloves, fecal samples were collected directly from the rectum of animals, put in screw capped glass bottles, packed in an ice box from the field and transported to Asella Regional Veterinary Laboratory. At the time of examination, necessary data were recorded including type of sample, species, sex, age, date of sampling and the body conditions of animals [9].

Parasitological Technique: In laboratory, isolation of lungworm larvae from feces of small ruminants was performed by using Modified Baerman technique. Five grams of fresh feces were weighed from each sample for the extraction of L1 larvae using Modified Baerman technique. Feces samples were fully enclosed in cheesecloth fixed with metallic stick (a graph) rest on the edges of the funnel glass. The glass was filled with clean cold water until the sample became submerged making sure that the corners of the cheesecloth did not hang over the edge of the funnel. The whole apparatus was left for 24 hours and then the sediment was examined under the lower power of the microscope after siphoning off the supernatant [10].

The larvae (L1) of *Dictyocaulus filaria* is larger in size, brown in color due to food granules in their intestinal cells with cranial cuticular knob and blunt tail while L1 of *Muellerius capillaris i*s smaller in size, whitish in color with “S” shaped tip and dorsal spine and L1 of *Protostrongylus* is also whitish in color smaller in size with “S” shaped tip that is similar with L1 of *Muellerius capillaris* but without dorsal spine [11].

Data Analysis: The data obtained were coded and entered to Microsoft Excel and analyzed in SPSS version 20. Descriptive statistics was used to determine the prevalence of lungworm in small ruminants and Chi-square test was used to point out the possible association of risk factors with the prevalence of lungworms infection for possible significant difference. The differences were regarded as significant if ($p < 0.05$).

RESULTS

There were 400 small ruminants (322 sheep and 78 goats) included in the study to determine prevalence, risk factors and species of lungworm. Coproscopic examination was employed to investigate larvae (L1).

Coprological Examination: Out of the total 400 fecal samples collected (322 sheep and 78 goats), 180 were positive for lungworms with overall prevalence of 45% (180/400). The examined animals were found to be infected

Table 1: Prevalence of lungworm infection on coproscopic examination

Species	No. examined	Positive	Prevalence (%)	X^2	P-value
Ovine	322	141	43.8	.979	.375
Caprine	78	39	50		
Total	400	180	45		

Table 2: Prevalence of small ruminant lungworm infection based on sex, age, body condition on coproscopic examination

Risk factors		No. examined	Positive	Prevalence (%)	X^2	P-value
Sex	Male	128	46	35.9	6.246	.012
	Female	272	134	49.3		
Age	≤ 1 year	164	60	36.6	8.422	.015
	>1year-≤3 year	206	103	50		
	>3 year	30	17	56.7		
Body condition score	Poor	91	81	89	142.694	.000
	Medium	118	68	57.6		
	Good	191	31	16.2		

Table 3: Percentage of lungworm species in coproscopic examination

Species of lungworm	No. Positive	Percentage (%)
D. filaria	42	10.5
M. capilaris	83	20.8
P. rufscens	11	2.8
Mixed	44	11
Total	180	45

with one or more larvae (L1) of lung worms when their fecal samples were examined by modified Baerman technique. The specific prevalence was found to be 43.8% (141/322) and 50% (39/78) in sheep and goats, respectively. There was no statistical significant difference in the prevalence of lungworm infection between species of animals during coprological examination ($p>0.05$) (Table 1).

Overall prevalence of lung worm infection in relation to sex of animals was found to be 35.9% (46/128) and 49.3% (134/272) in male and female animals, respectively. There was statistical significant difference (X^2= 6.246, $p<0.05$) between male and female animals in susceptibility to lungworm infection (Table 2). The infection rate of lungworms in different age groups was 36.6%, 50% and 56.7% in =1year, >1year -= 3year and > 3 year, respectively. There was statistical significant difference in the overall prevalence of infection among the age categories (X^2=8.422, $p<0.05$) (Table 2).

The body condition of animals was found to be significantly associated with the prevalence of lungworm infection (X^2 =142.694, $p <0.05$). A higher infection rate was observed in animals having poor body condition as compared to other groups. The lungworm infection was recorded to be 89% in animals with poor body condition, 57.6% in those with medium body condition and 16.2% in animals with a good body condition (Table 2).

In respective of species of lungworms among the whole samples were 10.5% (42/400), 20.8% (83/400), 2.8% (11/400) and 11% (44/400) for *Dictyocaulus filaria*, *Muellerius capillaris, Protostrongylus rufescens* and mixed infections, respectively (Table 3).

DISCUSSION

A cross-sectional study was conducted from November, 2015 to April, 2016 to determine prevalence, risk factors and species of lungworm. The current overall prevalence was 45% in coproscopical examination. The common species of lungworms in small ruminants were *Dictyocaulus filaria*, *Muellerius capillaris* and *Protostrongylus rufescens.* Association of the prevalence of lung worm infection in small ruminants with different risk factors was also assessed and analyzed.

The prevalence of lungworm infection was 45.0% in coprological examination. This finding was closely agreed with previous study done by Sisay[12] who reported 44.7% in Bahir Dar, Bogale *et al.* [13] reported 43.33% in Dessiezuria District, Northeastern Ethiopia and Regassa *et al*. [14] reported 40.4% in Dessie and Kombolcha districts, Northeastern Ethiopia. However, the overall prevalence of lung worm infection in small ruminants recorded in this study was lower than the overall prevalence of lung worm infection in small ruminants that

was reported by Serkalem *et al*. [15], Alemu *et al.* [4] and Paulos [16], who reported the overall prevalence of lung worm infection in small ruminants, 55.20 %, 53.60 % and 52.40 %; in Dale district, in Northern Ethiopia and in Chilalo, respectively. The difference might be due to the difference in detection of larvae or different in topography which favored larvae survival.

Whereas, the overall prevalence of lung worm infection in coproscopic examination in small ruminants was higher than Fentahun *et al*. [17], Dawit and Abdu [1] and Uqbazghi [18] who reported 29.04%, 26.70 and 27.60% in Dessie and Kombolcha districts, in Gondar town, in Jimma and in HamassinAwraja, respectively. The difference might be due to the nutritional status of the animals in the respective study areas which could influence level of immunity to be infested by lungworms.

Regarding to species, high prevalence of (50%) was observed in goats compared to sheep (43.8%) in coproscopic examination, with no significant difference ($p>0.05$). This result conceded with Alemu *et al*. [4] who reported that goats were more susceptible to lungworm infection. This might be due to the difference in grazing behavior of these species of ruminants. Goats appeared to be more susceptible to helminthes than sheep as they appeared to develop less immunity. Sheep predominantly graze; pick up more parasites so have higher acquired resistance than goats which mostly consume browse. Goats with their browsing behavior consume uncontaminated matter with parasite larvae, so being less exposed to infective larvae and therefore have lower acquired resistance than sheep [19].

Regarding sex, high prevalence (49.3%) in females as compared to 35.9% in males was recorded in coproscopic examination. The association of lung worm infection in relation to sex of animals was found to be statistically significant ($P <0.05$). The result was in agreement with previous work done by Tewodros [20] in and around Bahir Dar and Tigest [21] in North and South Gondar, female 28.9%, male 13.4% and female 43.3% and male 33.57%, respectively. Similarly, Addis *et al*. [22] reported the prevalence of lung worm infections 36.22% and 30.43% in female and male animals, respectively, in Gondar town. However, this finding disagreed with the work of Serkalem *et al.* [15] in Dale district, who reported the equal susceptibility of the two sex groups for lung worm infection. This difference in prevalence between female and male animals might be due to resistance to infection is abrogated at the time of parturition and during early lactation. This preparturient relaxation of resistance results in the female is inability to expel adult worms which cause higher level of larvae detection [23].

With regard to age, prevalence was high (56.7%) in animals >3years old (aged) followed by animals >1year ≤3years old (adult) (50%) and the least prevalence (36.6%) was detected in animals≤1year old (young) in coproscopic examination. There was statistical significant difference ($p<0.05$) between different age groups. These findings were in agreement with the study of Alemu *et al.* [4] who reported that the highest infection rate with lungworm was observed in older animals than in younger animals. This may be associated with *Protostrongylus rufescens* was higher in adults than in young. The reason why old affected more than young may be due to impaired development of acquired immunity in adult or due to young animals may not be exposed to intermediate host [9]. The prevalence of *D. filaria* was higher in infants than adults. However, the prevalence of *M. capillaris* and *P. rufescens* was higher in adult animals than younger. 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 small ruminants have the heaviest infection and the highest prevalence [24].

Concerning body condition; the prevalence of lungworm infection was higher (89%) in animals of poor body condition than those of medium (57.6%) and good (16%). The difference was statistically significant ($p<0.05$). This finding conceded with Alemu *et al*. [4], Muluken [25] and Mengestom [26] who reported that high prevalence was found in animals which had poor body condition. This might be associated with the nutritional management of animals. Poor body condition occurred as a result of lack of feed or nutritional management. This may lead to lack of resistance to infection and contribute for increased prevalence rate in poorly conditioned animals. Furthermore, considerable weight loss was associated with infection as a result of *D. filaria* [27]. Poorly nourished sheep and goat appeared to be less competent in getting rid of lungworm infection. Evidently, the infection with a parasite by itself might results in progressive emaciation of the animals [9].

The major species of lung worms of the area were identified coprologically. Hence, the prevalence of different species of lung worms was found to be different; and it was found 10.5%, 20.8%, 2.8% and 11% of animals were infected by, *Dictyocaulus filaria*, *Muellerius capillaris, Protostrongylus rufescens* and by mixed infection of two or more species of lung worms, respectively. *M. capillaris* were the predominant species

in the study area followed by *D. filaria* and *P. rufescens*. This finding was supported by Sissay[12] in Bahir Dar and Mezgebu [28] in Addis Ababa. In contrast to the present findings, Alemu *et al*. [4] reported that *D. filaria* was the most prevalent in their survey. This predominance of *M. capillaris* in the study area might be attributed to the presence of favorable environment for breeding and development of snail intermediate hosts and the parasite. The other reason might be the ability of L1 larva to survive for months in fecal pellets and the persistence of the L3 larva in the intermediate host for the life time of the mollusks [24].

CONCLUSION AND RECOMMENDATIONS

In general, this study revealed high prevalence of lungworm in the study area which had a significant impact on heath and production. The overall prevalence of lungworm was 45% in coproscopic examination. Different risk factors affecting the prevalence were body condition, age, sex and species. Female and poorly body conditioned animals were more prone to lungworm infection. The respiratory nematodes, *D. filaria*, *M. capillaris* and *P. rufescens* were the species of lungworms identified in coproscopical examination in the study area. *M. capilaris* was found predominantly in the study area.

Based on the aforementioned conclusion the following recommendations were forwarded:

- Strategic deworming of small ruminants using broad-spectrum anthelminthics should be exercised
- Choosing the best parasitic control strategy and grazing management system of small ruminants should be practiced.
- Further works were recommended to study the seasonal pattern of lung worms and define other species in this region.

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