

## Prevalence of Small Ruminant Lung Worm Infection in Yilmana Densa District Northwest Ethiopia

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**Abstract:** A cross-sectional study was conducted from November 2017 to March 2018 to estimate the prevalence of lungworms infection and to investigate possible risk factors associated with small ruminant lungworm infections in Yilmana densa district of Amahara region, Ethiopia. Fecal samples were collected from randomly selected 384 animals (242 sheep and 142 goats) to examine first stage larvae L (1) using modified Baerman technique. The overall prevalence of lungworm infections in the study area was 53.13% (95%CI: 48.11-58.13%) in coproscopic examination. Prevalence of lungworm infection was significantly higher in goats (59.86%) than in sheep (49.17%). Three species of lungworms were identified with higher proportion of infection with *Dictyocaulus filaria* (62.75%) and *Mulliries capillaries* (23.5%). Univariable and multivariable logistic regression analyses indicated that host related factors such as animal age, sex, body condition, respiratory illness and management were identified as potential risk factors for the occurrence of lungworms infection in small ruminants in the study area. Female animals were more likely of getting lungworm infection (OR= 2.056; p=0.001) as compared to male animals. Young age (OR=1.69; p=0.012), poor conditioned animals (OR=24.42; p=<0.001) and animals with respiratory illness were at higher risk of getting lungworm infections.

**Key words:** *Dictyocaulus filarial* • *Mulliries capillaries* • Coproscopic • Fecal Sample

### INTRODUCTION

Ethiopia has a population of about 29 million sheep and 23 million goats. However, the economic gains from these animals remain insignificant when it is compared to their huge number. The livestock sector plays a vital role in the national economy of developing countries. It plays a great role in food supply, a source of income and foreign currency. In Ethiopia, small ruminants contribute 35% of meat and 14% of milk consumption, 12-16% of the total export earnings [1].

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 and 11-13% of national sheep and goat flock per annum, respectively with average live weight loss of 70 kg for cattle and 6 kg for sheep and goat [2].

The national value of this direct loss estimated to be of 652 million Ethiopian birr [3]. Verminous pneumonia due to various lungworm species has been reported to exist in sheep and goats particularly in the high land areas

of Ethiopia [4]. Therefore to increase the potential of small ruminant production and to get the maximum benefit from them prevention and control of lungworms is very important.

Therefore, this study was designed with the following objectives:

- To determining the prevalence of lungworm infection in small ruminants in Yilmana Densa
- To identifying lungworm species prevalent in the study area
- To determine the possible risk factors associated with the occurrence of lungworm infections

### MATERIALS AND METHODS

**Study Area:** The study was conducted in Yilmana Densa District of Amhara regional, North-western part of Ethiopia. It is located at a distance about 565 km away from the capital city of the country Addis Ababa, Yilmana Densa is one of the Woredas in Mirab Gojjam Zone, Amhara Region of Ethiopia. Yilmana Densa is bordered on

the south by Kuarit, on the southwest by Sekela, on the west by Mecha, on the north by Bahir Dar Zuria, on the east by the Abay River which separates it from the Debub Gondar Zone and on the southeast by the W. Gojjam Zone. The major town in Yilmana Densa is Adet. The district is located at altitude ranging from 1552 to 3535 m. The average annual rain fall is 1270 mm with the main rainy season, from May to October. The agro-climatic zone comprises low land (12%), mid highland (64%) and highland (24) the temperature range is about 10°C- 30°C. The farming system in the area is mixed type (Crop-livestock production).

**Study Animal and Management:** Small ruminants (Sheep and goats) in the study area were kept under extensive and semi-intensive management system. These animals were maintained in small house hold flocks of mixed age for subsistence and small scale privet farms usually for sale. Most of small ruminants were managed under extensive management system but small number of sheep and goats were managed semi-intensive management system.

**Study Design:** The study was cross-sectional survey involving 384 small ruminants 242 ovine and 142 caprine of which were 173 males and 211 were females. The explanatory variables considered were body condition, respiratory sign, age, sex and species of animal and management system. Each individual of the sampled sheep and goats were examined for the presence of lungworm through clinical examination, to determine the prevalence of lungworm infection and also to assess host and environment related factors on the occurrence of the disease in sheep and goats in Yilmana densa district, West Gojam.

**Sample Size Determination:** Systematic Simple random sampling technique was used to calculate the total sample size, the following parameters were used: 95% level of Confidence (CL), 5% desired level of precision and with the assumption of 50% expected prevalence of lungworm in sheep and goats the sample sizes were determined using the formula given by Thrusfield [5].

$$n=1.96(1.96)*P_{exp}*(1-P_{exp})/d*d$$

where

N = required sample size

Pex = expected prevalence

D = desired absolute precision

**Sampling Procedure and Data Collection:** About 384 samples were taken randomly from extensive and semi intensive farms found in Adet town. Fecal samples were collected directly from rectum of all selected animals using disposable gloves and stored in universal bottle until examination. During sample collection the date, species, sex, age and management system were properly recorded.

Each bottle was properly labeled corresponding to the animal identity. The techniques recommended by Fraser and Urquhart were employed for identification of lungworm species from the collected samples. In the laboratory, following conventional method of Baerman technique for detection of lungworm larvae, 25 g of fresh faces was weighed from each sample for the excretion of L<sub>1</sub> larvae. Samples were enclosed with gauze fixed on to a string rod and submersed in a clean glass tube filed with warm water a Baerman apparatus.

The whole apparatus was left for 2-3 h and then the sediment was examined under the low power of microscope after siphoning off the sediment. If the samples were found to be positive a drop of 1% iodine solution was used to immobilize the larvae for species identification.

**Data Management and Analysis:** The result from fecal examination was properly recorded and entered into Microsoft Excel spreadsheet and summarized by descriptive statistics. The association between the prevalence of lungworm infection and different risk factors: body condition, respiratory sign, sex, age and management system was evaluated by using Chi-square (2) test. A P value < 0.05 was considered for prevalence of significance. STATA version 11.0 (Stata Corp College Station, TX) was used for all types of analyses.

## RESULTS

A total of 384 small ruminants (Sheep and goats) from different extensive and semi intensive husbandry systems were examined under coproscopy. Of the total small ruminants examined under coproscopy, the overall prevalence was found to be 53.13% (95%CI: 48.11-58.13%) (Table1). The variation of lungworm prevalence among sheep (49.17%) and goats (59.86%) was statistically significant (P<0.05).

The distribution of lungworm prevalence by sex was higher in female animals (61.13%) compared to their counter parts males (43.35%) and the difference was highly significant (P<0.001). Comparison of the prevalence

Table 1: Prevalence of small ruminant lungworm infections based on species, sex, age, body condition, respiratory sign and management

Category	Variables	No. examined	No. Positive	Prevalence (%)	95%CI	p-value
Species	Ovine	242	119	49.17	42.8-55.5	0.042
	Caprine	142	85	59.86	51.7-68.0	
	Total	384	204	53.13	48.11-58.13	
Sex	Male	211	129	61.13	54.5-67.8	0.001
	Female	173	75	43.35	35.9-50.8	
Age	Adult	217	103	47.46	40.8-54.2	0.011
	Young	167	101	60.47	53.0-68.0	
Body condition	Poor	102	81	79.41	71.4-87.4	0.001
	Medium	194	111	57.21	50.2-64.2	
	Good	88	12	13.64	6.3-20.9	
Respiratory Symptom	Absent	185	36	19.46	13.7-25.2	0.001
	Present	199	168	84.42	79.3-89.5	
Management	Extensive	240	128	53.30	44.5-61.0	0.92
	Semi-intensive	144	76	52.80	47.0-60.0	

Table 2: Species of lungworms identified in the study area

Parasitic lungworm spp.	Ovine	Percentage	Caprine	Percentage	Total number	Percentage
<i>D. filaria</i>	77	64.71	51	60.00	128	62.75
<i>M. capillaries</i>	29	24.37	19	22.35	48	23.53
<i>P. rufescense</i>	8	6.72	5	5.88	13	6.37
Mixed	5	4.20	10	11.76	15	7.35
Total	119	100	85	100	204	100

Table 3: Risk factor analysis of lungworm infection by using univariable and multi variable

Risk factor	Variables	Univariable (LR)			Multivariable		
		OR	95% CI (OR)	p-value	OR	95% CI (OR)	p-value
Species	Ovine	1.00			1.46	0.82-2.60	0.23
	Caprine	1.54	1.01-2.35	0.043			
Age	Adult	1.00			1.99	1.12-3.56	0.020
	Young	1.69	1.12-2.54	0.012			
Sex	Male	1.00			1.94	1.10-3.43	0.021
	Female	2.06	1.36-3.09	0.001	-	-	
Body condition	Good	1.00	-	-	3.02	1.91-4.77	<0.001
	Medium	8.46	4.32-16.58	<0.001	-	-	
	Poor	24.42	11.25-53.03	<0.001			
Respiratory Symptom	Absent	1.00			14.5	8.26-25.7	<0.001
	Present	22.43	13.22-38.04	<0.001	-	-	
Management	Semi intensive	1.00	-	-	6.05	0.71-52.0	0.101
	Extensive	0.81	0.51-1.31	0.046			

of lungworm infections in the different age groups showed relatively higher prevalence in young age group of <1 year (60.47%) and the lowest prevalence was observed in adults >1 years (47.46%). The difference was statistically significant ( $P<0.05$ ).

The influence of body condition of the animals on the prevalence of lungworm infection was also assessed and the prevalence variation was highly significant ( $p<0.001$ ). The prevalence of infection was higher in poor conditioned animals (79.41%) followed by medium conditioned animals (57.21%).

The lungworm infection was also assessed by the respiratory health status of animals based on coproscopic larvae burden and the prevalence was significantly ( $P<0.001$ ) higher in animals with respiratory syndromes (84.42%) compared to apparently healthy animals. Husbandry system has also affected the prevalence of lungworm infection where it was reported higher (90%) in free grazing animals.

Identification of the lungworm species were done based on the morphology of the larvae. Different species of pathogenic lungworms important in sheep and goats

were reported during the study (Table 2). The lungworm species identified were *Dictyocaulus filarial* (*D. filaria*), *Mullerius capillaris* (*M. capillaris*) and *Protostrongylus rufescens* (*P. rufescens*). The proportion was higher for *D. filarial* (68.8%) followed by *M. capillaris* (53.9%) and *P. rufescens* (23.2%). A mixed infection of *D. filarial* and *M. capillaries* was also reported at the rate of 28.3%.

#### Univariable and Multivariable Logistic Regression (LR)

**Analysis of Lungworm Infections:** The effect of different host and management related risk factors for the occurrence of lungworms infection in the study area was analyzed using univariable and multivariable logistic regression analysis. Univariable analysis was first conducted for each predictor variable independently. Then significant predictors with  $p < 0.25$  in the univariable analysis were modeled in multivariable analysis for identifying the possible risk factors associated with high prevalence of lungworm infections in the study district.

In the univariate analysis all predictor variables included in the study were found associated with the occurrence of lungworm infections. Regarding species of animals, goats were 1.54 times more likely of getting lungworm infection ( $OR = 1.54$ ;  $p = 0.043$ ) than sheep. Out of the total sheep and goats examined, female animals were at higher risk of being infected ( $OR = 2.05$ ;  $p = < 0.001$ ) than male animals. Similarly poor conditioned animals ( $OR = 24.42$ ;  $p < 0.001$ ) and animals with respiratory symptoms were at higher risk ( $OR = 22.43$ ;  $p < 0.001$  of getting lungworm infection.

After multivariable logistic regression analyses, all predictor variables except variable species and management were significantly associated with lungworm infection and were considered as potential risk factors.

#### DISCUSSION

The present study revealed the presence of nematode species parasitizing the respiratory tract of small ruminants that causes bronchitis and pneumonia with an overall prevalence of 53.1% by coproscopic examination. The prevalence distribution in species showed 49.17% in sheep and 59.86 in goats. This level of prevalence was in agreement with previous studies conducted by Alemu *et al.* [4] in North West Ethiopia, Mezgebu [6] in Addis Ababa and Mihreteab and Aman [7] in Tiyo who reported prevalence of 53.6%, 48% and 57.1%, respectively. However, the current finding was higher than prevalence's reported by Weldesenbet and Mohamed [8] in and around Jimma, Beyene *et al.* [9] around Ambo (34.9%), Addis *et al.* [10] 33.8% and

Terefe *et al.* [11] 46% in North Gondar, Tsegay [12] 32.2%, in Gaint, South Gondar and Dawit [13] 27.7% in and around Tse-Ada-Emba. The possible explanation for variation in the infection rate could be attributed to the variation in the altitude, rain fall, humidity and temperature in different areas of the country as well as with differences in the larval detection methods, the difference in the study areas which favors the survival of the larvae of the lungworm or the snail intermediate host in case of *P. rufescens* and the different sample sizes used by the researchers. It might also be associated with nutritional status, level of immunity, management practice of the animal, rain fall, humidity, temperature differences and season of examination in the respective study areas.

It was also disclosed that animals are infected with three nematode species parasitizing the respiratory tract of small ruminants of which *Dictyocaulus* and *Mullerius* species are the most abundant. *Dictyocaulus filarial* was the most prevalent (62.75%) followed by *M. capillaries* (23.5%). This finding is in agreement with the reports of Regassa *et al.* [14] in Desse, Kombolcha and around Gondar. But it disagrees with the report of Sissay [15] in Bahirdar (39.3%) and Mezgebu [6] in Addis Ababa who reported as *M. capilaris* is the most prevalent. This could be associated with the difference in the life cycles. *Dictyocaulus filarial* has a direct life cycle and takes less time to reach the infective stage and after ingestion, larvae can appear in the faces within 5 weeks [16]. Compared with *D. filarial*, transmission of *P. rufescens* and *M. capillaries* 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 area is because of sampling was done during dry season which is not suitable to the snails, intermediate host of these species to which larvae (L) develop to infective stage (L3). *P. rufescens* whose intermediate host range is restricted to certain species of snail has lower prevalence of the rest through its geographic range is just wide like.

The study revealed that goats were found to be more susceptible to lungworm infection (59.86%) than sheep (49.17). This finding agrees with the report of Alemu *et al.* [4] and Terefe *et al.* [11] who reported goats are more susceptible to infection than sheep. This could be because goats appear to develop less immunity due to their grazing behavior. Goats with their browsing behavior consume uncontaminated matter with parasite larvae, so being less exposed to larvae have lower acquired resistance than sheep [17]. Most of the goats in this study were also from lowland and mid altitude areas, which are thought to be suitable for survival of the larval stage of the parasite.

Prevalence of 61.13% and 43.35% was recorded in female and male animals respectively. This shows that there was highly significance difference ( $P < 0.001$ ) between the sex groups indicating female animals are more susceptible to lungworm infection than males. This result concurs with earlier observations of Alemu *et al.* [4], Abebe [18] and Mekonen *et al.* [19]. This difference in prevalence's between female and male animals could be due to the fact that resistance to infection decreases at the time of parturition and during early lactation. This per parturient relaxation of resistance result in the females inability to expel adult worm's which cause higher level of larvae detection and the high prevalence in females could be related to difference in management [20].

The influence of body condition on the prevalence of lungworm infection was reported in this study. The prevalence was significantly higher ( $P < 0.05$ ) in those sheep and goat with poor body conditions than in those with relatively good body conditions. This was in concurrence with Bekele and Aman Abu [21] and Thomson and Orita [22]. Further this might be attributed to immuno-suppression in sheep and goat with poor body conditions, concurrent infection by other GIT parasites and/or malnutrition [22]. Evidently, the infestation with a parasite by itself might result in progressive emaciation of the animals.

With regard to age, the overall prevalence of lungworm infection was higher in lambs ( $< 1$  year) than adults ( $> 1$  year). This finding is in line with Mekonen *et al.* [19], Radiostitis *et al.* [23] and Urquhart *et al.* [24] who reported that young sheep and goats were found to be infected more than adults. However, this finding was contrary to the reports of Alemu *et al.* [4]. This might be associated with the naturally acquired immunity against infection slowly develops with age and *D. filarial* infection decrease with increasing age of the animal.

In this study, small ruminants under extensive management system had more infection than those kept under semi-intensive management system. This finding is in line with reports of Sissay [15] and Mekonen *et al.* [19]. This could possibly be due to malnutrition of small ruminants in extensive management system which reduces the host-parasite response and favors the fecundity of the parasites that allows the animals for continuous larvae exposure. Increased cultivation of land in the district restricts animals on communal grazing land so that large numbers of the animals are kept together which could increase the degree of pasture contamination leading to higher prevalence rate. In contrary, management practice such as provision of ample nutrition and watering increases the resistance of the host under the semi-intensive system lead to less risk of helminthes [25].

High prevalence of lungworm infection was recorded in sheep and goats with clinical respiratory signs than in those apparently healthy ( $P < 0.05$ ). The result coincides with the observation of Hasen *et al.* [26]. The respiratory symptoms can be due to that lungworms infection. Many of animals with respiratory signs were infected with *D. filarial* which suppresses the level of animal's immunity and exposes to secondary bacterial complications that can lead to the development of verminous pneumonia or bronchopneumonia.

## CONCULLUSION AND RECOMMENDATIONS

Lungworms are one of the most common causes of chronic respiratory disorder that cause huge losses in small ruminants. In the present work the prevalence of lungworms was found to be higher in Yilmana Densa district which was 53.13%. The major identified lungworm species in the study were *D. filarial* followed by *M. capillaries* and *P. rufescens*. In this study it has been concluded that sex, age, body condition, respiratory illness and free grazing management were important risk factors associated with the occurrence of lungworm infection. Female, young and poor conditioned animals were much prone to and highly affected with lungworm infection.

Therefore, based on the above conclusion the following recommendations were forwarded:

- Animal health workers should give attention to animal health extension to practice the control and prevention of lungworm infection.
- It is better to the animal owners to practice the improved animal husbandry to keep their animals healthy.
- Isolation of most susceptible age groups during the season when pasture contamination occurs

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