

## Epidemiological Studies on Ovine Lungworm Species in Northern Ethiopia

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### Abstract

A cross sectional study was conducted from November, 2015 to April, 2016 to determine the prevalence, associated epidemiological factors and identifying the species of ovine respiratory helminthes circulating in and around Wogera district. Modified Baermann technique was conducted to detect first stage larvae (L1) from 386 randomly sampled sheep kept under extensive and semi intensive management systems. Out of the total 386 faecal samples examined 180 were found to harboring one or more lungworm parasites with an overall prevalence of 46.6% (180/386). *Dictyocaulus filarial* (*D. filaria*) was the dominant lungworm species with prevalence of 18.9%, followed by *Mulliries capillaries* (*M. capillaries*) 14.2%, *Protostrongylus rufescens* (*P. rufescens*) 2.3% and Mixed infection with *D. filarial* and *M. capillaries* species (11.1%). In this study, animals with poor body condition (23.1%) were highly infected with significant difference ( $P < 0.05$ ) than medium (14.8%) and good body conditions (8.8%). There was statistical significant difference in susceptibility between different age groups ( $P < 0.05$ ), the young (25.1%) being more affected than adult (22.5%) animals. Significant differences ( $P < 0.05$ ) were found among areas of different altitude with an infection rate of 29% and 17.6% at higher and medium altitude areas respectively. Sheep kept under extensive management system and semi intensive management system also showed statistically significant variation ( $P < 0.05$ ) in infection rate with different lung worm species. The overall results obtained during this investigation showed that *D. filaria* is the most common lungworm species in its not only high prevalence rate, but also high degree of association with occurrence of clinical respiratory signs. The result of this study indicated that lungworms in sheep are common parasites which induce heavy economic loss that needs greater attention due to its impact on sheep production of the study area.

**Keywords:** Epidemiological factors; Ethiopia; Lungworm; Prevalence; Wogera district

### Introduction

Ethiopia possesses over 25 million sheep and 21 million goats [1], parallel to its diverse ecology, production systems and ethnic communities. The CSA of Ethiopia estimated [1] that farmers in Amhara region, north eastern Ethiopia, had a total of 6.4 million sheep which are representing 25% sheep population of the country. According to FAO [2], 25% of the total annual meat production of the country comes from sheep. At the national level, sheep and goat account for about 90% of the live animal/meat and 92% of skin and hide export trade value of the country [2]. Small ruminants in Ethiopia are well adapted to local climatic and nutritional conditions and contribute greatly to the national economy however; poor animal management coupled with infectious and parasitic disease had reduced productivity of small ruminants [3].

Helminth parasites are among the causes of substantial productivity losses in ovine production of the country [4]. Respiratory diseases resulting from helminthes parasites are of a great economic concern in sheep production in the highlands of Ethiopia where sheep are important livestock units [5,6]. The three respiratory parasites that cause a significant damage in small ruminant production are *D. filaria*, *P. rufescens* and *M. capillarius*. From those lungworms particularly *D. filaria* can suppress the immunity of the respiratory tract and causes death, poor weight gain or loss of body weight as well as greatly affects the potential productivity of sheep in the areas where it is prevalent [7].

Few studies have been conducted in some areas of Ethiopia indicated high prevalence of lungworm infection in sheep population and its economic importance of the infection in certain areas of the country. Prevention and control of these parasites are therefore, essential for releasing the potential of sheep production in the country. However, in order to lay down lungworm control strategy at local and regional level, detailed investigation of current epidemiological

situation and infection rate of lungworm infection in sheep population in the present study area is necessary, where sheep are important assets to the local farmers. Therefore, the objectives of this study were, to determine the prevalence of lungworm infection in sheep, identifying the major lungworm species circulating in and around Wogera district and epidemiological factors affecting the prevalence.

### Materials and Methods

#### Study area

The study was conducted in Wogera district starting from November 2015 to April 2016. Wogera is one of the districts of North Gondar Administrative Zone, in Amhara regional state, located at 782 km northern of the capital city, Addis Ababa, in between 37.36°E and 12.46°N longitude and at an altitude of 2900 m.a.s.l in the northern highlands of Ethiopia. The rainfall pattern of the district is bimodal, with a short rainy season from March to May, followed by a long rainy season from June to September. It has an average annual rainfall of 700 mm and the mean annual temperature is 12.7°C [8].

#### Study population

Indigenous sheep reared under small holder farming system of

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extensive and semi intensive management system in the study area from two agro ecological areas (highland and midland) with different sex, age, and body condition score (poor, medium and good) [9] were used during the study period. The age of the animals was estimated by stage of dentition [10], based on these animals were categorized into young age groups (<1 years) and adult aged groups (>3 years). Sheep those have clinical respiratory sign as shown by coughing and nasal discharge were examined and recorded before sample taking and apparently healthy animals were also isolated and recorded before sampling. The risk factors were assessed for the presence of possible significant association with presence of lung worm infection.

### Study design and sampling method

A cross-sectional study to determine the prevalence of lungworm infestation and stratified random sampling techniques were used to collect the data. Out of 25 of peasant association of Wogera district, 6 peasant association of the district were selected by considering the difference in altitude. From the selected peasant associations, households were randomly selected. Sheep from each selected household of peasant association was examined with equal sample size from each peasant association.

### Sample size determination

Simple random sampling strategy was followed to collect feces from the individual animals and a total of 386 fecal samples were collected and examined for lung worm nematodes, from purposively selected 6 peasant association of the district. To calculate the total size, the sample size was decided based on the formula described by Thrusfield [11]. The previous prevalence report of lung worm infection in sheep in Wogera district was reported to be 67.69% [12]. Therefore, an expected prevalence of 67.69% will be taken to estimate the sample size. Taking 95% confidence level, 5% precision and 336 sheep was need to establish the prevalence. However, 50 sheep were added in the study to increase the level of precision and randomness, and 386 sheep was sampled.

### Sample collection and parasitological examination

Fecal samples were collected directly from the rectum of each sampled animal with strict sanitation and placed in air and water tight sample vial, while collecting fecal samples, necessary parameters (date of sampling, sex, age, body condition, respiratory symptoms, altitude and management system) were properly recorded, and brought to Gondar University Veterinary Parasitology Laboratory. When samples were reached in the laboratory they were immediately stored in the refrigerator (4°C) until they were processed.

For coproscopic examination of the fecal samples, a modified Baermann technique as described by Charles and Robinson [13] was employed to identify first stage larvae (L1) of lung worms. Briefly, 3 g of fecal sample was enclosed in gauze, fixed on to string rod and submerges in clean beaker filled with tape water and left for 24 hrs. The larvae in the feces migrate to the gauze and settle at the bottom of the beaker. After siphoning of the supernatant, the sediment was examined under stereo microscope, when L1 larvae of lung worms were observed under the microscope, a drop of 1% iodine solution was added to the sediment to immobilize the larvae for species identification [14]. Finally, first stage larvae (L1) were morphologically differentiated and identified [15].

### Data analysis

Data collected from the study were entered to MS Excel sheet and analyzed by using SSPS version 20 software. Descriptive statistics was

used to determine the prevalence of lung worm nematodes and Pearson chi square test was used to assess the degree of association between each risk factor such as sex, age, body condition, altitude, management system and respiratory syndromes with lung worm infection. In all analyses confidence level was held at 95% and P-value less than 0.05 was considered as significant.

### Results and Discussion

Of the total 386 sheep examined over the study period, 180 were positive for lung worm infections and the study indicated an overall lungworm infection prevalence of 46.6% in Wogera district, northern Ethiopia. First stage larvae of *D. filaria* (18.9%), *M. capillaris* (14.2%), and *P. rufescens* (2.3%) were observed as single and mixed infections. Mixed infections were formed and observed between *D. filaria* and *M. capillaries* in 11.1% of sheep. This finding almost coincides with previous reports of overall prevalence rate of lung worm infection 48% in Addis Ababa by Mezgebu [16], 43.33% in Dessie zuria by Basaznew et al. [17] and 42% in North Gondar Zone by Yitagel et al. [18]. However, it was higher than reports of Muluken [19] in and around Bahir Dar, Kassa and Abdu [20] in Bahir Dar and Gebreyohannes et al. [21] in Mekedella Woreda, south east Ethiopia who reported prevalence of 18.16%, 20.2% and 28.6% respectively. With regard to the species of lungworms, it was observed that *D. filarial* was the predominant lung worm species in the study area followed by *M. capillaries* and *P. rufescens* in sampled sheep. This finding is more or less agrees with the previous findings of Nibret et al. [12] in Wogera district, northern Ethiopia, Tefera and Mekuria [22] in Debre Birhan Town who reported *D. filarial* is the dominant species to cause lung worm infection in sheep. However, in contrast to the present finding higher proportion of *M. capillaries* species was identified by Yitagel et al. [18] in North Gondar zone and Asaye and Alemneh [23] in and Around Bahir Dar City. The possible explanation for such variation in the prevalence of lung worm infection in different study areas could be attributed variation in agro-ecology of the study areas which favor or disfavor the survival of parasites larvae in general and/or the presence or absence of snail intermediate host in case of *P. rufescens* and *M. capillaris* in the study sites. Moreover, according to Bradford [24], the occurrence of lungworms is associated with time of sampling, methods followed to detect the parasitic larvae, level of immunity of sampled animals, management practice of the animal and expansion of veterinary services (Table 1).

In relation to the prevalence of lung worm infection in different age groups, 25.1% of young examined sheep were infected with different species of lung worm while, 22.5% of adult sheep were found infected with different species of lungworm. There is statistically significant difference in age susceptibility, the young age group being more affected by *D. filaria* (10.4%). This is in agreement with reports of Feseha and Gebrenegus [25], Teffera et al. [26] and Yohannes [27] in different part of Ethiopia who reported young animals are significantly more affected by different lung worm species than adult sheep. In contrast, this finding Besaznew et al. [17] in Dessie Zuria District, northeastern Ethiopia, reported higher prevalence of lung worm infection in adult animals. This variation in prevalence among different age groups might be due to the fact that there is development of acquired immunity in the adults due to previous exposure to the parasite and sheep that have recovered from previous infection have better protection (immunity against) re-infection [15].

In the present finding both sexes showed insignificant difference in susceptibility to infection with lungworms, even though the prevalence in female (32.4%) relatively higher than male (14.2%). This

Factors	Animals examined (%)	Prevalence of lungworm species (%)					X <sup>2</sup>	P-value
		<i>D. filaria</i>	<i>M. capillaries</i>	<i>P. rufescens</i>	Mixed infection	Total positive		
Age							15	0.00
Young	170(44)	40(10.4)	27(7)	4(1)	26(6.7)	97(25.1)		
Adult	216(56)	33(8.5)	28(7.3)	5(1.3)	17(4.4)	83(22.5)		
Sex							4.6	0.33
Male	124(32.1)	27(7)	12(3.1)	4(1)	12(3.1)	55(14.2)		
Female	262(67.9)	46(11.9)	43(11.1)	5(1.3)	31(8)	125(32.4)		
Body Condition							48	0.00
Poor	127(32.9)	37(9.6)	23(6)	4(1)	25(6.5)	89(23.1)		
Medium	147(38.1)	20(5.2)	21(5.4)	4(1)	12(3.1)	57(14.8)		
Good	112(29.0)	16(4.1)	11(2.8)	1(0.3)	6(1.6)	34(8.8)		
Management System								
Extensive	340(88.1)	65(16.8)	51(13.2)	9(2.3)	41(10.6)	166(43)	7.1	0.01
Semi intensive	46(11.9)	8(2.1)	4(1)	-	2(0.5)	14(3.6)		
Location							6.5	0.04
Highland	206(53.4)	43(11.1)	34(8.8)	6(1.6)	29(7.5)	112(29)		
Midland	180(46.6)	30(7.7)	21(5.4)	3(0.8)	14(3.6)	68(17.6)		
Total	386(100)	73(18.9)	55(14.2)	9(2.3)	43(11.1)	180(46.6)		

**Table 1:** Lungworm infestation in sheep by age, sex, body condition, management system and altitudes taken as risk factors for infestation.

finding was in agreement with studies reported by Desta et al. [28] in Ambo District, Eyob and Matios [29,30] in Asella province and Gebreyohannes et al. [21] in Mekedella district, South Wollo, Ethiopia. This higher prevalence rate of lung worm infection in female animal could be due to the fact that the resistance to infection is abolished at the time of parturition and during early lactation in female animals. However, this result contradicts with the findings of Nibret et al. [12] in Wogera District; Weldesenebet and Mohamed [30] in Jimma, who reporter higher prevalence of lung worm infection in males than female animals. These variations may be due to the improper distribution of sample selection between the two sexes [31], and most of the sampled sheep are not in preparturient period during the study time.

With regard to the physical body condition the prevalence was significantly higher ( $P < 0.05$ ) in sheep with poor body conditions (23.1%) than in those with medium (14.8%) or good body conditions (8.8%). The current finding is in agreement with studies reported by Selam et al. [32], Mihreteab and Aman [33] they reported higher prevalence rate in animals with poor body condition, but disagree with the finding of Weldesenebet and Mohamed [30] who reported higher prevalence rate in animals with good body condition. The variation in prevalence among the different body conditions might be associated with immune suppression in sheep with poor body conditions and concurrent infection by other parasites including gastrointestinal tract helminthes and/or malnutrition [33]. Poorly nourished sheep appear to be less competent in getting rid of lungworm infection and the infestation with a parasite by itself might results in progressive emaciation of the animals [34,35] (Table 2).

There was high significant difference between the prevalence rate of lung worm infection of sheep in the two management systems ( $P < 0.05$ ). It was found that 43% prevalence rate of lung worm infection was observed in animals under extensive management system, while very low prevalence rate, 3.6% was found in semi intensive management system. The current findings are in accordance with previous results of Yitagel et al. [18] in North Gondar Zone who reported prevalence rate of, 51.8% and 24.5% in extensive and semi intensive management system respectively. This could be due to the fact that sheep in extensive management system have a chance of grazing in the field contaminated with intermediate host for *P. rufescens* and *M. capillaries* or they possibly infested with larvae as well as easily obtained *D. filarial* from the

herbage [36]. However, it contradicts with the result of Weldesenebet and Mohamed [30] who reported higher prevalence of lung worm infection in sheep under semi intensive management system (28.6%) than in extensive management system (26.0%).

The result of this study has shown that prevalence rate of lungworm infection in the study animals was significantly increase ( $P < 0.05$ ) with altitude, accordingly prevalence of 29% in high land and 17.6% in mid land areas was observed. This result is in agreement with the result reported by Alemu et al. [5] Mireteab and Aman [33] who found significant difference among the various agro-ecology ( $P < 0.05$ ) in their result. This might be due to the effect of altitude is attributable to climatic parameters. That is the survival and development of lungworm larvae is favored by low moisture content and high humidity [15].

The result of this study also showed that, 19.17% of those apparently healthy sheep and 27.46% of those showing clinical respiratory signs were infected with different lungworm species, with statistically significant variation ( $P < 0.005$ ) in prevalence rate. Similarly, with higher statistically significant variation ( $\chi^2 = 32.21$ ,  $P = 0.00$ ) *D. filaria* was the dominant prevalent species in sheep with respiratory signs from the other lung worm species as clearly indicated in Table 2. The result coincides with the observation of Alemu et al. [5], Desta et al. [28], Eyob and Matios [29] and Hasen et al. [37] in different parts of the country. This might probably due to the fact that during the end of prepatent phase of the parasite post patent parasitic bronchitis, which is responsible for clinical respiratory sign, developed and caused by immature lungworm in the air ways and cellular infiltration of the epithelium [24].

## Conclusion

The result of present study indicated that lungworm is one of the major helminthosis of sheep in and around Wogera district, which is affecting the health and production performance of sheep. The prevalence of lung worm infection is significantly higher in young and animals under extensive management system but very low prevalence rate was observed in sheep kept under semi intensive management system. *Dictocaulos flaria* is the dominant lungworm species responsible for clinical manifestation of respiratory sign and higher prevalence rate of lungworm infection was observed in animal

Lungworm Species	Apparently healthy animals (n=240) Prevalence (%)	Animals with respiratory sign (n=146) Prevalence (%)	$\chi^2$	P-value
<i>D. filaria</i>	32(8.3)	41(10.6)	32.21	0.00
<i>M. capillaries</i>	23(6)	32(8.3)	8.74	0.00
<i>P. rufescens</i>	5(1.3)	4(1)	0.87	0.32
Mixed infection	14(3.6)	29(7.5)	18.05	0.01
Total	74(19.17)	106(27.46)	60.5	0.00

**Table 2:** Lungworm infection in relation to respiratory signs manifested.

with poor body condition and sheep sampled from relatively higher altitude areas. Therefore, emphasis should be given towards improving the overall health, nutritional conditions and management system of sheep in the study areas.

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