Research Article

Prevalence of Ovine Lung Worm and Associated Risk Factors In HonkoloWabe District, East Arsi Zone, Ethiopia

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ABSTRACT

A cross-sectional study was conducted in Honkolowabe district, East Arsi zone, from November, 2017 to March, 2018 with aim of determining the prevalence of ovine lungworm infection, to assess associated risk factors and identification of species of lungworm which circulate in study area by using coproscopic examination. In this study faecal samples were randomly collected from 384 sheep from different PAs. Age groups, sexes, body conditions and respiratory signs were used as risk factors. Then, (L1) were extracted by Modified Baerman technique and examined under low magnification power of Compound Microscope.The finding indicate that 259 (67.4%) were infected with different species of lungworm; namely, Dictyocaulusfilaria (40.1%), Protostrongylusrufescens (15.9%), mixed infection (6.8%) and Muellerius capillaries (4.7%). There were statistically significant difference (p<0.05) in the prevalence of lungworm with regard to body conditions(poor 76.5%, medium 68.4%, good 55.1%) and manifestation of respiratory signs (83%, shown respiratory sign and 51% didn't show). 69.8% females and 64.8% male; 70.3% young and 66% adult were infected with one or more species of parasite. In conclusion, this study revealed that lungworm is one of the major respiratory parasites that affect the health and productivity of sheep in Honkolowabe; that needs attention for its control and prevention to reduce the currently reported high prevalence.

Introduction

Ethiopia is known by having the highest number of livestock population. According to the recent estimate of livestock population of the country, Ethiopia is a home for about 59.5 million cattle, 30.7 million sheep, 30.2 million goats, 12.22 million equines and 56.5 million poultry CSA [1]. About 99.8% of the sheep and nearly all goat population of the country are local breeds. Of the total sheep population, 75% are raised in highlands with altitudes above 1,500 meter above sea level CSA [2]. Sheep and goats are the most numerous of man's domestic livestock. In Ethiopia, sheep are the dominant livestock providing up to 63% of cash income and 23% of food substance value obtained from livestock production Bogale, et al.[3,4] It is estimated that 1, 078, 000 sheep and 1, 128, 000 goats are used in Ethiopia for domestic consumption annually Alemu, et al. [5]. However, the productivity is much less when compared with the population size of small ruminant in Ethiopia Fentahun, et al. [6] and the economic benefits to the farmers remain marginal due to prevailing disease, poor nutrition, poor animal production systems and general lack of veterinary care Sissay et al. [7].

Helminth parasites are among the causes of substantial productivity losses in ovine production of the country by causing respiratory diseases resulting in great economic concern in the highlands of Ethiopia where sheep are important livestock units Basaznew, et al. [8] Sheep Lungworm disease are one of the major respiratory disease that widely distributed throughout the world but are particularly common in countries with temperate climate and in the high land of tropical and sub- tropical countries of the world providing nearly perfect condition for their survival and development.Lung worm infection is also called Verminous Bronchitis or Verminous Pneumonia which caused by the three economically important species of lungworm of sheep and goat namely; Dictyocaulusfiaria, Protostrongylusrufescens and Muellerius capillaries Abebe, et al. [9]. These nematode parasites

belong to two super family, *Trichostrongyloidea* (*D. filaria*) and *Metastrongyloidea (P. rufescensand M. capillaries)*.Its pathogenic effect depends on their location within the respiratory tract, the number of infective larvae ingested and the immune system of the animals. Protostrongylidae species occur in the alveoli, bronchioles and parenchyma of the lungs of various species of mammals Umur, et al. [10].

Dictyacaulusfilariahas a direct life cycle whereas M. capillaries and *P. rufescenshave* indirect life cycles. Dictyacaulus filarial infection is acquired by ingestion of infective larvae with herbages but M. capillarysand P. rufescensare transmitted when intermediate hosts are accidentally ingested by grazing animals. Dictyacaulusfilariais the most important lungworm of sheep and goats and commonly associated with a sign of coughing and unthriftiness, which usually affects lambs and kids. *Muellerius capillaries* and *P. rufescensare* more common but less pathogenic when compared to *D. filarial* Radostits, et al. [11]. The clinical sign of infected animals can be less obvious than signs of other livestock diseases Tamire, et al. [12]. However, in naturally affected animals clinical signs like reduced growth, loss of appetite, increase respiratory rate and coughing are usually observable Shite et al. Prevention and control of these parasites is critical to enhance the economic benefit from these species of livestock Alemu, et al. [13]. In Ethiopia, although fragment studies have been done and reports are available, however, little information has been documented on the status of ovine lungworm infection. Moreover, no information has been documented on the status and associated risk factors of the disease in ovine in Honkolowabe district.

Therefore, this study was aimed to;

1.   Determine the prevalence of lungworm infection in sheep population in selected areas of honkolowabe district

2.   To identify risk factors and quantify their degree of association with the disease

Materials and Study Methodology

Study Areas

The study was conducted from November 2017 to April 2018 in 5 selected peasant association(PA), Bekojimirx, Changicha, Siltana 01, Machitulaman and Tajiwalkite of HonkoloWabe district, East Arsi zone, Ethiopia. It lies East of Wabe River, which separate East Arsi zone from Bale zone and it is located, 269 km East of Addis Ababa. The area receives an annual range of rain fall from 1200-2150mm and has a biomodal rainfall occurring from March to April (a short rainy season) and from July to October (long rainy season). Topographically, it is situated at altitude of 2200 - 3850 m above sea level with the mean annual minimum and maximum temperature 18 °C and 20%, respectively. This area is characterized by mixed farming system, which is engaged in agricultural and livestock production HWWADO [14]. Honkolowabe district has 9 peasant Associations and 2 town kebeles and of these the study was done in randomly selected 5 representative peasant Associations.

Study Population

The estimated animal population in the area was about 87216 cattle, 17994 sheep, 9094 goats, 9360 horses, 9520 donkey and 39250 chickens HWWFLO [15]. The study animals, sheep, in selected peasant association were maintained under extensive management system in small household flocks of mixed age groups and sexes with no supplementary feed. All animal in selected peasant association were indigenous (local breeds). Sheep with age group of young and adult from both sexes, with different body condition, with clinical respiratory signs and those that appeared apparently healthy was included in the study. The age of every sampled sheep was categorized in to young and adult using dentition and information from the owners. Age was determined using dental eruption formula into two age categories (Greater than 2 years and less than two years) Steel [16] and by asking the owner's. The body conditions score of study animals was divided into good, medium and poor based up on their criteria of body score Abebe [9].

Study Design, Sampling Strategy and Sample Size Determination

A cross sectional study design was selected to determine the prevalence of lung worm in the study area, the predominant species of lungworm and to evaluate the effect of major host related risk factors on the occurrence of the parasites in 5 peasant Associations of Honkolowabe district. The samples were collected by using simple random sampling method to select the study animals in the area. Since the prevalence of ovine lung worm in HonkoloWabe district has not been reported, 50% expected prevalence rate, 95% confidence interval and 5% desired absolute precision was used Thrustfield [17]. Therefore, the total sample size required was 384 based on the given formula below. Where, n = required sample size

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

Pexp = expected prevalence

d =   desired absolute precision

Sample Collection and Laboratory Analysis

Faecal samples were collected directly from the rectum of selected animals in universal bottle. While collecting faecal sample; sex, age, body condition and respiratory signs are properly recorded on the prepared format. Specimens were transported to Asella regional veterinary laboratory in universal bottles under airtight conditions within 4 h. In the laboratory, faecal sample examination for the presence of L1 larvae was conducted using modified Baermann technique. Briefly 5gm to 10gm of fecal material was wrapped in double layered gauze and suspended in conical flask containing warm water (approximately 40 °C) using

a clip wire. The whole apparatus was left for 24 h overnight. So that the larvae left the faeces and migrated through the gauze and settled at the bottom of the glass Urquhart, et al. [18] Then after, the wrapped feaces were removed and the supernatant was discarded from the conical flask gently. After that, a small amount (3-5 ml) of sediment was transferred to a watching glass using Pasteur pipette for examination of L1 under low power of the microscope. A drop of 1% iodine solution was added to the positive sample to immobilize the larvae for the identification of species Urquhart, et al. [18] All larvae were indentified morphologically as described by previous workers Hansen, et al. [19]. Then, the result was recorded on the prepared format.

Data Management and Analysis

The raw data was entered and managed using Microsoft Excel worksheet and summarized with descriptive statistics. Statistical Package for Social Science (SPSS) software version 20 was used to determine the prevalence of the disease and the association between risk factors and the disease. The association between prevalence and risk factor was assessed by using Pearson's Chi-Square. A statically significant association between variables was considered to exist if the computed P-value is less than 0.05.

Results

The overall prevalence of ovine lung worm in the study area was 67.4%. The result revealed that of total 384 fecal samples examined 259(67.4%) were found positive for lung worms with different species of lungworm. Out of these 40.1%, 15.9%, 4.7% and 6.8%, was due to *D.filaria, P.rufescens, M.capillaries*, and mixed infection, respectively. Thus, D. filarial was the most dominant species followed by P.rufescens. M. capillaries were the least, and certain animals were infected by mixed infection (Table 1). In this study, variables such as PAs, sex, age, respiratory signs and body condition were considered to be risk factors for the occurrence of lungworm in sheep. The findings on these factors and association between the prevalence of the disease and the risk factors were as presented here below.

Table 1: Prevalence of different species of lungworm in total examined sheep.

Species of Lung Worm	№ of Examined Animals	№ of Positive	Prevalence(%)
D. filarial	384	154	40.1
P. rufescens	384	61	15.9
M. capillaries	384	18	4.7
Mixed infection	384	26	6.8
Total	**384**	**259**	**67.4**

Prevalence of Lungworm Infection According to Peasant Association

The prevalence of lungworm in selected PA showed that 71.6%, 69.2%, 62.2%, 59.3% and 71.4% in Bekojimirx, Changicha, Siltana 01, Machitulaman and Tajiwalkite respectively. The highest prevalence was observed in Bekojimirx (71.6%) and the lowest prevalence was observed in Machitulaman (59.3 %). There was no significant difference (P>0.05) in the prevalence of lung worms among the kebeles (Table2).

Table 2: Prevalence of ovine lung worm in the selected study area.

PA	№. Examined	№. Positive	Prevalence of lung worm species (%)				Tot. prevalence (%)	χ^2	*P*- value
			Df	Pr	Mc	Mix			
Bekojimirx	95	68	38 (40%)	19 (20%)	6 (6.3%)	5 (5.3%)	71.6%		
Changicha	91	63	34 (37.3%)	16 (17.6%)	5 (5.5%)	8 (8.8%)	69.2%		
Siltana 01	74	46	30 (40.5%)	10 (13.5%)	2 (2.7%)	4 (5.4%)	62.2%		
Machitulaman	54	32	19 (35.2%)	7 (13%)	2 (3.7%)	4 (7.4%)	59.3%		
Tajiwalkite	70	50	33 (47.1%)	9 (13%)	3 (4.3%)	5 (7.1%)	71.4%	8.713	0.925
Total	384	259	154 (40.1%)	61 (15.9%)	18 (4.7%)	26 (6.8%)	67.4%		

Note: PA =Peasant association, Mix= Mixed infection, Df= Dictocaulus filarial, Pr= Protostronglus rufescens, Mc= Mullerius capillaries, P-value= Pearson's value, Tot.= Total

Prevalence of Lungworm Infection According to Age of Study Animals

The prevalence of lungworm infection according to age of study animals was higher in young sheep (70.3%) than in adult sheep (66%), however, the difference was not statistically significant (p>0.05) (Table 3).

Table 3: Prevalence of Lungworm Infection According to Age of Study Animals.

Age	№ Examined	№ Positive	Prevalence of Lung Worm Species (%)				Tot. Prevalence (%)	χ^2	*P*- Value
			Df	**Pr**	**Mc**	**Mix**			
Young	128	90	50 (39.1%)	24 (18.7%)	6 (4.7%)	10 (7.8%)	70.3%		
Adult	256	169	104 (40.6%)	37 (14.4%)	12 (4.7%)	16 (6.2%)	66%		
Total	**384**	**259**	**154 (40.1%)**	**61 (15.9%)**	**18 (4.7%)**	**26 (6.8%)**	**67.4%**	1.835	0.766

Note: Mix= Mixed infection, Df= Dictocaulus filarial, Pr= Protostronglus rufescens, Mc= mullerius capillaries, P-value= Pearson's value, Tot.= Total, χ2 = chi-square

Prevalence of Lungworm Infection According to Sex of Study Animals

The prevalence of lung worm in both sex's shows that from 173 males examined 112 (64.7%) and from 211 females 147 (69.7%) were positive for lung worm. Although the prevalence of lung worm was relatively higher in females than male individuals, no statistically significant difference was observed among them (P>0.05) (Table 4).

Table 4: Prevalence of Lungworm Infection According to Sex of Study Animals.

Sex	№ Examined	№ Positive	Prevalence of Lung Worm Species (%)				Tot. Prev. (%)	χ^2	*P*- Value
			Df	**Pr**	**Mc**	**Mix**			
Female	211	147	85 (40.3%)	36 (17.1%)	9 (4.3%)	17 (8.1%)	69.7%		
Male	173	112	69 (39.9%)	25 (14.5%)	9 (5.2%)	9 (5.2%)	64.7%	2.443	0.655
Total	**384**	**259**	**154 (40.1%)**	**61 (15.9%)**	**18 (4.7%)**	**26 (6.8%)**	**67.4%**		

Note: Mix= Mixed infection, Df= Dictocaulus filarial, Pr= Protostronglus rufescens, Mc= mullerius capillaries, P-value= Pearson's value, Tot.= Total, χ2 = chi-square

Prevalence of Lungworm Infection According to Body Condition of Study Animals

Prevalence of lungworm infection according to body condition of study animals was 76.5%, 68.4%, and 55.1% in poor, medium, and good, respectively. In this study, animals having poor body condition were found to have higher prevalence to ovine lungworm infection than moderate and good body conditions and the difference among the different body condition categories was statistically significant (p<0.05)(Table 5).

Table 5: Prevalence of lungworm infection according to body condition of study animals.

BCS	№ Examined	№ Positive	Prevalence of Lung Worm Species (%)				Tot. Prev. (%)	χ^2	*P*- Value
			Df	Pr	Mc	Mix			
Poor	102	78	52 (51%)	13 (12.7%)	3 (2.9%)	10 (9.8%)	76.5%		
Medium	193	132	82 (42.5%)	29 (15%)	12 (6.2%)	9 (4.7%)	68.4%		
Good	89	49	20 (22.5%)	19 (21.3%)	3 (3.4%)	7 (7.9%)	55.1%	24.145	0.002
Total	**384**	**259**	**154 (40.1%)**	**61 (15.9%)**	**18 (4.7%)**	**26 (6.8%)**	**67.4%**		

Note: BCS =Body Conditions, Mix= Mixed infection, Df= Dictocaulus filarial, Pr= Protostronglus rufescens, Mc= mullerius capillaries, P-value= Pearson's value, Tot.= Total χ2= chi-square

Prevalence of Lungworm Infection According to Manifestation of Respiratory Signs

Prevalence of lungworm infection in study animals according to manifestation of respiratory signs (coghing and nasal discharge) was 82.3% and 51% in apparently healthy sheep, respectively. The difference between the prevalence of lungworms in animals showing respiratory signs and in animals which were apparently healthy was statistically highly significant ($p<0.05$) (Table 6).

Table 6: Prevalence of lungworm infection according to manifestation of respiratory signs of study animals.

Resp. Sign	№ Examined	№ Positive	Prevalence of Lung Worm Species (%)				Tot. Preval. (%)	χ^2	P- Value
			Df	Pr	Mc	Mix			
Show	203	167	97 (47.8%)	37 (18.2%)	13 (6.4%)	20 (10%)	83%	45.615	0.000
Not show	181	92	57 (31.5%)	24 (13.3%)	5 (2.8%)	6 (3.3%)	51%		
Total	**384**	**259**	**154 (40.1%)**	**61 (15.9%)**	**18 (4.7%)**	**26 (6.8%)**	**67.4%**		

Note: Resp.Sign =Rspiratory sign Mix= Mixed infection, Df= Dictocaulus filarial Pr= Protostronglus rufescens, Mc= mullerius capillaries, P-value= Pearson's,value, Tot.= Total χ2=chi-square, Preval.=prevalence

Discussion

The present study result indicated that lungworm infection was one of the most common respiratory diseases of sheep with an overall prevalence of 67.4%. This result is almost in agreement with research findings that were conducted in Munesa district, 66.67%, by Abdella, et al. [20], Debra Tabor Awraja, 70.7%, by Yohannes [21], Asella, 59.9%, by Hussein, et al. [22], Bassona Worena district, 62.67%, by Zelalem [23], Debra Birhan, 64.7% by Brook, et al. [24] However, the current finding was relatively lower than the prevalence reported by Jovanovic, et al. [25] in highland of Shoa province 83 to 99.5%, Eyob, et al. [26] in Asella province, 72.44%, Netsanet [27] in DebreBirhan, 73.75% and Sefinew [28] in six district of Wollo, 71.3%. The current finding was higher than study conducted by Ibrahim, et al. [29] in Mekeletown, 13.4%, Mekonnen, et al. [30] at Gonder, 32.7%, Regassa, et al. [31], in Dessie and Kombolcha districts, Northern Ethiopia, 40.4%. The variation in the overall prevalence rate in those areas might be due to differences in nutritional status, level of immunity, management practice of the animal, rain fall, humidity and temperature differences and season of examination which may favor / disfavor the survival of parasite larvae on their respective study area Kebede, et al. [32]

In current study, the prevalence of different species of lungworm was 40.1%, 15.9%, 4.7% and 6.8% due to D. filaria, P. rufescens, M. capillaries, and mixed infection with two or three species of lungworm, respectively. It was observed that *D. filarial* was the most predominant species in the area followed by P. rufescens, whereas *M. capillaries* were the least prevalent. This finding is supported by Mihreteab, et al. [20,22,33] who reported D. filarial to be the most prevalent in their study. In contrast to these findings, Sisay [34] in Bahir Dar and Basaznew, et al. [8], in Dessiezuria district reported that M. capillaries were the most prevalent in their studies. The possible reason for the predominance of *D. flaria* in the study area might be attributed to the difference in the life cycles of the parasites. Thus, *D. flaria* has a direct life cycle and requires shorter time to develop to an infective stage. After ingestion, the larvae of these parasites can be shed with feces within 5 weeks Soulsby [35]. Unlike *D. flaria* the transmission of *P.rufescens* and *M. capillaries* needs an intermediate snail for completing its life cycle.

In addition to this the low prevalence of both M. capillaries and P.rufescensin 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 inter mediate hosts Kahn [36]. Mixed infection was also observed in the current study as in many previous studies Poulos [20,22,37]. On the attempt to assess the influence of the study area on lung worm infection of sheep, Insignificant effect (P> 0.05) was observed on the prevalence of lung worm infection. The highest prevalence (71.6%) was observed in Bekojimirx followed by Tajiwalkite (71.4%) and the lowest in Machitulaman (59.3%). The reason might be associated with the time of sampling as Samples were not collected at the same month from the study area. This insignificant difference agrees with the report of Desta, et al. [38], in Ambo Wondwossen, 1992, in and around Asella. In contrary to the present study, a significant difference has been reported by Alemu, et al. [5,22]

These differences between researchers might be associated with variation in sample size, duration of study time, difference in agro-ecology and season of study period. Highest prevalence in Bekojimirxmight be due to it has relatively low temperature, higher moisture and humidity than other ecologies which is favorable for survival and development of larvae and intermediate hosts Radostits, et al. [39] An attempt was made to know the influence of age on the prevalence of lungworm infection and there is no statistically significant difference (P>0.05) in the infestation rate of lungworm. However, a high infection prevalence of lungworm was recorded in younger (70.3%) than an adult (66%) which is in agreement with the observations of Eyob, et al. [26,33]. This might be associated with the apparent inability of the host to develop acquired immunity. Relatively, adult animals have more frequent

exposure to lungworms than young animals; so that more likely to develop acquired resistance to these specific parasites or recovered animals have better immunity against re-infection Soulsby [35].

In this study, attempts were made to know if there is variation in lung worm infection between different sex groups. The prevalence was higher in female (69.7%) than male (64.7%), but the difference was statistically insignificant. This agrees with research reported by Addis, et al. [22,26,40], but disagree with report of Alemu, et al.[13,33]. These differences between researchers might be either due to improper distribution of sample selection between e sampled or most of the sampled females are not in preparturient period during the study time that make both sexes equally susceptible to disease. In current finding prevalence was higher in female; this might due to certain sampled animal were lactating which suppress immunity of the animal Urquhart, et al. [18] Higher infection prevalence was recorded in sheep showing clinical respiratory sithe two sexes that makes prevalence higher in female Addis, et al. [40] where almost all female sheep wergns (83% than those apparently healthy (51%). Hence, the variation was statistically significant (P<0.05). The result coincides with the observation of Paulos [22,26,37].

Even though apparently healthy sheep show low infection compare to those showing clinical respiratory signs groups, about 51% of them were infected with lungworm. The reason might be due to the parasites were in pre-patent stage or due to small adult worm burden in sheep which couldn't produce eggs and hence larvae; or as a result of immunity developed due to exposure to a few lungworms which is not associated with clinical sign but animal shed larvae Soulsby [35]. About 17.7% of those animals manifesting respiratory signs were appeared negative on examination; this might be, due to bacterial or viral diseases that may causes occurrence of respiratory signs Gelagay, et al. [41] With regard to body condition, the prevalence of lungworm infection was higher (76.5%) in animals of poor body condition than those of medium (68.4%) and good (55.1%). The difference among body condition was statistically significant (p<0.05). This finding agrees with study reported by Muhammed, et al. [23,42] that reported high prevalence in animals with poor body conditions. This might be associated with the nutritional management of animals. The possible explanation for this observation could be due to immune-suppression in sheep with poor body conditions, concurrent infection by other parasites including gasstrointestinal helminthes and malnutrition which leads to lack of resistance to infection and contribute for increased prevalence. Evidently, the infection with a parasite by itself might results in progressive emaciation of the animals Radostits, et al. [31,43, 44]

Conclusion and Recommendations

Lung worms are one of the most common causes of respiratory problem in Ovine. The result of present study indicated that prevalence of lung worm was high in Honkolowabe district, East Arsi zone. The Coproscopical examination indicated that 67.4% of the examined sheep were infected with different species of lungworms. Sheep with poor body condition and those with clinical respiratory signs were highly significantly infected with either of the lungworm species than their counterparts. Out of the recovered lungworms (*D. filarial, P.rufescens, M. capillaries* and mixed), D. filarial was found to be the highly prevalent lungworm of ovine's in the study area. The high prevalence of lungworm infection in the study area revealed the need much attention in the control and prevention of these parasites.

In view of the above facts, the following recommendations are forwarded;

    a. Regular deworming with effective antihelmintic should be routinely practiced in the area

    b. Supplementation of additional feed to make sheep well nourished and good body condition.

    c. Emphasis should be given to the control and prevention in order to reduce the prevalence from the current high finding

    d. Further research should be carried out in this study area since the prevalence of the diseases was most significant.

    e. Veterinary service provider in the area should have the facility to diagnose and treat ovine lung worm infected animals to mitigate production losses.

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