

The Prevalence of Caprine Lung Worm in Digalu and Tijo Districts of Arsi Zone, Central Ethiopia

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Abstract: This study was conducted from November 2017 to April 2018 in Digalu and Tijo district. The aims of this study were to determine the prevalence of goat lungworm infection and to assess some of the risk factors associated with goat lungworm infection and to identify species of parasites involved by coprological examination. Fecal samples were collected from 384 local goats to examine first stage larva (L1) by using modified Barman technique. The overall prevalence of lungworm infection in the area was 45.1% by fecal examination. The finding indicate that 173(45.1%) were infected with different species of lungworm; namely, *Muellerius capillaries* (20.3%) *Dictyocaulus filaria* (9.6%), *Protostrongylus rufescens*(8.6%) and mixed infection (6.5%) and among the different species identified there was no significant difference ($P>0.05$). The study showed that there was no significant difference ($p>0.05$) on the prevalence of lungworm infection between different PAs from which animals were sampled. The infection rate between male and female animals also showed insignificant difference ($p>0.05$) with prevalence rate of 39.7% and 47.4%, respectively. Regarding to age, the highest prevalence (66.0%) was observed in young animals while the lowest prevalence (32.1%) was observed in adult animals. The prevalence between the age groups was statistically significant ($P>0.05$). Different prevalence rates were observed among poor (79.6%), medium (59.5%) and good (18.3%) body conditioned animals and the difference was statistically significant ($p>0.05$). In conclusion, lungworm belongs to the respiratory helminthes among respiratory disease complex that affect the health and productivity of goats in the study area; therefore, attention should be given for the control and prevention to reduce the burden of parasite.

Key words: Goat • Lungworm • *Muellerius capillaris* • Prevalence

INTRODUCTION

In Ethiopia, directly or indirectly disease is one of the major barriers for the improvement of livestock production, reproduction and marketing. Diseases of various origins (Bacterial, viral, parasitic, etc.) are among the numerous factors responsible for poor production and productivity [1, 2] Small ruminants especially goats are among the livestock species that are densely populated in Ethiopia and mostly their productivity is hampered by prevalence of different diseases. The goat population of Ethiopia was estimated to be 23 million. The country holds 13.5% of the African goats' population [3].

However, the country is not making use of this huge potential attributed to different constraints among which disease stands in the front line [1, 4]. Accordingly,

parasitic diseases are among those, which play a detrimental role in hampering small ruminant production leading to serious economic loss [5]. The annual economic loss due to disease, mortality, reduced reproductive and productive performance was estimated by 150 million USD [6]. In Ethiopia, 5-7 million sheep and goats die each year due to disease and the overall economic loss from meat industry due to parasitic diseases is estimated at 400 million annually [7].

Helminthes parasites of small ruminants are ubiquitous, with many tropical and subtropical environments of the world providing nearly perfect conditions for their survival and development. Although these parasites are widely prevalent, they can be less obvious than signs of other livestock diseases. Partly for this reason, infection with helminthes parasites are among

the most established that high prevalence rates of the infection with less obvious signs are associated with poor production and unthriftiness [8].

The three respiratory parasites that cause a significant damage in small ruminant production are *Dictyocaulus filaria*, *Protostrongylus rufescence* and *Muellerius capillaries*. These lungworms particularly *Dictyocaulus filaria* can suppress the immunity of the respiratory tract [9] and causes death, poor weight gain or loss of body weight as well as greatly affects the potential productivity of goat's industry in the areas where it is prevalent.

Different lungworm species are reported in goats from different parts of Ethiopia. However, paucity of information so far pertaining to respiratory helminthes of goats in the study area with respect to prevalence, associated risk factors, species composition and detailed study on the burden of parasite on goats, So there is a need to do sufficient studies by assessing the prevalence and major risk factors associated with the disease under village condition to recommend disease control practices to study area. Therefore, the objectives of the study were to:

- Determine the prevalence of lungworms in goats
- Assess major risk factors associated with the disease
- Identify the involved lungworm species in the study area

MATERIALS AND METHODS

Study Area: The study was carried out from November, 2017 to April, 2018, in Digalu and Tijo district, Arsi Zone, Oromia region, Central Ethiopia. The zone is located at 181km Southeast to Addis Ababa at 07°45'N 39°09'E latitude and longitude & the elevation/altitude of the area is The altitudes of this District ranges from 2500 to 3560 meters above sea level [10]. The area receives bimodal annual rainfall with the ranges of 900-1400mm, in which the long rainy season extends from June to September, while the short rainy season occurs from March to May [10]. The day and night temperature of the area ranges from 10-22°C and 10-20°C respectively. The District has a diverse agro-ecology suitable for the production of different crops and livestock, the area's agro ecology is highland (78%) & midland (22%) and it has a relative humidity of 19%. Livestock population in the District include; cattle 213167, sheep 119544, goat 8170, horse 23354, donkey 15560, Mule 324 and poultry 104830 [11].

Study Population: The study population includes indigenous Goats raised in Digalu and Tijo district Goats of different age group, both sexes; body condition score from study area was included. Age estimation was estimated using the procedure given by [12].

Study Design and Sampling Strategies: A cross-sectional study design was carried out to determine the prevalence of lungworms in Goats in Digalu and Tijo district, Oromia region, Central Ethiopia. The variables of interest considered as an input variable versus risk factors during the study was fecal status for larvae. The sampling procedure used was simple random sampling.

Sample Size Determination: The sample size was determined according to the formula of Thrusfield [13]. To calculate the total sample size, the following confidence level (CL), 5% desired level of precision; and parameters was used: 95% of with the assumption of 50% expected prevalence of lungworm among goats in the study area.

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

when: n = required sample size; P_{exp} = expected prevalence d = desired absolute precision. Hence, by using this formula, the sample size required for the study was 384.

Sample Collection and Transportation: After wearing plastic disposable gloves, fecal samples was collected directly from the rectum of animals and transported to parasitology laboratory for examination. 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 [14].

Fecal Examination Techniques, Equipment and Procedures: In laboratory, isolation of lungworm larvae from feces of small ruminants was performed by using Modified Baerman technique. Four 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 [15].

Data Analysis: The data which was collected from the study area, result obtained from fecal examination was recorded in the format developed for this purpose and will be entered in to Microsoft Excel spread sheet. Statistical Package for Social Sciences (SPSS, version 20) was used for analysis of the data. The significant association between the prevalence of lungworm and explanatory variables was determined using Chi-square test (χ^2). The explanatory variables included were: sex, age, body condition and their associations with the level of prevalence were described. The difference was regarded as significant if P-value is <0.05 at 95% confidence interval.

RESULTS

Overall Prevalence of Lungworm Infection in Goat: Out of 384 goats fecal samples examined, 173 (45.1%) were infected with different species of lungworm. Among these, 20.3%, 9.6%, 8.6% and 6.5% was due to *Muellerius capillaris*, *Dictyocaulus filarial*, *Protostrongylus rufescens* and mixed infection respectively. Thus, *M. capillaries* was the most dominant species followed by *Dictyocaulus filaria* and *Protostrongylus rufescens* was the least and certain investigated animals were infected by mixed infection (Table 1).

This study showed that there was insignificant difference ($p>0.05$) on the prevalence of lungworm infection between different PAs from which animals were sampled. However the highest prevalence was observed in Sagure (02) (53.6%) followed by Buchosilase (51.1%) and the lowest was observed at Ashabakawelkete (30.4%) (Table 2 below).

The overall prevalence of lung worm infection in relation to sex of animals was found to be 39.7% and 47.4% in male and female groups of animals respectively. The prevalence of different species of lung worms was also different in different sex groups of animals. Prevalence was higher in female than male; however, statistically there was insignificant difference between sex ($p> 0.05$) and from the total positive animals on examination of fecal samples; 21.3%, 10.8, 8.6% and 6.7% were infected by *Muellerius capillaris*, *Dictyocaulus filarial*, *Protostrongylus rufescens* and by mixed infection respectively in female category of animals; and 18.1%, 6.9%, 8.6% and 6.0% were infected by *Muellerius capillaris*, *Dictyocaulus filaria*, *Protostrongylus rufescens* and by mixed infection respectively in male category of animals as shown in Table 3 below.

The overall prevalence of lungworm infection in relation to different age groups of animals was found to be 32.1 % (76/237), 66.0% (97/147) in adult and young respectively. It was found that the prevalence of different

Table 1: Prevalence of different species of lungworm in total examined Goats

Species of lungworm	No. Positive	Prevalence (%)
<i>M. capillaries</i>	78	20.3
<i>D. filarial</i>	37	9.6
<i>P. rufescens</i>	33	8.6
Mixed infection	25	6.5
Total	173	45.1

Table 2: Prevalence of lung worm infection in goat displayed based on PA of study area

PA	No. Animals examined	No. animals Positive	Prevalence (%)	χ^2	P
Ashabakawelkete	56	17	30.4	10.429	0.299
Kachama	64	32	50.0		
Sagure(02)	69	37	53.6		
Buchosilase	90	46	48.9		
Lolehofi	105	41	39.0		

Table 3: Prevalence of lungworm infection with respect to sex

Sex	No of Examined	No of Positive	Prevalence (%)	Prevalence of lungworm (%)			
				<i>M. capillaris</i>	<i>D. filaria</i>	<i>P. rufescens</i>	Mixed infection
Female	268	127	47.4	57(21.3)	29(10.8)	23(8.6)	18(6.7)
Male	116	46	39.7	21(18.1)	8(6.9)	10(8.6)	7(6.0)
Total	384	173	45.1	78(20.3)	37(9.6)	33(8.6)	25(6.5)

Table 4: Prevalence of lungworm infections in different age

Age	No of Examined	No of Positive	Prevalence (%)	Prevalence of lung worms (%)			
				<i>M. capillaris</i>	<i>D. filaria</i>	<i>P. rufescens</i>	Mixed infection
Adult	237	76	32.1	35(14.8)	17(7.2)	13(5.5)	11(4.6)
Young	147	97	66.0	43(29.3)	20(13.6)	20(13.6)	14(9.5)
Total	384	173	45.1	78(20.3)	37(9.6)	33(8.6)	25(6.5)

Table 5: Prevalence of lungworm infection in different body condition of study animals

BCS	No of Examined	No of Positive	Prevalence (%)	Prevalence (%)			
				<i>M. capillaris</i>	<i>D. filaria</i>	<i>P. rufescens</i>	Mixed infection
Good	180	33	18.3	10(5.6)	13(7.2)	3(1.7)	7(3.9)
Medium	111	66	59.5	22(19.8)	15(13.5)	17(15.3)	12(10.8)
Poor	93	74	79.6	46(49.5)	9(9.7)	13(14.0)	6(6.5)
Total	384	173	45.1	78(20.3)	37(9.6)	33(8.6)	25(6.5)

species of lung worms was also different in different age groups of animals; and from the total positive animals on examination of fecal samples; 14.8% (35/76), 7.2% (17/76), 5.5% (13/76) and 4.6% (11/76) were infected by *Muellerius capillaris*, *Dictyocaulus filaria*, *Protostrongylus rufescens* and by mixed infection respectively in adult animals and 29.3% (43/97), 13.6% (20/97), 13.6% (20/97) and 9.5% (14/97) were infected by *Muellerius capillaris*, *Dictyocaulus filaria*, *Protostrongylus rufescens* and by mixed infection respectively in young animals. The prevalence of lungworm infection between age group of study animals was statistically significant ($p < 0.05$), as shown in Table 4 below.

The overall prevalence of lung worm infection in relation to different body condition categories of animals was found to be 18.3%, 59.5% and 79.6% in good, medium and poor body condition categories of animals respectively. The prevalence of different species of lung worms was also different in different body condition categories of animals; and from the total positive animals on examination of fecal samples; 5.6%, 7.2%, 1.7% and 3.9% were infected by *Muellerius capillaris*, *Dictyocaulus filaria*, *Protostrongylus rufescens* and by mixed infection respectively in good body condition category of animals; and 19.8%, 13.5%, 15.3% and 10.8% were infected by *Muellerius capillaris*, *Dictyocaulus filaria*, *Protostrongylus rufescens* and by mixed infection respectively in medium body condition category of animals; and 49.5%, 9.7%, 14.0% and 6.5% were infected by *Muellerius capillaris*, *Dictyocaulus filaria*, *Protostrongylus rufescens* and by mixed infection respectively in poor body condition category of animals. Variation among body condition with relative to infection of lungworm was statistically significant. ($p < 0.05$) as shown in Table 5 below.

DISCUSSION

The overall prevalence of goat lungworms recorded in the present study was 45.1% by fecal sample examinations. This level of prevalence is almost in agreement with previous study done by Fentahun *et al.* [16] around Gondar town, Terefe *et al.* [17] in North Gondar zone and Regassa *et al.* [18] in Dessie and Kombolcha and Tigist [19] in North and South Gondar with the prevalence of 44.64%, 46.70%, 44.70% and 40.40% respectively. However, the current finding was lower than the prevalence reported by Alemu *et al.* [20] in six district of northeastern of Ethiopia, 50.7% [21] in Hitosa district, 50% and Abera *et al.* [22] in highland of Bale and Arsi zone, 50%.

The result of current finding is higher than the study conducted by Kassa *et al.* [23] in three district of south Wollo, 31.0%, by Abebe *et al.* [24] in Wolaita sodo town, 19.2%, by Assaye and Alemneh [25] in and around Bahir Dar city, 28.7%, by Weldesenbet and Mohamed [26] in Jimma town, 28.2%. The possible explanation for such prevalence variation could be due to variation in altitude, rainfall, humidity, temperature and season of examination on the respective study areas which favor or disfavor the survival of parasite larvae [27, 28].

With regard to the species of lungworms, it was observed that *M. capillaries* was the most predominant species in the area followed by, *D. filaria* where as *P. rufescens* was the least prevalent. This finding is supported by In contrast to this findings, agrees with that of Alemu *et al.* [20] in six district of north eastern Ethiopia, Fentahun *et al.* [16] in and around Gondar, Terefe *et al.* [17] in Gondar and Regassa *et al.* [18] in Dessie and Kombolcha, but disagree with that of Abera *et al.* [22], Kassa *et al.* [23], Abebe *et al.* [24] and

Assaye and Alemneh [25] reported that *D. filaria* was the most prevalent. The reason for this high prevalence of *M. capillaries* compared with *D. filarial* could be partly attributable to its wide range of intermediate host and the ability of larvae to over winter in the molluscs. Additional factors which play a part in ensuring the endemicity of the worm are, first, the ability of L1 (First stage larva) to survive for the L3 (Third stage larva) in the intermediate host for the life time of the mollusks. On the other hand, the longevity and development of free larvae of *Dictyocaulus* are known to be dependent on humidity and temperature condition. Dry seasons are characterized by high mortality of larvae in the pasture [29].

The prevalence of lung worm infection in relation to different body condition of animals was found to be 18.3, 59.5 and 79.5% in good medium and poor body condition category of animals respectively and the overall prevalence of lung worm infection in relation to the three different body condition categories of animals was statistically significant ($P < 0.05$) this finding agrees with study reported by Haji *et al.* [21], Abera *et al.* [22] and Assaye and Alemneh [25]. The possible reason for this difference might be due to the fact that animals of good body condition were more nourished, properly managed and less exposed to lungworm infection than others.

The prevalence rate of lungworm infection was relatively higher in female (47.4%) than male (39.7%) animal but the difference was statistically insignificant ($P > 0.05$). This agrees with the findings reported by Abebe *et al.* [24] and Kebede *et al.* [30] but disagree with report of Alemu *et al.* [20] and Assaye and Alemneh [25]. These differences might be either due to improper distribution of sample selection between the two sexes that makes prevalence higher in female than males or thus most of the sampled females are not in preparturient period during the study time that make both sexes equally susceptible to disease.

With regard to age, generally, the highest prevalence was observed in young animals (66.0%) while lower infection rate was observed in adult animals (32.1%) and showed significant difference ($p < 0.05$). This agrees with the findings reported by Fentahun *et al.* [16], Kassa *et al.* [23] and Assaye and Alemneh [25] but it disagrees with findings reported by Haji *et al.* [21] and Muktar *et al.* [31]

CONCLUSION AND RECOMMENDATIONS

The recent study conducted in Digalu and Tijo district revealed that Lung worms are one of the most common causes of respiratory problem among respiratory

disease complex in goat. The result of the present study showed that the major lungworm species identified in the study area were *M. capillaries*, *D. filaria* and *P. rufescens*. *M. capillaries* were identified as the most dominant lungworm species. Different risk factors were found affecting the prevalence; age, sex and body conditions were the major. Young animals were found more infected by lungworms than adult animals but sex did not show a significant variation in lungworm infection and animal with poor body condition harbor more infection.

Based on the above conclusion the following recommendations are forwarded:

- Strategic regular deworming with broad spectrum anthelmintic should be implemented.
- Environmental hygienic protocols should be implemented to reduce the load of infective stages of worms in the environment.
- Proper diagnosis and treatment of sick animals and deworming of newly introduced animal to the flock should be practical.
- Awareness creation on provision of balanced diet and pastures rotation should be practiced.
- Further investigation should be carried out in the country on other microorganisms those acts as synergists for occurrence of respiratory disease complex in animals.

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