

Prevalence and Factors Associated with Small Ruminant's Lungworm Infection in and around Mekelle Town, Tigray, Northern Ethiopia

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Abstract

A cross-sectional study was conducted from November, 2016 to April, 2017 to estimate the prevalence of lungworm infection and its associated risk factors, and to identify predominant species of lungworms in small ruminants in and around Mekelle town, Tigray, northern Ethiopia. In this study both coproscopic examination and Berman techniques were employed on a total of 384 fecal samples of small ruminants (218 sheep and 166 goats) of different age groups and both sexes. The overall prevalence of lungworm infection in small ruminant was found to be 23.4%, where goats (25.9%) were more susceptible than sheep (21.6%). In the present study the highest prevalence was observed in goats (25.9%) than in sheep (21.6%). Regarding age, the highest prevalence was observed in animals <1 years (31.7%), followed by 1-3 years (23.5%) and >3 years (18.2%). Animals with poor body condition have higher prevalence than (27.5%), medium (26%) and good (18.1%) ones. Furthermore, animals kept under extensive management system have highest prevalence (25.8%) than those kept under semi-intensive management system (17.7%). The study revealed that there was no statistical significant difference ($p>0.05$) between prevalence of lungworm infection and risk factors such as species, age, sex, body condition and management system. In the present study *Dictyocaulus filarial* was found to be the highest in prevalence (11.4%) followed by *Muellerius capillaris* (6.25%); while *Protostrongylus rufescens* was found the least prevalent (4.16%) and mixed infection (1.04%) and the difference was statistical significant ($p<0.05$). Hence, it was concluded that lungworm infection is quite prevalent in the present study and warrants implementation of economically acceptable control measures both on the hosts and the intermediate host.

Keywords: Berman technique; Lungworm; Mekelle; Prevalence; Small ruminant

Introduction

In Ethiopia, small ruminants provide 33% of meat and 14% of milk consumption [1] and accounts for 40% of cash income and 19% of the house hold meat consumption in the central high lands where mixed crop-livestock production system is practiced [2]. Among export of livestock producers skin and hide have the largest share of exports followed by live animals [3].

In spite of the huge population and importance of small ruminants the country has benefited little from those animal's resource owing to a multiple of problems. The productivity is much less when compared with the population size of small ruminant in Ethiopia [4], 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 [5]. 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 70 kg for cattle and 6 kg for sheep and goat [6]. Disease is one of the most important causes of loss of production [7]. Helminthes parasites of ruminants are ubiquitous and prevalent with has however been established that high prevalence of the infection with less obvious sign associate with poor production and unthriftiness [8].

Lungworms are confronted with such enormous losses caused by parasitic nematodes known for infection of the lower helminthes parasites; it is unaffordable to the country [9]. Lungworm infection is known as verminous pneumonia. It is a chronic and prolonged infection of sheep and goat is characterized by respiratory distress, bronchitis and bronco pneumonia; which is caused by nematode parasites under family Dictyocaulidae and Protostrongylidae species include: *Dictyocaulus filarial* (*D. filaria*), *Protostrongylus rufescens* (*P. rufescens*) and *Muellerius capillaris* are affecting sheep and goats. The dictyocaulidae includes *Dictyocaulus viviparus* in cattle and buffaloes and *Dictyocaulus filarial* in sheep and goats [10]. These lungworms particularly *Dictyocaulus filarial* 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 industry in the areas where it is prevalent [11].

In the highland areas, infection with lungworm is the common cause of high mortality and morbidity in sheep and goats population [12]. Lungworms are commonly found in sheep and they are an important problem for sheep breeders though out the world [13]. These lungworms particularly *Dictyocaulus filarial* 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 and goat industry in the areas where it is prevalent [11].

In temperate region the severity and incidence of the parasite including respiratory helminthes in most livestock farms is now minimized through the seasonal use of anthelmintic and pasture

management, the problem still persists in the vast majority of the tropical and sub tropical regions. Although environmental conditions are conducive for lungworm infection in the high lands of tigray and lungworm infection is considered as an important disease in this region. Very limited studies have been conducted so far. It is important to assess the type and level of respiratory helminthes in small ruminant livestock in order to be able to determine the significance of parasitic infections and to recommend the most beneficial and economically acceptable control measures. The determination of the associated risk factors associated with parasite occurrence can be used to design an effective control strategy [14,15]. Therefore, the present study was aimed to estimate the prevalence and associated risk factors of lungworms, and to identify predominant species of lungworm in small ruminants in and around Mekelle town.

Materials and Methods

Study area

The study was conducted in and round mekelle town, the capital city of Tigray region, which is located 783 kms north of Addis Ababa. Geographically; it is located between 39°24'30" to 13°36'52" latitude and 39°25'30" longitude. It lies in an altitude range of 2000-2200 meter above sea level. The average temperature ranges of the year ranges from 11-24°C. The total annual rainfall are 579 mm-650 mm. The weather condition is hot and humid. The livestock population of the area includes a total of 36516 cattle; 8442 shoats; 800 horses; 200 mule; 3080 donkey; 100 camel; 53796 poultry; 3000 dogs [16].

Study population

Three hundred eighty four samples were taken randomly from extensive and semi intensive farms found in and around Mekelle town. All animals that were included in the study were local breeds. Age (<1 year, between 1 and 3 years, and >3 years) body condition score (poor, medium and good) of small ruminants was determination based on the method used by Gatenby [17].

Sampling method and sample size determination

The sampling method was simple random sampling technique to select the animals and to determine the sample size. The animals were sampled in respective to species, sex, age, management, and body condition. The sample size was decided using the formula given by Thrusfield [18]. With 95% confidence interval. Expected prevalence was 50% and at 5% absolute precision.

$$N = [1.96^2 P_{exp} (1 - P_{exp})] / d^2$$

Where: N=sample size; P_{exp} =minimum expected prevalence=50%; Za=related to confidence level (value of a level of significance); D=Desired accuracy level at 95% confidence interval; and 1.96=The value of Z at 95% confidence interval. Accordingly, the calculated sample size was 384.

Study design

A cross-sectional study design was carried out to determine the prevalence of small ruminant lungworm infection. A total of 384 small ruminants (sheep and goats) obtained from different Kebele of Mekelle town and its surroundings were examined.

Sample collection and study methodology

Fecal samples were collected directly from the rectum of randomly selected animals using plastic gloves, put into a screw capped glass bottles (Universal bottles) and transported to Mekelle University parasitology laboratory in the fresh state. The sample was then processed by using Modified technique as described by Hansen and Perry [8]. The procedure was as follows: 10 gram of feces was placed in a piece of double-layer cheese cloth, which was gathered around the sample so that it was fully enclosed. Use a rubber band to fasten the cloth, passé through the rubber band by two applicator sticks, which rest the edge of glass suspended the sample. Dip the feces with nylon in to conical glass filled with Luke warm water. Allow the feces to stand at 3-4 hours and discard the feces with nylon collect the material at the bottom of hollow stem Petri dish, examine with 10 x objective lens and then transfer to microscopic slide to identify the species by using pipette. The species of lungworm was identified based on the morphological features given for each species using the method described by Hansen and Perry [8]. While collecting fecal samples, the species of the animal, date of sampling, sex, age, management system, and Keble were properly labeled.

Results

In this study, an overall prevalence of lungworm infection was found to be 23.4% that accounted prevalence of 21.6% and 25.9% in sheep and goat respectively (Table 1). This level of prevalence is slightly similar with reports of previous studies conducted in different parts of Ethiopia. For example Mengestom [19] in Tigray (Atsbi) and Dawit and Abd [20] in Jimma reported prevalence of 21.5% and 26.7%, respectively. However the prevalence of the present study is lower than with that of Sissay [21] in and around Bahir-Dar city (44.7%), Tigist [22] in North and South Gondar Zones (39.6%), Alemu et al. [23] in North East Ethiopia (53.6%), Netsanet [24] in Debre-Birhan (73.25%), Mekonen et al. [25] in Gonder town (33.83%), Bekele and Abu [26] in Tiyo district, South East Ethiopia (57.1%), Regassa et al. [27] in Dessie and Kombolcha (40.4%), and Yimer et al. [28] in Ambo town (41.5%). In the contrary the present finding is higher than the reports of Selam et al. [29] in and around Mekelle town (13.1%). The discrepancies in the prevalence of lungworm infection in the various studies might be due to the use of different methods of larvae detection, difference in the geographical area which plays major role for the survival of larvae of lungworm infection, the snail intermediate host in case of *P. rufescens*. It might be also the difference of nutritional status, stage of immunity, management practice, and distribution of veterinary service, climate differences and season of examination in the respective study areas [30].

The present study revealed numerically higher prevalence of lungworm infection in goats (25.9%) than sheep (21.6%) but the difference was not statistically significant ($p > 0.05$) (Table 1). Previous studies also reported that goats are more susceptible than sheep [23,28,31]. The difference in the susceptibility might be due to the variation in grazing behavior of the animals. 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 [32].

The sex wise prevalence in this study revealed that prevalence of lungworm infection was numerically higher in female (25.8%) than males (21%), even though there was no statistically significant difference ($p > 0.05$) (Table 1). This result disagrees with the report of

previous study by Teffera [33] in Dessie and Kombolcha, and by Netsanet [24] in and around Debre-Birhan. However, it agrees with other reports done elsewhere [21,23,25]. The numerically higher prevalence in female in the present study might be due to decrease in immunity during pregnancy, parturition and lactation stage in case of female animals. But male are free from those stress which are resistant to the parasite as compared to females as well as they might kept for fattening in order to be sold and for breeding which was supplied with enough and palatable feeds which improves its resistance to disease, lungworm infection [23].

In the present study prevalence of lungworm infection was the highest (31.7%) in animals <1 year old followed by 1-3 years of age (23.5%), with the lowest prevalence (18.2%) observed in animals >3 years, but the difference was not statistically significant ($p>0.05$) (Table 1). This finding is in agreement with Gebreyohannes et al. [34] who reported higher prevalence in young (33.7%) than adult animals (24.4%) from Mekedella Woreda. Similarly other studies also reported a higher prevalence of lungworm infection in younger animals [22,31,35]. This might be related to the reason that adult animals have an acquired immunity due to previous exposure of lungworm infection. However young animals have got relatively low exposure which makes them highly susceptible [36].

Lungworm infection was higher in animals with poor body condition (27.5%) than medium (26%) and good (18.1%) body condition animals. Nonetheless, the difference was not statistically significant ($p>0.05$) (Table 1). This agrees with Kassa and Abdu [37] from around Bahir-Dar, who reported prevalence of 24%, 19.8% and 19.6% in poor, medium and good body, conditioned animals respectively. Animals with poor body conditions are a relatively lower resistance to infection. In addition, considerable weight loss is associated with infection as a result of *D. filarial* [38].

| Risk Factors | No. Examined | Prevalence (%) | X ² (p-value) |
|-----------------------|--------------|----------------|--------------------------|
| Species | | | |
| Ovine | 218 | 47(21.6%) | 0.991(0.319) |
| Caprine | 166 | 43(25.9%) | |
| Sex | | | |
| Male | 186 | 39(21%) | 1.225(0.268) |
| Female | 198 | 51(25.8%) | |
| Age | | | |
| >3 years | 132 | 24(18.2%) | 5.158(0.076) |
| 1-3 Years | 170 | 40(23.5%) | |
| <1 years | 82 | 26(31.7%) | |
| Body condition | | | |
| Poor | 109 | 30(27.5%) | 3.800(0.560) |
| Medium | 131 | 34(26%) | |
| Good | 144 | 26(18.1%) | |

Table 1: Intrinsic risk factors and associated prevalence of lungworms in sheep and goats.

With regard to the management system, the prevalence of lungworm infection was numerically higher in extensive (25.8%) than in the semi intensive (17.7%) management system, but the prevalence was not statistically significant (Table 2). This is in agreement with the results of Eyob [39] in Asella, who reported numerically higher prevalence of lungworm infection in extensive (34.4%), and semi intensive (30.9%) management system in Gonder town. Similarly Dawit and Abd [20] reported that the prevalence of lungworm infection was higher in extensive (28%) than semi intensive (26.6%) management system in Jimma town. This implies that animals kept under extensive management system have higher chance of getting infection than those under semi-intensive management system for the very reason that animals under extensive management systems repeatedly graze on the pasture, which increase the chance of getting infection, but in case of semi intensive management system animals have low chance of pasture contamination hence leading to low exposure to lungworm infection [40]. Additionally, animals under semi-intensive management practice were supplied with well enough, palatable and nutritious feeds which increase their immunity against lungworm infections unlike those kept under extensively managed animals which do not get enough feeds which compromise their immunity and favors the growth of the parasites that allows the animals for continuous larvae exposure [41].

In the present study *D. filaria* showed highest prevalence followed by *M. capillaris*, whereas *P. rufescens* was the least prevalent. The difference was statistically significant ($p<0.05$) (Table 2). This result agrees with previous reports of studies carried out elsewhere in the country [42-46]. But disagree with the result of Muluken [35] and Basaznew et al. [47], who reported *M. capillaris* as the most prevalent lungworm. The possible explanation for the predominance of *D. filaria* in the present study area might be attributed to the difference in the life cycles of the parasites where *D. filaria* which has direct life cycles takes less time to reach infective stage and after ingestion larvae can appear in feces after 5 weeks [19]. Furthermore, the low prevalence of *M. capillaris* and *P. rufescens* as compared to *D. filaria* might be due to the requirement of a snail as an intermediate host for their transmissions by the former ones and since the present study was conducted in the dry season which doesn't favor the survival of the larvae, contributing to the low prevalence of this lungworm.

| Risk factors | No. examined | Prevalence (%) | X ² (p-value) |
|-----------------------------|--------------|----------------|--------------------------|
| Management | | | |
| Semi Intensive | 113 | 20(17.7%) | 2.938(0.087) |
| Extensive | 271 | 70(25.8%) | |
| Species of lungworms | | | |
| <i>D. filaria</i> | 384 | 44(11.4%) | 3.800(0.000)* |
| <i>M. capillaris</i> | 384 | 24(6.25%) | |
| <i>P. rufescens</i> | 384 | 16(4.166%) | |
| Mixed | 384 | 4(1.04%) | |

Table 2: Extrinsic risk factors and associated prevalence of lungworms in sheep and goats.

Conclusion

In developing countries like Ethiopia, small ruminants are an integral part of the livestock sector of the economy and the main stay

of livelihood of the majority of population. However, economic benefits remain marginal chiefly due to prevailing disease. Among the diseases that restraint the survival and productivity of small ruminant, lungworm infection is overwhelming significance. The epidemiological evidence of the present investigation showed that the prevalence of lungworms was found to be higher in and around Mekelle town. The major identified lungworm species in the study area were *Dictyocaulus filarial* was significantly higher which is followed by *Muellerius capillaris* and *Protostrongylus rufescens*. From this study it has been concluded goats are more prone to lungworm infection than sheep, female animals are more susceptible than male animals and the prevalence of lungworm infection is higher in animals under the age of <1 years than 1-3 years and >3 years.

Hence isolation of the most susceptible age groups during the season when pasture contamination occurs should be carried out. There should be strategic and regular anthelmintic treatment and pasture management that enables to minimize the disease. In farmers training center, farmers should be educated regularly and different workshop should be prepared to enhance and update the awareness of professionals and stakeholders pertaining to the host status of the disease and control strategies. Further studies are also needed on epidemiology, particularly molecular one of lungworm species and its economic significance in the study areas.

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