Lungworms of Sheep and Cattle Slaughtered at Abattoir
(Study of Debre Birhan Municipal Abattoir and Private Hotels in Central Ethiopia)

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Abstract: The study was conducted from November, 2017 to April, 2018 at Debre Birhan municipal abattoir and private hotels, with the objectives of determining percentage, comparison of lungworms in sheep and cattle, identifying the species of the respiratory helminthes circulating in the area and assessing the possible risk factors of lungworms in sheep and cattle in the study area. Postmortem examination was conducted on 400 animals (204 sheep and 196 cattle) at Debre Birhan municipal abattoir and private hotels. An overall percentage of 20.8% lungworm was recorded as a result of postmortem examination. The occurrence of lungworm was 40.7% in sheep and 0% in cattle. Dictyocaulus filaria was the only lungworm species identified in this study. Age, body condition and season of the year have significant difference (p<0.05) on occurrence of lungworms in sheep. The occurrence of lungworm in sheep was significantly higher (p<0.05) in young sheep (54.9%) than in adult sheep (34.5%), also in sheep with poor body condition (58.1%) than in sheep with medium (37.5%) and good body conditions (25.9%); and during the Autumn season (51.4%) than during the other seasons of the study period, Winter (40.5%) and Spring (26.0%). However, significant difference in percentage of lungworms between male and female sheep was not observed (P>0.05). A mild (low) degree of lungworm burden was observed in sheep with good (9.26%), medium (7.95%) and poor (12.90%) body conditions. However, heavy lungworm burden was significantly higher in sheep with poor body conditions (27.42%) than those sheep with medium (12.50%) and good body conditions (3.70%). Likewise, heavy degree of lungworm burden was recorded during the Autumn (15.71%) and Winter (19.05%) seasons than during in the Spring (6.00%). Lungworms have great negative impact on livestock production and as a result emphasis should be given to regular and strategic de-worming to control and prevent lungworms in domestic animals and further studies are needed to clarify the economic significance and overall situation of lungworms in all species of domestic animals found in various agro-ecological zones of Ethiopia.

Keywords: Cattle; Debre Birhan; Lungworm; Percentage; Postmortem; Sheep.

1. Introduction

Ethiopia has one of the largest livestock populations in Africa with livestock ownership currently supporting and sustaining the livelihoods of an estimated 80 percent of the rural community [1]. The livestock sector in Ethiopia contributes 12 and 33% of the total and agricultural gross domestic product, respectively [2]. In the highlands, which account for over 75 percent of the livestock population, cattle provide traction power for 95% of grain production. The contribution of Ethiopian livestock and livestock products export to foreign exchange earnings is also significant [3; 4]. However, it is characterized by less productivity due to morbidity and mortality caused by different parasitic diseases. Lungworms are incriminated as one of the major and common parasitic diseases of ruminants around the world [5].
Lungworms are parasitic nematode worms of the order Strongylida that infest the lungs of vertebrates. The most common lungworms belong to one of two groups, the superfamily Trichostrongylidea or the superfamily Metastrongylidea [6]. The lungworms in the superfamily Trichostrongylidea include several species in the genus *Dictyocaulus* which infest cattle (*D. viviparous*), small ruminants (*D. filaria*) and equines (*D. arnfeldi*). These parasites have direct life cycles [7, 8]. The lungworms from the superfamily of Metastrongylidea include *Protostrongylidae* (*Protostrongylus rufescens*, *Muellerius capillaris*) that infest sheep and goats and this group have indirect life cycle which involves an intermediate host (IH) of either snail or slug [6].

Lungworms are widely distributed throughout the world but are particularly common in countries with temperate climates, and in the highlands of tropical and subtropical countries, and it is common in Ethiopia [9]. Epidemiological distribution of lungworms depends more on pasture contamination by carrier animals and pasture infectivity is related to rainfall which stimulates the activity of the larvae and the mollusk [10]. The prevalence of lungworms of ruminants depends on different factors like, the climate of area, intermediate hosts and favorable ecological conditions [71]. Overpopulation increases the concentration of parasites and also forces animals to graze closer to the ground. Young animals at first grazing are at high risk of infection than adult stocks [12].

*Dictyocaulus* have a direct life cycle and the adult females lay larvated eggs in the bronchi. The eggs are coughed up and swallowed with mucus and the L1 hatch out during their passage through the GIT and L1 are excreted in faeces. On pasture, the larvae molt into the second stage (L2) and develop to the infective L3. Then it is ingested by the animal while grazing in the pasture [13]. *Protostrongylus* and *Mullerius* have indirect life cycle involving IH of several snails and slugs [14]. Adult worms lay eggs which then coughed up with sputum toward bronchi and trachea. The eggs became hatched to first stage larvae (L1- larvae) in the trachea or during its passage in GIT and L1-larvae are passed in the feces. Once in the environment, larvae penetrate into the snails and develop to infective L3 larvae. Livestock becomes infected after eating contaminated snails or slugs while grazing [15].

The pathogenesis of lungworms depends on their location within the respiratory tract, the number of infective larvae ingested, the animal immune status, the nutritional status and age of the host. The signs of lungworm infection (verminous pneumonia), range from moderate coughing with slightly increased respiratory rates to sever persistent coughing. Unthriftness, dyspnea, nasal discharge, weight loss, in case of associated bronchopneumonia, also fever and death are important clinical signs [16]. Diagnosis can be based on the clinical signs and grazing history. Usually, the clinical signs, the time of the year and a history of grazing are sufficient to make diagnosis [17]. The confirmation of lungworm is by detecting the L1 stage in faecal samples using the Baermann technique [18].

The anthelmintics available for the treatment of lungworms are the modern albendazole, levamisole and ivermectin [19]. These drugs have shown to be effective against all stages of lungworms with a consequent amelioration of clinical signs [20]. The control and prevention of lungworm can be achieved by deworming all animals at the end of the rainy season to avoid heavy parasitic burden during grazing and deworming all animals at the end of the dry season before the rain starts as it is very important in reducing pasture contamination [7]. Providing balanced nutrition is very important to keep animals healthy and help them to develop appropriate resistance to external pathogens [21]. The other method is vaccination that was developed from larvae of *Dictyocaulus* [22].

In Ethiopia, the prevalence of lungworms in ruminants and the species of the parasite involved have been reported by many researchers such as [23; 24; 25; 26; 27; 11; 28; 29]. But most of these researchers used coprology alone or with some combination of postmortem examination of lungs. According to these studies, the prevalence of lungworms in Ethiopia ranges from 13.4–72.4% in sheep and 1.5–3.1% in cattle. In contrast to the availablity of several studies on ovine lungworm, only very few studies are available on bovine lungworm. Due to the presence of diverse ecological and climatic conditions suitable for survival and development of lungworms in Ethiopia; studies that generate basic information on the occurrence, species diversity and risk factors are extremely helpful to design practically appropriate control and prevention strategies in Ethiopia.

Therefore, this DVM research was designed to attain the objectives:

- To determine the occurrence of lungworms in sheep and cattle and compare the percentage between sheep and cattle slaughtered at Debre Birhan municipal abattoir and private hotels in Debre Birhan.
- To identify the species of lungworm helminthes that circulating in sheep and cattle in the study area and
- To assess the possible risk factors of lungworms in sheep and cattle in the study area.

2. Material and Methods

2.1. The study area

The study was conducted to determine the occurrence of lungworms in sheep and cattle slaughtered at Debre Birhan municipal abattoir and private hotels from November, 2017 to April, 2018. Debre Birhan is a town located in North Shewa administrative zone of Amihara regional state situated 130 km northeast of Addis Ababa. Debre Birhan town is geographically located at latitude 09°31’ N and longitude 39°42’ E with an altitude of 2840 meter above sea level (Fig 1). This area is mountainous with large plane grazing lands and dissected by two rivers, namely Dalicha and Beressa. In the study area indigenous and cross breed of cattle and sheep are the major livestock with traditional crop-livestock farming [30]. Mean livestock holdings are larger than elsewhere in the Ethiopian highlands. The largest population of sheep and cattle are the source of income and security [31]. Livestock population comprises of 144,638 cattle, 97,815 sheep, and 47,970 goats and 39,038 equines [32].
The climatic condition is characterized by the presence of biannual rainfall (short and long) and the dry season which is relatively cool temperature. The rainy season of this area extends from February to April and June to September while the dry season extends from November to January. The mean annual temperature of Debre Birhan is 15.84 °C, where the minimum and maximum temperature is 6.1 °C and 19.9 °C, respectively. The average annual rain fall is 1728 mm and relative humidity is 62.3%. Debre Birhan and the surrounding areas have apparently a well spread rainfall throughout the year. The minimum (1.7 °C) and maximum (21.60 °C) temperature are registered in November and July, respectively [33]. In literatures, minimum temperature about 10 °C and maximum temperature below 30 °C are favorable to parasite development and egg hatching [34].

2.2. Study population
Cattle and sheep brought for slaughter were the study animals with different body condition category of both sexes that were slaughtered in Debre Birhan municipal abattoir and private hotels. Cattle and sheep slaughtered at Debire Birhan municipal abattoir and in hotels were studied for the presence of lungworms by standard post-mortem examination methods [35]. The sex, age and body condition of all animals included in the study were recorded during the study. The body condition scoring was classified in to three categories as poor, moderate and good. As most bovines being slaughtered reach maturity, age comparison was unavailable, but in sheep age comparison is available in this study [36; 37].

2.3. Sampling method and sample size determination
Simple random sampling technique where each individual is chosen entirely by chance was used as the sampling strategy to collect all the necessary data from abattoir survey of the study. An investigation was carried out on cattle and sheep by random selection with special emphasis on animals coming from grazing. To accommodate the sample size for this study random sampling was applied for study cattle and sheep of any age and sex slaughtered in Debre Birhan municipal abattoir and private hotels for post-mortem lung inspection. The desired sample size for the study was determined using the formula described by Thrusfield [38].

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

Where
- \( n \) = required sample size
- \( P_{exp} \) = expected prevalence
- \( d \) = desired absolute precision
- \( 1.96^2 \) = \( z \)- value for 95% confidence interval

As there are no previous studies which establish the percentage and the risk factors of lungworm infestation of sheep and cattle as a whole, the sample size was determined by taking the occurrence of 50% lungworm infestation. Accordingly 384 animals were sampled, but in order to increase the precision 400 study animals were used. In study undertaken on the prevalence of lungworm in sheep alone, the prevalence of lungworm was found to be 56.3% in 2013/4 [25].
2.4. Study design and sample collection methodology

A cross-sectional investigation on the occurrence of lungworms in ruminants of various age group, sex, body condition score and sampled during different seasons was carried out from November, 2017 to April, 2018. In addition, the degree of lungworm burden (degree of parasitic infestation) [39], and the species of the lungworm parasites were determined by standard methods of post-mortem examination.

2.4.1. Postmortem examination

During ante-mortem examination each of the study animals were given an identification number by a paint mark on their body. Detail records about the species, age, sex and body conditions of the study animals were performed using data collection format (Annex 3). While during the postmortem examination, lungs were examined first by visual inspection, palpation and then finally systemic incision to appreciate the presence, the size (the burden) and the species of lungworm [40]. Each lung from study animals was inspected by incising it starting from trachea down to bronchi and bronchioles, and then making multiple deep incisions of the lobes with a number of small sub cuts. The recovered worms were kept in 70% alcohol and then were transferred to laboratory for examination. Adult parasites were examined under the stereomicroscope for determining the degree of lungworm parasitic burden; [41; 42] and the identification (classification) of adult lungworm parasites to the species level as has been done previously [43].

2.5. Data management and statistical analysis

The data that was generated entered into Microsoft excels spread sheet and summarized using descriptive statistics. Many attribute data that was imported to database system includes; host risk factors including species, sex, age and body condition of the sampled animals, the season of the year and examination result including the degree of parasitic infestation and lungworm species. The occurrence of lungworms was calculated by dividing the number of animals affected to the total number of animals examined. Variation in the percentages of lungworms between species, sex, age, body condition and season of the year was determined by using logistic regression statistics. Statistically significant variation was considered to exist when p-value is less than 0.05.

3. Results

3.1. Percentage of lungworms

Among 400 animals (sheep and cattle) examined for the presence of lungworms 83 (20.8%) were positive. Out of 204 sheep and 196 cattle examined for lungworms, 83 sheep (40.7%) and zero cattle (0%) were found positive. A significant difference was observed in the occurrence of lungworm between sheep and cattle (P-value of 0.000, where p < 0.05). Dictyocaulus filaria was the only species of lungworm identified in sheep (Table 1).

<table>
<thead>
<tr>
<th>Species of the Animal</th>
<th>No of animals examined</th>
<th>No of animals positive</th>
<th>Percentage</th>
<th>OR (95% CI)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheep</td>
<td>204</td>
<td>83</td>
<td>40.7</td>
<td>1 (Ref)</td>
<td></td>
</tr>
<tr>
<td>Cattle</td>
<td>196</td>
<td>0</td>
<td>0</td>
<td>0.01 (0.5-0.9)</td>
<td>0.000</td>
</tr>
<tr>
<td>Over all</td>
<td>400</td>
<td>83</td>
<td>20.8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.2. Overall percentage of lungworm in sheep by risk factors

Different potential risk factors were evaluated in relation with the percentages of lungworm with logistic regression statistical analysis in order to assess association between individual risk factors and presence of lungworms in sheep. Among the presumed risk factors, age and body condition of the sheep and season of the year were found to have a significant association with the prevalence of D. filaria (p<0.05), on the other hand the sex of the animals never showed significant effect on the occurrence of lungworm in sheep (Table 2).
Table 2: Percentages and logistic regression statistical analysis of ovine lungworm against hypothesized risk factors

<table>
<thead>
<tr>
<th>Variables</th>
<th>No of animals examined</th>
<th>No of animals positive</th>
<th>Percentage</th>
<th>OR (95% CI)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>114</td>
<td>47</td>
<td>41.2</td>
<td>Ref</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>90</td>
<td>36</td>
<td>40.0</td>
<td>0.9 (0.5-1.7)</td>
<td>0.765</td>
</tr>
<tr>
<td>Over all</td>
<td>204</td>
<td>83</td>
<td>40.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adult</td>
<td>142</td>
<td>49</td>
<td>34.5</td>
<td>Ref</td>
<td></td>
</tr>
<tr>
<td>Young</td>
<td>62</td>
<td>34</td>
<td>54.8</td>
<td>2.2 (1.2-4.2)</td>
<td>0.014</td>
</tr>
<tr>
<td>Over all</td>
<td>204</td>
<td>83</td>
<td>40.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Body condition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>54</td>
<td>14</td>
<td>25.9</td>
<td>Ref</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>88</td>
<td>33</td>
<td>37.5</td>
<td>1.5 (0.7-3.2)</td>
<td>0.324</td>
</tr>
<tr>
<td>Poor</td>
<td>62</td>
<td>36</td>
<td>58.1</td>
<td>4.1 (1.8-9.4)</td>
<td>0.001</td>
</tr>
<tr>
<td>Over all</td>
<td>204</td>
<td>83</td>
<td>40.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Season of the year</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Autumn</td>
<td>70</td>
<td>36</td>
<td>51.4</td>
<td>Ref</td>
<td></td>
</tr>
<tr>
<td>Winter</td>
<td>84</td>
<td>34</td>
<td>40.5</td>
<td>0.6 (0.3-1.2)</td>
<td>0.173</td>
</tr>
<tr>
<td>Spring</td>
<td>50</td>
<td>13</td>
<td>26.0</td>
<td>0.3 (0.1-0.7)</td>
<td>0.005</td>
</tr>
<tr>
<td>Over all</td>
<td>204</td>
<td>83</td>
<td>40.7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Beyond assessing the occurrence of lungworm infection and its’ association with hypothesized risk factors, this study also showed the parasitic burden (degree of parasitic infestation). The study showed that majority of animals were with moderate degree (39.8%) and heavy (36.1%) degree of lungworm infestation and the rest 24.1% of them were with light degree of lungworm burden (Table 3).

Table 3: Overall proportion of the degree of lungworm infestation in sheep slaughtered at Debre Birhan municipal abattoir and private hotels

<table>
<thead>
<tr>
<th>Degree of lungworm infestation</th>
<th>No of sheep positive for lungworm</th>
<th>Proportion (%) of degree of infestation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>20</td>
<td>24.1</td>
</tr>
<tr>
<td>Moderate</td>
<td>33</td>
<td>39.8</td>
</tr>
<tr>
<td>Heavy</td>
<td>30</td>
<td>36.1</td>
</tr>
<tr>
<td>Over all</td>
<td>83</td>
<td>100</td>
</tr>
</tbody>
</table>

The result of the present study revealed that was no variation in parasitic worm burden between male and female animals (p>0.05) (Table 4). Young sheep tend to possess significantly a higher moderate (27.42%) and heavy (17.74%) degree of lungworm burden (P<0.05) than adult animals with odd ratio of 2.3. Statistically significantly higher lungworm burden was observed in sheep with poor body condition score (p>0.001) than those sheep with medium and good body condition scores (Fig. 2). Likewise, significantly higher (p<0.006) lungworm burden was recorded in sheep during the Autumn and Winter seasons of the study period than in Spring season (Table 4).
Table 4: Logistic regression analysis of hypothesized risk factors against the degree of lungworm burden

<table>
<thead>
<tr>
<th>Risk factors</th>
<th>No of animals examined</th>
<th>Degree of parasitic infestation</th>
<th>OR (95% CI)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Low (7.02%)</td>
<td>Moderate (21.05%)</td>
<td>Heavy (13.16%)</td>
</tr>
<tr>
<td>Sex</td>
<td>Male</td>
<td>114</td>
<td>24 (21.05%)</td>
<td>15 (13.16%)</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>90</td>
<td>12 (13.33%)</td>
<td>9 (10.00%)</td>
</tr>
<tr>
<td>Age</td>
<td>Adult</td>
<td>142</td>
<td>14 (9.86%)</td>
<td>16 (11.28%)</td>
</tr>
<tr>
<td></td>
<td>Young</td>
<td>62</td>
<td>6 (9.68%)</td>
<td>17 (27.42%)</td>
</tr>
<tr>
<td></td>
<td>Good</td>
<td>54</td>
<td>5 (9.26%)</td>
<td>7 (12.96%)</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>88</td>
<td>7 (7.95%)</td>
<td>15 (17.05%)</td>
</tr>
<tr>
<td></td>
<td>Poor</td>
<td>62</td>
<td>8 (12.90%)</td>
<td>11 (17.74%)</td>
</tr>
<tr>
<td></td>
<td>Autumn</td>
<td>70</td>
<td>10 (14.29%)</td>
<td>15 (21.43%)</td>
</tr>
<tr>
<td></td>
<td>Winter</td>
<td>84</td>
<td>5 (5.95%)</td>
<td>13 (15.48%)</td>
</tr>
<tr>
<td></td>
<td>Spring</td>
<td>50</td>
<td>5 (10.00%)</td>
<td>5 (10.00%)</td>
</tr>
</tbody>
</table>

Figure 2: The relationship between body conditions with the degree of parasitic infestation

Heavy parasitic burden has a marked increase in animals in poor body condition (27.42%) followed by medium body condition animal (12.50%); while, in animals with good body condition (3.70%), it was rarely occurred (Fig. 2). Heavy degree of parasitic infestation also rises in the seasons when there are available infective larvae (Autumn 15.71%, Winter 19.05%, Spring 6.00%) due to the effect of climatic condition.

4. Discussion

Lungworm is the common health problem in ruminants particularly; in small ruminants and is associated with significant economic losses due to unthriftness, loss of body condition and morbidity. This study revealed high percentage of lungworms in sheep slaughtered at Debre Birhan municipal abattoir and private hotels which can represent the occurrence and percentage of the disease caused by lungworms in and around Debre Birhan. However, the overall percentage (0%) lungworms in cattle might not be representative of lungworm in cattle in the study area. Because cattle slaughtered at Debre Birhan abattoir were mostly brought from feedlots which had low exposure to the disease [44; 45].

Furthermore, usually the owners of cattle kept for fattening normally treat these animals with broad spectrum anthelmintic to get the possible maximum weight gain that significantly reduces the chance of lungworms. In agreement with the present study, zero prevalence of bovine lungworm was already reported in the Kirikkale province of Turkey [46].
Low prevalence of cattle lungworm was already reported [36], who reported 0.5% in Addis Ababa abattoir. There is also reported 1.5% and 3.1% in Addis Ababa abattoir and Gonder, respectively [28; 29].

The overall percentage of 40.7% lungworm in sheep recorded in this study was high and coincides with previous prevalence of 43.33% lungworm reported in Dessie zuria [47], 42% in North Gondar Zone [48] and 48% in Addis Ababa [49]. However, results of the present study is higher than the previous reports [50] in and around Bahir Dar, [51] in Bahir Dar and [52] in Mekedela district, south east Ethiopia, who reported prevalence of 18.16%, 20.2% and 28.6%, respectively. On the other hand the percentage reported in this study is lower than those reported [25] in and around Debre Birhan, [27] around Dessie, Kombolcha and [53] around Chilallo area which reported prevalences of 56.3%, 60.5%, 67.83% and 81% in sheep, respectively. Such variation in percentages of lungworms in sheep could be attributed to the difference in study type, number of sample size, study area and month and seasons of the year of sample collections by different studies.

Dictyocaulus filaria was the only species of lungworm identified in the present study. The small lungworms, P. rufescens and M. capillaris, were not detected. The absence of small lungworms in the present study area could be associated with their life cycle and the season of the study. Unlike D. filaria, which has a direct life cycle, P. rufescens and M. capillaris have an indirect life cycle requiring a molluscan intermediate host to complete their development [19]. As this study was conducted in relatively non rainy seasons, the climatic conditions in the study area might not be conducive for the survival and breeding of the intermediate hosts. In agreement with this finding, [9] in and around Wollayita Sodo reported that D. filaria was the only lungworm species. Many other previous studies [26; 54; 55; 11] also reported D. filaria as the predominant species circulating in Ethiopian sheep and goats managed under traditional husbandry system although mixed infections with the small lungworms was reported by some previous investigators at low proportions. In contrast, other studies reported the preponderance of the small lungworms over D. filaria [23; 24; 12].

The absence of significant (p>0.05) difference in the percentages of lungworm between male and female sheep using logistic regression analysis in the current study is in agreement with previous researchers [25; 9], who reported insignificant difference between sex groups. However, a result of the present finding is not in agreement with the earlier study around Bahir-Dar [56], in six districts of Wollo [57] and in Gojam [51], who reported significant variation between sexes. These variations among different studies probably reflect the fact that improper distribution of sample selection between the two sexes. For example in study reported earlier, there were 179 males and 277 females, around 100 additional females over the number of males [51].

The observation of significant variation between age (young and adult) groups (P<0.05) in this study agrees with previous researchers, who reported significant difference among age groups [23; 58; 27; 29]. But there was a study that reported insignificant difference between age groups (young, adult and old sheep), this difference might reflect the variations regarding the cut point for age classification of sheep or other types unforeseen factor [59].

The observation of sheep with poor (38.06%) or moderate (37.50%) condition were 3 times more likely to shed D. filaria with an odd ratio of 4.1 and 1.5, respectively than those in good (25.93%) condition might be attributed to the nutritional status of the animals. This study was conducted during the dry season where feed shortage is a serious problem for small ruminants kept under extensive management system in Ethiopia. Therefore, during the dry season free-ranging animals are not able to meet their maintenance requirements, and lose a substantial amount of weight [60]. It is well documented fact that poor nutrition lowers both the resistance (ability to resist the parasites) and resilience (ability to tolerate or ameliorate the effects of the parasites) of the animal thus enhancing the establishment of worms and increasing the prevalence in sheep with poor body condition score [61].

The observation of significantly higher percentages of lungworms in sheep with poor body condition in the present study agrees with many other previous reports, which includes earlier reports, who reported prevalence of 64.5%, 25.13% and 18% in poor, medium and good body condition, respectively and in and around Tseadaemba [62]; There was also a reported prevalence of 79.1%, 52.1% and 30.9% in poor medium and good body condition respectively in Assela area [63; 64]. This may be due to, immune suppression in sheep with poor body conditions, concurrent infection by other parasites including GIT helminthes and/or malnutrition that reduce the ability of the animal to resist or ameliorate the infection [65].

The findings of the highest percentage of D. filaria during November in Autumn (51.4%) and Winter (40.48%) in the present study is in agreement with the previous reports by other researchers [66; 67; 23; 24; 68]. This suggests that damp and cool environment is very suitable for the development of D. filaria and third stage larva (L3) is resistant to cold [69].

The absence of significant variation in the load lungworm of infestation between male and female sheep in the present study showed similar pattern in lungworm occurrence in both sexes. The possible explanation for the finding of 3.70%, 12.50% and 27.42% heavy parasitic infestation in good, medium and poor body condition sheep, respectively in the resent study could be an increase in degree of pasture contamination in extensive system of production may increase degree of exposure, so result in high degree of parasitic burden [5]. In addition, the reason for this could partly be due to the fact that poorly nourished animals appeared to be less competent in getting rid of lungworms although it is not usual for well-fed animals to succumb to the disease provided the right environmental conditions are available [65].

The finding of heavy degree of infestation during the Autumn (15.71%) and winter (19.05%) while minimal heavy parasitic burden (6.00%) during the Spring was due to the highest availability of active infective lungworm larvae in Autumn and Winter as the climatic condition favors them. This allowed sheep to ingest large amount of infective larvae. Late summer/autumn is the key risk period for young animals so treat at intervals during this time, according to the anthelmintic used [11; 10].
5. Conclusion and Recommendation

The current study revealed that the overall occurrence of D. filaria was 40.7% in sheep and zero percent of in cattle. The main reason assumed for zero percent occurrence of bovine lungworm is that, cattle brought for slaughter comes from feedlot and possibly received broad spectrum anthelmintics deworming. While, most of the sheep brought for slaughter comes from rural areas that graze in a free range, the probability for presence of the parasite in the lung was high. D. filaria is the only ovine lungworm species isolated in the current study. The probable reason for this is D. filaria has a direct life cycle. Compared with the Dictyocaulus filaria, transmission of P. rufescens and M. capillaries are epidemiologically complex event involving host, parasite and intermediate host. There was no significant difference in lungworm prevalence between male and female animal. Age (young and adult), body condition (poor, medium and good) and season of the year (Autumn, Winter and Spring) were significantly associated with percentages of lungworm in sheep. There was found seasonal variation in parasitic load, significant heavy degree of infestation was observed in autumn and winter. Sheep with good body condition harbor lower parasite than sheep with medium and poor body condition. Further research is required to investigate if improving the nutritional status, thereby improving BCS, will result in lower occurrence of lungworm. Based on the aforementioned points, the following recommendations are forwarded:

- Prohibition of animals from grazing early in the morning and evening when there is high activity of larvae due to moisture when pasture contamination is very high.
- Strategic anthelmintic drug treatment should be implemented at the beginning of rainy season and at the end of rainy season could appear to be most effective.
- Further studies are needed to clarify issues regarding seasonal variations of lungworms in all domestic animals

6. Acknowledgements

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7. List of Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>BCS</td>
<td>Body condition score</td>
</tr>
<tr>
<td>CI</td>
<td>Confidence Interval</td>
</tr>
<tr>
<td>D. filaria</td>
<td>Dictyocaulus filaria</td>
</tr>
<tr>
<td>D. viviparous</td>
<td>Dictyocaulus viviparous</td>
</tr>
<tr>
<td>ESGPIP</td>
<td>Ethiopia Sheep and Goat Productivity Improvement Program</td>
</tr>
<tr>
<td>FAO</td>
<td>Food and Agriculture Organization</td>
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<tr>
<td>GIT</td>
<td>Gastrointestinal tract</td>
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<tr>
<td>IH</td>
<td>Intermediate host</td>
</tr>
<tr>
<td>L1</td>
<td>First stage larvae</td>
</tr>
<tr>
<td>L3</td>
<td>Third stage larvae (infective stage)</td>
</tr>
<tr>
<td>M. capillaris</td>
<td>Muellerius capillaries</td>
</tr>
<tr>
<td>No</td>
<td>Number</td>
</tr>
<tr>
<td>°C</td>
<td>Degree Celsius</td>
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<tr>
<td>OR</td>
<td>Odds Ratio</td>
</tr>
<tr>
<td>P. rufescens</td>
<td>Protostrongylus rufescens</td>
</tr>
<tr>
<td>Ref</td>
<td>Reference Category</td>
</tr>
</tbody>
</table>

8. References

1. FAO (2004): Livestock sector of Ethiopia, Food and Agriculture Organization of the united nation, “livestock information, and sector analysis and policy branch.”
30. Gryseels, G. (1988): The role of livestock in the generation of smallholder farm income in two Vertical areas of the central Ethiopian highland.s


50. Mulukken, Y. (2009): Prevalence of ovine lungworms in and around Bahir Dar. “DVM thesis, college of Agriculture and Veterinary Medicine, School of Veterinary Medicine, Jimma University, Jimma, Ethiopia.”


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