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Original Article

Investigating the Situation Of Infection With Respiratory System Parasitic Worms in Ethiopian Sheep

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Abstract

Introduction: This study was conducted from October 2019 to April 2020 to determine the prevalence of lungworm infection and to assess some of the determinant risk factors associated with sheep lungworm infections in Ambo, Central Ethiopia.

Methods: Fecal samples were collected from randomly selected 349 sheep, kept under extensive management systems, to examine first-stage larvae (L1) using the Baermann technique. Additionally, samples were collected from 44 sheep slaughtered in different restaurants and hotels to explore the presence of adult lungworm parasites.

Results: The overall prevalence recorded from fecal and postmortem examinations was 23.2% and 31.8%, respectively. A higher prevalence was observed in females (26.2%) than in males (17.7%). Age-wise, a higher prevalence (29.1%) was observed in animals greater than six months to 2 years old, while the lowest (13.5%) was observed in animals less than or equal to 6 months. The prevalence of lungworm infection during postmortem examination of slaughtered sheep was higher (31.8%) than the result obtained at coprology (23.2%).

Conclusion: This study showed that lungworm infection was a common problem among sheep in the study area. Due to its impact on production, emphasis should be given to controlling and preventing lungworm infection in the study area, such as through repeated deworming and grazing management.

Keywords: Infection, Respiratory system, Parasitic worms, Ethiopian sheep

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Introduction

Livestock has several benefits for humans, especially in developing nations. In Africa, small-ruminant production is a significant portion of the continent's livestock industry (1). Of the 475 million goats and 1614 million sheep on the globe, 95% and 65%, respectively, are found in developing nations. Africa is home to 205 million sheep and 174 million goats, roughly 17% and 31% of the global population, respectively (2). Africa has a very diverse distribution of small ruminants; they are more prevalent in arid regions than in humid ones (3).

Due to minimal input requirements such as small initial capital, fewer resources, and maintenance costs such as small ruminant households in African society, these factors account for a larger share of impoverished families' total income. With marginal areas, insufficient pasture, and agricultural leftovers, they can also generate milk and meat in easily consumable quantities. Additionally, because of their rapid production cycle, they can quickly reassemble flocks following calamities and meet demand (4).

Ethiopia is home to diverse indigenous sheep and ranks second in Africa and sixth in the world (2,5), with an estimated population of nearly 23.62 million sheep (6). In Ethiopia, the livestock sector is the major source of income for rural communities and a significant contributor to foreign currency from exports (7,8).

Despite this, sheep production and productivity are limited due to parasitic diseases. Ovine lungworms are widely distributed throughout the world but are particularly common in countries with temperate climates and in the highlands of tropical and sub-tropical countries (9,10). Lungworm infection in sheep is caused by nematode parasites such as *Dictyocaulus filaria, Muellerius capillaris,* and *Protostrongylus rufescens* (11). *Dictyocaulus filaria* is acquired by ingestion of infective larvae with herbages, but *M. capillaris* and *P. rufescens* are transmitted when Molluscan intermediate hosts are accidentally ingested by grazing animals (12).

The pathogenic effect of lungworms varies depending on where they are located in the respiratory tract, how many infectious larvae they ingest, and the animal's immune system. Lungworms are parasitic nematodes that cause lower respiratory tract infections characterized by

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respiratory distress, trachitis, bronchitis, and pneumonia (13). Lungworm infection manifests clinically as severe, chronic coughing to mild coughing with modestly elevated respiratory rates (14). Other significant clinical indicators include weight loss, nasal discharge, dyspnea, and nausea (11). The main parasitological method of confirming lungworm disease is detecting the L1 stage in fecal samples using the Baermann technique. Still, several factors can affect larval excretion, such as season, lactation, and reproductive effort. On post-mortem examination, the air passage opened to detect adult worms in the lower respiratory tract (lung) (15).

Therefore, control and prevention of these parasites are essential for increasing sheep production and reducing their impact on sheep. A comprehensive understanding of parasite infections and their prevalence is essential for effectively applying appropriate control methods (16,17).

Materials and Method

Description of Study Area

This study was conducted from October 2019 to April 2020 in and around Ambo, West Shewa zone, Oromia regional state. The town is located in central Ethiopia, about 110 km from Addis Ababa in the west. The area is situated at a latitude of 8°47 to 9°20°N and a longitude of 37°32° to 38°3°E.

Study Population

The study population consisted of 349 sheep randomly selected from the sheep populations in the study area. All the study animals were local breeds and were kept under a traditional management system where animals were allowed to graze freely in the daytime and stay in the pen at night. Of the total sampled animals, 225 were female, and 124 were male. The farmers' answers were used to estimate the animals' ages, which were then double-checked by looking at their teeth. The animals were divided into three age groups: younger than six months, between six months and two years, and more than two years, based on the replies. In each age group, there were 37, 127, and 185 animals, in that order. The Ethiopia Sheep and Goat Productivity Improvement Programme (18) was followed in the body condition rating.

Study Design

This cross-sectional study was conducted in and around Ambo town, among the field population and sheep brought for slaughter at hotels and restaurants. The individual animals' biodata were collected from clinical assessments and owner information, where appropriate.

Laboratory Assay

Coprological Examination

Fresh fecal samples were directly collected from the rectum of individual sheep using disposable gloves. The samples were placed in a universal bottle and packed in an icebox. Information on various risk factors, such as sampling date, sex, body condition, clinical respiratory signs, and age of individual animals, was recorded correctly during sample collection. Each bottle was properly labeled to correspond with the animal's identity. The sample was then transported to the Ambo University Veterinary Laboratory Technology. The recommended techniques (19,20) were used to identify lungworm larvae from the collected samples. The conventional Baermann technique was employed in the laboratory to detect lungworm larvae.

Postmortem Examination

For the postmortem examination, the lungs of sheep slaughtered at different restaurants and/or hotels in Ambo town were collected and transported to Ambo University Veterinary Laboratory Technology after slaughter for examination of adult lungworms. The sex, body condition, and date of sampling of the slaughtered animal were labeled. The air passages were opened, starting from the trachea down to the bronchi, with fine, blunt-pointed scissors to detect the parasites.

Results

Coprological Examination

A total of 349 sheep were examined for lungworm infection using the Baermann technique in Ambo town and its surroundings. The survey showed an overall prevalence of 23.2%. In this study, a number of hypothesized risk factors, including age, sex, body condition, and the presence or absence of respiratory clinical signs, were considered to observe the prevalence trend. Accordingly, the prevalence in males was 17.7%, while that of females was 26.2%. Similarly, the prevalence in lamb was 13.5%, young adults were 29.1%, and adults were 21.1%, and no statistically significant difference was noted between categories in the respective risk factors ($P > 0.05$).

The infection prevalence was associated with sheep body condition among the hypothesized risk factors. Accordingly, the prevalence was 12.4% for good, 21.9% for moderate, and 37.6% for poor body condition (Table 1). The difference noted was significant statistically ($P < 0.05$). Similarly, the prevalence of lungworm infection in apparently healthy groups was 17.0%, while that of the sick was 52.5%, and the difference was significant statistically ($P < 0.05$).

The data were further regressed in a univariable logistic regression analysis (Table 2), and those predictors with a P value less than or equal to 0.25 were further subjected to a multivariable logistic regression analysis. As all four predictors considered in univariable logistic regression fulfilled the benchmark criteria, they were all subjected to multivariable regression analysis; however, body

condition score and status of respiratory signs fitted the final model significantly (Table 3).

Postmortem examination

A total of 44 sheep were examined postmortem in different restaurants in Ambo town. Of these, 14 (31.8%) tested positive for lungworm infection (Table 4).

The comparison of the overall prevalence of lungworm infection was found to be higher in a postmortem examination (31.8%) than in a coprological examination (23.2%) (Table 5).

Table 1. Prevalence of Lungworm Infection in Sheep Hosts Concerning Different Risk Factors (Variables)

Factors	Category	No. of Examined	Proportion (%)	95% CI
Age	≤6 months	37	5 (13.5)	2.3–24.7
	>6 month-2 years	127	37 (29.1)	21.2–37.1
	>2 years	185	39 (21.1)	15.2–27.0
Sex	Female	225	59 (26.2)	20.4–32.0
	Male	124	22 (17.7)	11.0–24.5
BCS	Poor	93	35 (37.6)	27.7–47.6
	Moderate	151	33 (21.9)	15.2–28.5
	Good	105	13 (12.4)	6.0–18.7
Respiratory clinical sign	Showing respiratory clinical sign	61	32 (52.5)	39.8–65.1
	Apparently healthy	288	49 (17)	12.7–21.4
Total		349	81 (23.2)	19.1–28.0

BCS, body condition score

Discussion

Lungworm infection (verminous pneumonia) is a chronic parasitic disease affecting animals' respiratory systems. This results in substantial economic loss due to unthriftiness, loss of body condition, reduction of growth rate, poor skin quality, morbidity, and mortality by predisposing the animal to secondary infection (21). The current study revealed the importance of lungworm parasites in Ambo for all indigenous breeds of sheep kept under an extensive traditional management system. Out of the total sheep examined, fecal and postmortem examinations recorded an overall prevalence rate of 23.2% and 31.8%, respectively. This widespread prevalence agrees with the work done by other researchers, who reported 22.7% in and around Bahir-Dar (22), 21.57% in and around Atsbi (23), 25.78% in Banja District (23), and 22.1% in and around Wolaita Soddo (24).

However, the present finding was lower compared with the findings of (18) in three peasant associations from some areas of the country: (25) in Wogera District, (26) in Tiyo District, and (27) in Debre Birhan, who reported 34.90%, 67.69%, 57.1%, and 56.3%, respectively. On the other hand, the present report was higher than (28) in and around Wukro, (29) in and around Bahir-Dar, and (30) in Mekelle town, reporting a prevalence of 13.1%, 17.5%, and 13.4%, respectively.

The differences in the prevalence of lungworms in sheep in the above studies might be associated with differences in methods employed in the detection of lungworm larvae, the difference in the study areas

Table 2. Univariable Logistic Regression Analysis of Different Risk Factors for Lungworm Infection in Sheep

Factors	Category	No. of Examined	Proportion (%)	OR	95% CI for OR	*P* Value
Age	≤6 months	37	5 (13.5)	Ref		
	>6month-2 years	127	37 (29.1)	2.6	0.95–7.3	0.062
	>2 years	185	39 (21.1)	1.7	0.6–4.7	0.296
Sex	Female	225	59 (26.2)	Ref		
	Male	124	22 (17.7)	0.6	0.4–1.45	0.074
BCS	Poor	93	35 (37.6)	Ref		
	Moderate	151	33 (21.9)	0.5	0.26–0.81	0.008
	Good	105	13 (12.4)	0.6	0.11–0.48	0.000
Respiratory clinical sign	Apparently healthy	288	49 (17)	Ref		
	Showing respiratory clinical Sign	61	32 (52.5)	5.4	2.98–9.7	0.000

BCS, body condition score

Table 3. Multivariable Logistic Regression Analysis of Different Risk Factors Associated With Lungworm Infection in Sheep

Factors	Category	No. of Examined	Proportion (%)	OR	95% CI for OR	*P* Value
BCS	Poor	93	35 (37.6)	Ref		
	Moderate	151	33 (21.9)	0.5	0.29 – 0.98	0.045
	Good	105	13 (12.4)	0.29	0.13 – 0.63	0.002
Respiratory clinical sign	Apparently healthy	288	49 (17)	Ref		
	Showing respiratory clinical sign	61	32 (52.5)	4.5	2.4 – 8.5	0.000

BCS, body condition score

Table 4. Postmortem-Based Lung Worm Infection Prevalence in Sheep

Factors	Category	No. of examined	Proportion (%)	95% CI
Gender	Female	18	44.4	6.1–40.1
	Male	26	23.1	20.1–68.7
BCS	Poor	5	8	3.96–20.3
	Moderate	22	27.3	7.7–46.9
	Good	17	23.5	2.1–45
Total		44	31.8	19.4–47.1

BCS, body condition score

attributed to climatic factors like humidity and weather and other factors that favor the survival of the lungworm larvae, and the sample size variation used by researchers.

The reason for the low prevalence of the disease in this study could be attributed to the establishment of an open-air clinic in rural Kebeles, an increase in the number of private veterinary pharmacies, and increased farm awareness to deworm their sheep. The increase in prevalence in this study could be explained by the fact that all earlier researchers conducted their research in different management systems. However, in the present study, only extensive management types were examined. A higher prevalence of infection was noted where the husbandry of sheep was extensive type than in the semi-intensive type because sheep with extensive management type has a higher chance to ingest the intermediate host (snail and slugs) for lungworms with indirect life cycles (*P. rufescens* and *M. capillaries*) or are they possibly infested with larvae as well as easily obtained lungworms (*Dictyocaulus filaria*) from the herbage (31).

The study showed a higher level of prevalence was observed in female (26.2%) animals compared to the level of prevalence observed in male animals (17.7%), with an insignificant difference ($P > 0.05$). This result agrees with the earlier study of (32) in Gondar Town and (33), who reported an insignificant difference in lungworm infection between sexes. However, there was a significant variation in the infection rate of lungworms in males and females. The difference may be due to the improper distribution of sample selection between the two sexes, as observed by (33), where almost all female sheep were sampled.

Regarding age, a higher prevalence of lungworm infection was observed in the groups of > 6 months to 2 years (29.1%) as compared to age groups of less than or equal to 6 months (13.5%) and greater than two years (21.1%). The lower proportion in the age group of ≤ 6 months could be attributed to sampling a small and disproportionate number of animals or might be associated with the infrequent grazing behavior of animals less than six months of age and the acquired resistance of adult animals. Accordingly, as the age of animals increases, their susceptibility to lungworm infection decreases (12).

The body condition of animals was significantly associated with lungworm infection's prevalence in univariable and multivariable logistic regression analyses. A higher infection rate was observed in animals with poor body condition than in other groups. This, in part, may be attributed to the animal's nutritional status. The odds of animals with medium and good body condition score (BCS) (odds ratio [OR] = 0.5, 95% CI: 0.29, 0.98; OR = 0.29, 95% CI: 0.13, 0.63), respectively, are less likely to be infected with lungworm than poor body-conditioned animals. The finding was in agreement with the reports of (34,35) in and around Wukro, (23) in Banja District, and (27) in Debre Birhan.

Table 5. Coproscopic and Post-mortem Results of Lungworm Infection in Sheep

Type of Examination	No. of Examined	Proportion (%)	95% CI
Coproscopic	349	81 (23.2)	19.1–28.0
Post mortem	44	14 (31.8)	19.4–47.1

The prevalence of lungworm infection by coproscopic examination was significantly higher (52.5%) in animals showing clinical respiratory signs than in those apparently healthy (17.0%). The OR of infection in animals that showed clinical respiratory signs was 4.5 times higher than that of sub-clinically infected animals. This report is consistent with that of (36) and (37).

The prevalence of lungworm infection at postmortem examination of slaughtered sheep was higher (31.8%) than the result obtained through coprology (23.2%). This finding is consistent with the observations of (29) and (7) but not in agreement with the reports of (38-40).

Conclusion and Recommendation

This study showed that lungworm infection is a problem for sheep in the Ambo area. In the present study, the infection prevalence of lungworms was estimated to be 23.2% on Coprological and 31.8% on a postmortem test. There was no significant difference between the age and gender categories of animals in the study area. The prevalence noted along body condition status was different statistically. A higher prevalence was recorded in those sheep with poor body conditions than those with medium and good body conditions. The prevalence of lungworms in sheep using the necropsy method was much higher than the fecal test.

According to the results of our study, the following are recommended:

- Regular Strategic deworming practices need to be adopted.
- Sick individuals and sheep with poor body condition need to be treated.
- The efficacy of anthelmintic in use has to be monitored regularly.

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Authors' Contribution

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Competing Interests

The authors have no conflict of interest.

Ethical Approval

Not applicable.

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