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Prevalence and Identification of Ovine Lungworms in and Around Assela Town, Central Ethiopia

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Abstract: The objectives of this study were to determine the prevalence, identify the species involved and assess possible risk factors of ovine lung worm infection in and around Assela, Arsi zone, Ethiopia. Faecal and postmortem examinations were conducted on 402 and 100 sheep, respectively. The overall prevalence of lungworm infection was 58% and 60.5% found by fecal and postmortem examinations, respectively. The proportion of infection with the individual lungworm species revealed, *Dictyocaulus filaria* (*D. filaria*) (26.1%), *Protostrongylus rufescens* (*P. rufescens*) (15.9%), *Muellerius capillaris* (*M. capillaris*) (11.2%) and mixed infection (4.7%). A statistically significant difference ($P<0.05$) was found among the three study areas with an infection rates of 50.7%, 52.2% and 70.9% for Katarganet (low), Kombolcha (medium) and Simbero (high altitude) respectively indicating direct relation of infection with altitude. The prevalence of all the three species of lungworm infection showed a significant difference ($P<0.05$) between young and adult age groups and in animals with respiratory signs. Animals with poor body condition were highly infected (75.0%) and with a significant difference ($P<0.05$) than those with moderate (62.7%) and good (44.9%) body conditions. The infection rate between male and female sheep showed significant difference ($P<0.05$) with prevalence rate of 53.6% and 61.1%, respectively. The overall result of the study have shown that *D. filaria* is the most common lungworm species not only in its high prevalence rate but also in its high degree of association with occurrence of clinical respiratory signs, poor body condition, young age groups and high altitude.

Key words: Cross-Sectional Study · Lungworm · Prevalence · Ovine · Assela

INTRODUCTION

Livestock production has enormous potential in reducing poverty and improving the livelihood of owners and contributing greatly to the national economy. Food security initiatives, first and foremost animal food product such as meat, milk and eggs are concentrated source of high quality protein, vitamins and minerals. More generally animals have a positive impact on diet, health incomes, financial security, sustainable crop yields, employment prospects and social status to our growing human population [1, 2].

Small ruminants represent an important component of the Ethiopia livestock production system, providing 12% of the value of livestock products consumed at the farm level and 48% of the cash income generated. Ethiopia is second in Africa and sixth in the world in terms of sheep population. Ethiopia with its estimated 24 million sheep and 18.5 million goats, together with its great variation in agro-climatic zones represent a good reservoir of small ruminant genotypes [3]. The highlands of Ethiopia which receive more than 700 ml of annual rainfall, support 92% of human population, 75% of the national sheep and 27% of goats [4].

Based on their body size, high reproductive capacity and growth rates, ideally sheep and goats resource are suited to small holders. According to the IAR report [4] despite the low input in extensive management system an estimated 132,000 tones of sheep and goats meat is produced annually, providing more than 30% of all domestic meat consumption. Small ruminants also generate cash income to the farming community and

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significantly contribute to the foreign exchange earnings for national economy from exports of meat, skin and hide and other bi-products [5]. Consumption of milk from sheep and goats is also acceptable in some highland and in pastoral areas [4].

In spite of the huge population and importance of small ruminants, the country has benefited little from this enormous resource owning to a multitude of problems of which disease being the most important. Disease alone accounts for mortality of up to 30% in lambs and 20% in adults. Productivity losses attributable to helminth parasites are often substantial and for that an annual loss of about 81.8 million USD are often reported to be due to helminth parasites. In a country confronted with such enormous losses caused by helminth parasites, 'the silent predators are often intolerable [6, 7]. In the highlands of Arsi, lungworm infection still remains an important disease causing high mortality and weight loss of sheep in these areas. Hence, the current study was devised to be conducted with the objectives of determining the prevalence of lungworm infection in ovine and identification of the infecting species involved in and around Assela town.

MATERIALS AND METHODS

Description of the Study Area

Arsi Zone, Central Ethiopia: *Topography and climate*: Arsi zone is situated at 6°59'-8°49' N latitude and 38°41'-40°44' E longitude in central Ethiopia at a distance of 175 Km south east of the capital city Addis Ababa. The altitude of the area ranges from 1,780-3,100 meters above sea level (m.a.s.l) and it is characterized by a mild subtropical weather ranging from 5-28°C [8].

Vegetation and Livestock Population: The major land cover is used for grazing and supports an average of 27 livestock per hectare. Livestock are the major agricultural resource of the area. Arsi has livestock population of 5,234,598 (2,249,479 cattle, 928,603 sheep, 467,221 goats, 154,701 donkeys, 197,365 horses, 36,016 mules, 11,716 camels and about 1,189,497 poultry) [8].

The Study Sites: The present study was conducted from October, 2010 to March, 2011 in three agro-ecologically different grazing districts of Assela town under the same production system (extensive management).

Simbero district is located outside the town at a distance of 10 Km from Arsi town and represented by an altitude of 2,700 m.a.s.l. The dominant species of animals in this area are sheep, cattle and equines. Kombolcha district is located inside Assela town, represented by an altitude of 2,300 m.a.s.l. The third study district was Katarganet, it is located around Assela town about 35 Km far apart. The altitude of the area is 2,000 m.a.s.l. In this area, mostly all species of farm animals of smallholder farmers with different age groups graze together [8].

Sampling Design and Study Protocol: Fresh fecal samples from a total of 402 sheep were collected from the study sites in intervals of two weeks and for this a stratified random sampling with equal sample size (n=134) from each study area were considered during sampling and the number of sex and age identified and recorded. Besides, the body condition of every sampled sheep was recorded and scored as poor, medium and good based on previously stated criteria and scoring methods [9]. The age of every sampled sheep was also recorded as lambs (< 9 months old) and adults (> 9 months) as indicated by Yohannes [10].

Coproscopic Larval Examination: Fecal samples were taken from the rectum of grazing sheep and transported to Assela Regional Veterinary Laboratory and individual samples processed using the Modified Baerman Technique as described by Soulsby [11] and all recovered larva were morphologically identified.

Identification of Adult Worms: Postmortem examination of lungs of 100 sheep was carried up on daily visits to Assela abattoir during the study period. Slaughtered sheep were originated from areas around Assela town within a radius of 30 Km. Prior to their slaughter, individual animals were identified and recorded for their body condition scores and respiratory signs [9]. Besides, fecal samples were also collected prior to slaughter from the rectum and subjected to the Modified Baerman Technique as described by Soulsby [11].

Postmortem Examination Procedures: Soon after slaughter, the lungs along with the trachea were removed and put on a clean metallic tray. They were first inflated with running water during which time the minute alveoli broke down and liberated the maximum possible number of worms in cases of positive samples. The water was poured through a fine wire mesh screen for examination. The trachea, bronchi and bronchioles were cut to open with blunt scissors and taken in turns starting at the tips of the main bronchioles and working backwards systematically towards the bronchi. Any worm seen in the

course of cutting were picked and put into a petri dish. When the entire bronchial tree had been laid open, the dish was filled with normal saline solution in which the lungs were thoroughly washed. The saline, after pouring through a fine wire mesh screen and sedimentation for some time, was left for examination. Lung tissues with nodules were examined by gentle compression of the nodules between two pieces of thick glasses and carefully taking the worm away from the tissue with a pair of needles. The extracts were poured in small volumes into a petri dish and each lungworm species was morphologically identified [11].

Data Management and Analysis: A computer based statistical software packages were used to carry out different statistical analysis of the collected data. The data were depicted by ANOVA statistical analysis and a 95% probability level ($P<0.05$) was considered to be significant. The prevalence rate of lungworm infection was calculated for different risk factors. The Pearson′s value was used to compare the prevalence of lungworm infection with the study sites, sheep sex and age groups, their body condition scores and health status.

RESULTS

Infection Prevalence under Field Coproscopic Examination: Out of the total coproscopically examined 402 sheep, 233 (58%) sheep were found to be invariably infected with different spp. of lungworms, of which *D. filaria* was the dominant species identified (26.1%), followed by *P. rufescens* (15.9%) and *M. capillaries* (11.2%) and the least being for a mixed infection (4.7%) with either of these parasites. There was a statistically significant variation ($P<0.05$) between the infection with each lungworm species and the overall infection prevalence (Table 1).

Variation Between Sex Groups: The overall lungworm prevalence in male and female sheep were 53.6% and 61.1%, respectively, revealing a statistically significant difference ($P<0.05$) between the two sex groups and the infection prevalence. Results have, thus, shown that ewes were highly infected with either of the three lungworm spp. than rums (Table 1).

Variation Between Age Groups: Out of the totally examined sheep, 132 (32.84%) were lambs and the rest 270 (67.16%) were adults. As a result, the overall infection prevalence in lambs (78.8%) was found to be significantly higher than in adults (47.8%). Out of the recovered lungworm spp. *D. filaria* and *M. capillaries* tend to predominately infect lambs (38.6 and 18.2% respectively); while *P. rufescens* mainly infected adults (17.04%) with a significant variation ($P<0.05$) from the other two lungworm species. Similarly, lambs have also exhibited a higher mixed infection rate (8.3%) than adults (3.0%) (Table 1).

Variation among Study Sites: There was a statistically significant difference in infection prevalence among the study sites. Sheep from Simbero showed the highest (70.9%) infection prevalence, followed by Kombolcha (52.2%) and Katargenet (50.7%). In all the study sites, *D. filaria* was found to be the dominant lungworm species of sheep followed by *P. rufescens*, *M. capillaries* and mixed infection, respectively (Table 2).

Variation among Body Condition Scores: Assessment of body condition scores was further made prior to sample collection in the field. Hence, sheep were categorized as having poor (140), medium (126) and good (133) body condition scores. Accordingly, sheep with poor body condition have showed a significantly higher ($P<0.05$) infection prevalence (75%) than those with good body condition scores (59%) (Table 3).

Variation with Clinical Respiratory Signs: The health status of the examined sheep was conjointly examined during sampling with a particular emphasis given to sheep with associated respiratory signs of illness. Hence, 190 sheep were presented with clinical respiratory signs like coughing and nasal discharges while rest 212 sheep were apparently healthy. Accordingly, 75.5% of those with respiratory signs and 42% of apparently healthy sheep were found to be infected with different lungworm species. *D. filaria* infection was significantly higher ($P<0.05$) in sheep with clinical respiratory signs. However, there was no significant variation ($P>0.05$) in prevalence rates of the different lungworm spp. in apparently healthy sheep (Table 4).

Infection Prevalence under Postmortem Examination: Of the totally inspected 100 sheep slaughtered at Assela municipal abattoir, postmortem examinations of the trachea and lung showed an overall infection prevalence of 60.5%. Likewise, there was a significant variation ($P<0.05$) in infection among each of the lungworm species, in that, *D. filaria* was dominantly found (25%), followed by *P. rufescens* (19%), *M. capillaries* (6%) and mixed infection (10%) (Table 5).

Table 1: Overall infection prevalence of lungworm in sheep under field coproscopic examination in association with age and sex as risk factors.

	Male, n=168						Female, n=234											
Lungworm spp.	Lamb n=68	P (%)	Adult n=100	P (%)	Total n=168	P (%)	Lamb n=64	P (%)	Adult n=170	P (%)	Total n=234	P (%)	P (%)	Total lamb n=132	Total adult n=270	P (%)	Over all n=402	P (%)
D. filaria	24	35.3	14	14	38	22.6	27	42.2	40	23.5	67	28.6	51	38.6	54	20	105	26.1
P. rufscens	8	11.8	16	16	24	14.3	10	15.6	30	17.6	40	17.2	18	13.6	46	17.1	64	15.9
M. capillaris	9	13.2	6	6	15	8.9	15	23.4	15	8.8	30	12.8	24	18.2	21	7.8	45	11.2
Mixed infection	8	11.8	5	5	13	7.7	3	4.7	3	1.8	6	2.6	11	8.3	8	3.0	19	4.7
Total	49	72.1	41	41.0	90	53.6	55	85.9	88	51.8	143	61.1	104	78.8	129	47.8	233	58

There is statistically significant variation (P<0.05) between infection rate and the risk factors.

Table 2: Infection prevalence of lungworms in sheep from the three study sites.

Lungworm spp.	Simbero n=134	P (%)	Kombolcha n=134	P (%)	Katargenet n=134	P (%)
D. filaria	48	35.8	35	26.1	22	16.4
P. rufescens	25	18.7	20	14.9	25	14.9
M. capillaries	14	10.4	10	7.5	18	13.4
Mixed infection	8	6.0	5	3.7	3	2.2
Total	95	70.9	70	52.2	68	50.7

There was a statistically significant difference (P<0.05) among the study sites.

Table 3: Infection prevalence variation among body condition scores in sheep from the three study sites.

Lungworm spp.	Poor n=140	P (%)	Medium n=126	P (%)	Good n=133	P (%)
D. filaria	50	35.7	33	26.2	22	16.2
P. rufescens	30	21.4	25	19.8	15	11.3
M. capillaries	16	11.4	22	9.5	14	10.5
Mixed infection	9	6.4	6	4.8	3	2.3
Total	105	75	79	62.7	59	44.9

There was a statistically significant variation (P<0.05) among body condition scores.

Table 4: Variation in infection prevalence of lungworm spp. in sheep with clinical respiratory signs and the apparently healthy ones in the study sites.

Lungworm spp.	Sheep with Respiratory Signs (n=190)	P (%)	Apparently Healthy Sheep (n=212)	P (%)
D. filarial	65	34.2	40	18.9
P. rufescens	42	22.1	26	12.3
M. capillaries	24	12.6	18	8.5
Mixed infection	13	6.8	5	2.4
Total	144	75.8	89	42

There was a statistical difference (P<0.05) in infection between the two categories.

Table 5: Overall infection prevalence of lungworms in sheep under postmortem examination in association with sex and age risk factors.

	Male, n=56						Female, n=44							
Lungworm spp.	Lamb n=25	P (%)	Adult n=31	P (%)	Total n=56	P (%)	Lamb n=18	P (%)	Adult n=26	P (%)	Total n=44	P (%)	Over All n=100	P (%)
D. filaria	8	32	5	16.1	13	23.2	6	33.3	6	23.1	14	25.6	25	25
P. rufescens	3	12	7	22.6	10	17.9	3	16.7	6	23.1	6	14	19	19
M. capillaries	1	4	2	6.5	3	5.4	1	5.6	2	7.7	2	4.7	6	6
Mixed infection	2	8	2	6.5	4	7.1	2	11.1	4	15.4	4	9.3	10	10
Total	18	72	12	38.7	30	53.6	15	83.3	15	57.8	26	60.5	60	60

Variation Between Sex and Age Categories: Out of the totally inspected males (56) and females (44) slaughtered in the study abattoir, the overall lungworm infection prevalence in rums and ewes were 53.6% and 60.5%, respectively revealing no significant variation (P>0.05) between sex groups. However, the infection prevalence in slaughtered lambs (76.7%) was found to be significantly higher (P<0.05) than adults (47.4%) (Table 5).

Table 6: Overall Infection prevalence of lungworms under coproscopic examination from slaughtered sheep.

Lungworm Spp.	Lamb n=25	P (%)	Adult n=31	P (%)	Total Male	P (%)	Lamb N=18	P (%)	Adult n=26	P (%)	Total Female	P (%)	Total Lamb n=43	P (%)	Total adult n=57	P (%)	Over all	P (%)
D. filaria	8	32	5	16.1	13	23.2	5	27.8	6	23.1	11	25	13	30.2	11	19.3	24	24
P. rufescens	3	12	5	16.1	8	14.3	3	16.8	4	14.3	7	15.9	6	14	9	15.8	18	18
M. capillaries	1	16	1	3.2	5	8.9	2	11.1	1	3.8	3	6.8	6	14	2	3.5	8	8
Mixed infection	2	8	3	9.7	5	8.9	1	5.6	3	11.5	4	9.1	3	7	6	10.5	13	13
Total	18	72	14	45.2	32	57	11	61	14	53.8	26	59.1	29	67.4	28	49.1	55	55

Infection Prevalence under Coproscopic Examination of Slaughtered Sheep: Coproscopic examination made on all of the slaughtered sheep have shown an overall infection prevalence of 24% with *D. filaria* being the significantly ($P<0.05$) predominant species recovered, followed by others (Table 6).

Variation Between Sexes and Age Categories: The coproscopic prevalence of infection in rums and ewes were 57% and 59.1%, respectively with no significant variation ($P>0.05$) between the two sexes in either of the lungworm infections. Likewise, a significantly higher coproscopic infection rate (67.4%) was recorded in lambs than adults (49.1%) (Table 6).

DISCUSSION

The observations made in the present study unequivocally proved that lungworm is one of the major respiratory diseases of sheep in and around Assela, Arsi zone of central Ethiopia. In addition, it was disclosed that *D. filaria*, is the lungworm species that ranks first in prevalence of infections, being predominantly existing in sheep with clinical respiratory signs, poor body condition and young age groups.

The field coproscopic results disclosed an overall lungworm infection prevalence of 58% in sheep of the study areas. This Finding agrees with observations made from studies in some areas of Ethiopia as 60% [12], 48.33% [13] and 52.54% [14]. In this study infection due to *D. filaria* was present in 26.1% of the examined sheep where as *P. rufescens*, *M. capillaries* and mixed infection occurred 15.9%, 11.2% and 4.7%, respectively of the cases. Comparable findings were previously reported in different parts of the country as 32.2% in Gayint [15], 30.74% in Chillalo [14] and 33% in Debre Tabor [10].

For infections with *P. rufescens*, different results were obtained including 31.2% in Gayint [15], lower values of 8.77% in Jimma town [16], 4.61% in Dessie [13] and 11.9% in Bahir Dar [12]. As for *M. capillaries,* similar results were reported in Modjo governmental farm as 12.6% [17]. However, the mixed infection in the present study was different from previous reports carried in Dessie as 2.05% [13] and in Chillalo areas as 88.5% [14]. The variations reported might be described for the differences in altitude among the different study sites, the sample sizes undertaken, sampling strategies followed and the length of the study periods.

As for the altitude and host parasite relationships, sheep in relatively high land areas were found to be more infected with lungworms than in the relatively mid- and low altitudes. This goes in agreement with previous reports who have underlined the influence of low temperature and high moisture on the disease prevalence [11,13,18]. Furthermore, it was indicated that the larvae require moisture for their development and can withstand moderately dry conditions for a few days but are able to live in moist conditions for several months and are fairly resistant to lower temperature [11,12,19]. When infection rate on age was subjected to analysis, lambs of the current study were found more frequently infected than adult sheep which is similar to some previously reported observations [7, 11-13, 19]. The possible explanation is that adult sheep after primary infection develop a rapid solid immunity. In fact, sheep continually exposed to infection are at low risk provided that the rate of acquisition of infective larvae is sufficient to stimulate satisfactory response and not cause any clinical illness [11].

Comparison of the infection prevalence between apparently healthy sheep and those showing respiratory signs revealed a higher infection rate in those showing clinical respiratory signs with a significant variation for *D. filaria* and *P. rufescens*. Although infection with *M. capillaries* appears not to produce significant clinical signs when compared to the rest lungworms, it was stated that heavy infections can weaken the lung and assist in reducing the general health and resistance of the host [14,19]. Similarly, there was a non-significant variation in infection prevalence between rums (53.6%) and ewes (60.5%). These findings were in agreement with other reports that underline on the equal infection opportunity between male and female sheep [6,13]. However, the larger sample size of female taken and the post-parturient parasite rise in ewes following lambing can be the causes for the slight non-significant variations observed between the two sexes in the current study.

Sheep with poor body condition scores manifested the highest prevalence of infection and *D. filaria* was the dominant species in these groups of animals. in line with this finding, it was stated that poorly nourished sheep appear to be less competent in getting rid of lungworm infection as they are with a stressed body and weaken immunity as well [13,14, 19]. This explains that *D. filaria* was not only the most prevalent lungworm species in the study area but also significantly affected the productivity of sheep at large.

Lungs and trachea of slaughtered sheep in the study abattoir revealed overall infection prevalence of 60% of which 25% was due to *D. filaria* indicating that it was the dominant and important parasite species as a cause of verminious pneumonia in sheep. Unlike the current finding, Mokhtaria *et al.* [20] and Addis *et al.* [21] have reported a lower infection prevalence of 22.0% and 32.6% respectively of the total sheep cases slaughtered in Tiaret abattoir, Algeria. In addition, the results from coproscopic examination of slaughtered sheep indicated an infection prevalence of 55% and this showed variation from that of postmortem infection prevalence of adult worm′s recovery (60%). However, similar results were also observed in Chillalo as 61.1% and 55.4% for coproscopic and postmortem examinations respectively [14]. Generally, these findings indicate that coproscopic examination do have limited value, in terms of estimating the prevalence of lungworm infection in live sheep.

CONCLUSION

In conclusion, the antemortem coproscopic examination of the current study have indicated that 58% of the examined sheep were invariably infected with different sppecies of lungworms. Lambs, sheep with poor body condition and those with clinical respiratory signs were highly significantly infected with either of the lungworm species than their counterparts. Furthermore, an overall infection prevalence of 60.5 and 24% were observed under postmortem examinations of the lungs and trachea and coproscopy of recovered feces respectively, indicationg the lesser relevance of postmortem coroscopic fecal examination. Out of the recovered lungworms (*D. filaria*, *M. capilaris* and *P. rufiscens*), *D. filaria* was found to be the significant highly prevalent lungworm of ovines in the study area.

Hence, inlight with these findings, the high prevalence of lungworm infection in the study area revealed the need for a higher attention in the control and prevention of the production-reducing disease/parasite. Regular and periodic deworming of sheep is highly important and the entire rearing of sheep under extensive production system should be minimized. Last, but not least, sheep owning farmers and stakholders should take an immediate medical measures for sheep with poor body conditions and those showing any sort of clinical respiratory signs.

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