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Full Length Research

Small ruminant lungworms: Parasite detection, identification and prevalence estimation in three districts of South Wollo, Ethiopia

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ABSTRACT: The prevalence, species, age, sex and seasonal variation of lungworm infection in small ruminants were studied using Coproscopic and Postmortem examinations in Three districts of South Wollo: Kombolcha, Dessie and Kalu. Faecal samples were collected from 586 sheep and goats of all age groups (below 6 months, 6 months to 2 years, 2 to4 years and above 4 years) and both sexes. Modified Baermann technique was used for extraction of L_1 larvae from the faeces. Post-mortem examination had also been done on 98 animals in Dessie abattoir during the study period. An overall prevalence of 31.2% and 7.1% were detected by faecal and post-mortem examinations, respectively. Significant difference ($p<0.05$) was found between areas of different altitude with an infection rate of 47.5%, 35.5% and 28.5% in Dessie, Kombolcha and Kalu respectively. Factors such as age, species of parasite, season and origin of animals showed significant differences ($p<0.05$) on the prevalence of small ruminant lungworm infection. However, there was no significant difference ($p>0.05$) observed among sex, species, management system and body condition score of animals. Due to its impact on production, emphasis should be given for the control and prevention of lungworm infection in the areas.

Key words: Lungworm, prevalence, small ruminant.

INTRODUCTION

Sheep and goats provide as much as 30% of the meat and milk consumed in sub-Saharan Africa and is found on smallholdings throughout the continent. Production and marketing of sheep and goats and their products are a vital source of income, especially for small holders who do not have access to credit or farm income. Due to the small size, high reproductive capacity and rapid growth rate, small ruminants provide a more flexible short-term investment than cattle. Yet these species have received much less attention from research and development agencies than cattle (ILCA, 1990).

Helminthes parasites of ruminants are ubiquitous, with many tropical and subtropical environments of the world providing nearly perfect conditions for their survival and development. Although, these parasites are widely prevalent, the clinical signs they cause in infected animals can be less obvious than signs of other livestock diseases. Partly for this reason, infections with gastro-intestinal and other helminthes parasites are among the most neglected areas of veterinary care in much of the developing world. High prevalence rates of the infection result in poor production and unthriftiness (Hansen and Perry, 1994).

Among many constraints, which limit productivity in livestock populations, parasites are of major importance (Mboera and Kitalyi, 1992). Endo-parasites are important problem for sheep and goat farmers causing gastroenteritis in these animals in Africa and throughout the world (ILCA, 1991).

Dictyocaulidae and/or certain Metastrongylidae are known to exist in East Africa (Ethiopia, Kenya and Tanzania) and South Africa (Torncy, 1989). Endo-parasites, including *Dictyocaulus filaria* are major causes of mortality in the Ethiopian highlands (ILCA, 1993, 1992). About 50% of mortality in sheep in farms of Ethiopian highlands is caused by pneumonia and endo-parasites (ILCA, 1990). Control of these parasites is essential for harnessing the potential of small ruminant production. For proper control to be instituted, however, diseases and their dynamics must be known. At our present state of knowledge of parasitic diseases, it is difficult and even dangerous to lay down rigid rules for their control which are applicable to all regions. For this reason a study of epidemiology of each parasitic disease should be limited to small areas (Rodostitis et al., 1994). The incidence of parasitic diseases, including respiratory helminthosis varies greatly from place to place depending on the relative importance of many of the factors. In this regard, very few studies were conducted so far pertaining to respiratory helminths of small ruminants in Wollo, Amhara National Regional State, Ethiopia.

The present study was undertaken to find out the prevalence and species variation on respiratory helminths of small ruminants in different zones of WoIlo, in Amhara Regional State, Ethiopia.

MATERIAL AND METHODS

Study area

Topography and climate

The study was conducted at Kombolcha town, which is found in South Wollo administrative Zone of Amhara Regional State in North Eastern Ethiopia. The study area is located 376 km North of Addis Ababa with 11°084′49″°N latitude and 0.39°737′46″°E longitude at an altitude of 1840 meter above sea level (msl) (Figure 1). The Kombolcha town experiences a bi-modal rainfall, the short rainy season occurs usually from March to May while the long rainy season occurs from June to August. The minimum and maximum mean annual rainfall in and around Kombolcha ranges from 750 to 900 mm. The average minimum and maximum daily temperature during short and long rains are 23.9°C and 11.7°C respectively and the relative humidity of the area varies from 23.9% to 79%.

Vegetation

The nature of vegetation varies from savannah grass land, bushes and dense shrubs to huge trees like *Juniper, Acacia, Hagina abysinica* (Kosso), *Cordial africana.* Vegetation dries off during the dry season in almost all regions except on high land grazing areas and revival of vegetation with the commencement of rain on the low lands.

Farming system in the area

The type of farming in the area is mixed crop to livestock production system. Small ruminant production in the area is an integral component of the traditional farming system. The main livestock grazing land available to animals are swampy water-lodged areas, forest margin, hilly tops and mountain sides, stony and infertile lands, and road sides. According to the Agricultural Office report (2010), livestock population in the area comprises of 1,826,900 cattle, 1,401,470 sheep, 980,750 goats, 262,420 donkeys, 3,420 camels and 2,046,710 poultry.

Study animals and their management

The animals used in this study are owned by subsistence farmers and small-scale private farms. The breeds of sheep and goats in the study area are Menz and Small East-African breeds respectively.

Management

Sheep and goats are traditionally kept on extensive management system. These animals are maintained in small household flocks of mixed ages usually less than 10 animals in lowlands but 20 to 50 or more at the extreme of the high land areas.

Sheep and goats are kept close to the village and they are allowed to graze native pastures on grasslands. Supplementary feeding and forage conservation is not practiced, however, after harvest when there is no risk of damage to crops, animals may have access to hay, stubbles and other leftovers of the year's harvest. Watering is only once at the middle of the day from the nearby streams, rivers or shallow wells.

Study design

Cross-sectional study design was carried out to determine the prevalence of small ruminants' lung worm infection in selected three districts of south Wollo.

Sample size

The sample size required for this study was determined depending on the expected prevalence of small ruminant lung worm infection and the desired absolute precision according to Thrusfield (2005) by the following formula.

$$n = \frac{1.96^2 \text{ Pexp } (1 - \text{ Pexp})}{d^2}$$

Where: n = required sample size; P_{exp} = expected prevalence (50%); d = desired absolute precision (5%).

According to the above formula, the calculated sample size was 384. However, in order to increase the accuracy the number of sampled small ruminants was 586.

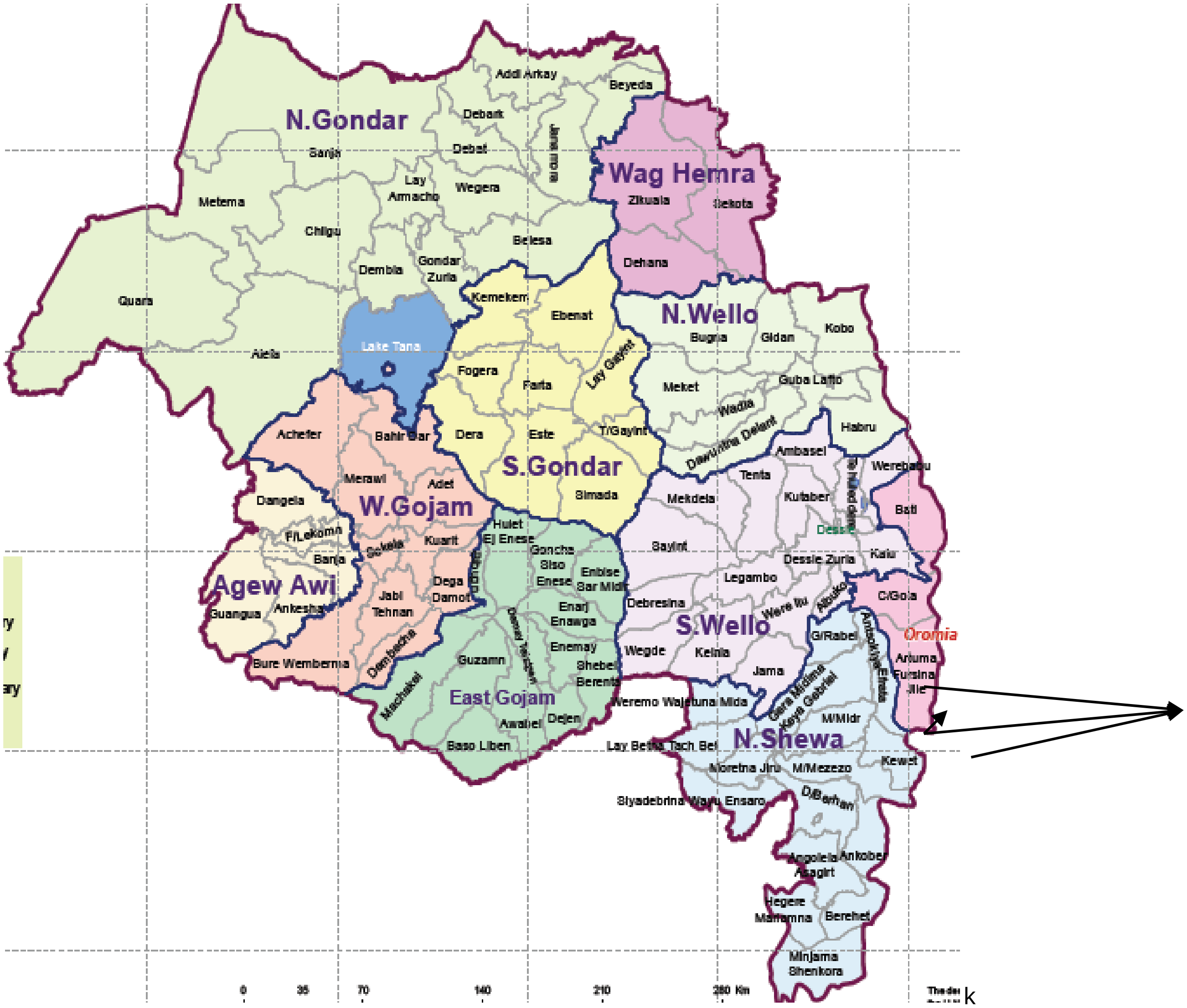

Figure 1. Map of Amhara Region; the arrow on the right indicates the study areas. (Source: http://en Wikipedia.Org/wiki/ Amhara-Region, 2009).

Sampling procedure

In this study, the area was classified into three districts (Woredas) which are Dessie, Kombolcha, and Kalu. The study subjects were managed under extensive and semi-intensive production system.

Sample collection

Faecal sample were collected directly from the rectum of selected animals in screw capped glass bottle (universal bottles) and packed in ice box. While collecting faecal sample, the species of the animals, sex, age, management, date of sampling and the area were properly recorded.

Diagnosis

Laboratory diagnosis

In the laboratory, 2.5 g of fresh faeces was weighed from each sample for the extraction of L_1 larvae using modified Baermann technique. These were enclosed in gauze fixed on to a string rod and submerged in a clean glass tube filled with warm water. The whole apparatus was left for 2 to 4 hours. The larvae then leave the faeces, migrate through the gauze and settle at the bottom of the glass. After siphoning of the supernatant, the sediment was examined under the low power of the microscope. When positive, a drop of 1% iodine solution was used to immobilize the larvae for identification of species, otherwise

otherwise it was registered negative for lung worm infection (Fraser, 1991; Urquhart et al., 1994).

Post mortem examination

The lungs were palpated for presence of metastrongyloid nodules, which are usually grayish white in color. If present, they are trimmed of and worms extracted from the tissue by gentle compressing a small non calcified nodule or part a large nodule between two glass slides, and then teasing the worms away from the tissue with thumb forceps. To collect all worms at the bottom of the beaker added with that of the previous and transferred to glass beakers containing saline. The air passages were opened starting from the trachea down to the small bronchi with fine blunt pointed scissors to detect parasites; visible worms were then removed from the opened lungs and transferred to glass beakers containing saline. The worms collected were identified and recorded (ILCA, 1991; Fraser, 1991).

Data analysis

The results were analyzed in relation to sex, species of animal, age, management, origin, body condition, species of lungworms and season. Animals were categorized in to four age groups. Age group I (< 6 months), age group II (6 months to 2 years), age group III (2 to 4 years) and age group IV (> 4 years). The data obtained were coded for the above factors and entered in to excel. Then Chi-square was used to compare the prevalence of small ruminants' lungworm infection for possible significance difference. The differences were regarded as significant if p-value is < 0.05 using SPSS.

RESULTS

Coproscopic examination

Out of all animals examined, 183 were positive for lungworm infection with an overall prevalence of 31.2% (Table 1).

There was significant difference on the prevalence of lungworm infection of small ruminants in different districts of south Wollo (x^2 = 41.324, P<0.05, df = 3). The highest prevalence was recorded in Dessie (47.5%) followed by Kombolcha (35.5%) while the lowest in Dessie abattoir (7.1%) (Table 1).

There was no significant difference (p> 0.05) on the prevalence of lungworm infection on the basis of species and sex of small ruminants. However, the prevalence was slightly higher in ovine (31.4%) and males (31.8%) as compared to that of caprine (31.0%) and females (31.0%) (Table 1).

There was significant difference (x^2 = 11.127, df = 3, p<0.05) on the prevalence of lungworms among the four age groups of small ruminants. The highest prevalence was in group I (61.7%) and the lowest was in group IV (11.4%) (Table 1).

There was no significant difference (x^2cal = 4.136, df = 2, p>0.05) on body condition score of the animals. However, the highest prevalence was noticed in poor (50%) and the lowest prevalence in medium (28.2%) body condition score of the small ruminants. Similarly, there was no significant difference (x^2cal = 0.331, df = 1, p>0.05) of lungworm infection under different management system. However, the highest prevalence was found in extensive management system (31.8%) while the lowest prevalence in semi-intensive management system (29.1%).

There was significant difference (x^2cal = 5.860, df = 4, p<0.05) on the prevalence of lungworm infection with species of lungworms. The prevalence was decreased when the age of animals increased in the cases of *M. capillaries*, *P. rufescens* and *DFMC* infection, but not in case of *D. filarial* infection (Table 2).

There was significant difference (x^2 = 17.660, df = 4, p<0.05) on the basis of monthly prevalence of lungworm infections. The result showed that the highest prevalence was recorded in January (40.1%) while the lowest in November (19.8%) (Table 3 and Figure 2).

Post-mortem examination

A total of 98 lungs from small ruminants slaughtered at Dessie abattoir were examined through post-mortem inspection, of which 7 (7.1%) were positive for lungworm infection. The lungworm species encountered during intact lung incisions during the study period was *D. filaria* with a prevalence of 7.1% (Table 4).

DISCUSSION

Coproscopic *e*xamination

The current study revealed that the presence of three nematode species parasitizing the respiratory tract of small ruminants with an overall infection rate of 31.2%. These parasites had also been reported in sheep from different climatic areas of the world and from different regions of Ethiopia (Thomson et al., 1988). A similarly high prevalence (50%) was recorded in previous study conducted at Kombolcha and Dessie by Teffera 1993. Studies made in other parts of Ethiopia had also underlined the relative importance of this disease in small ruminants. For instance, Wondewosen (1992) had reported 58% in Assela, Assaye and Alemneh (2015) reported 22.7% in and around Bahir Dar and Muluken (2009) had reported a prevalence of 18.16% in Bahir Dar.

The current overall prevalence result almost coincides

Table 1. The prevalence of lungworm infection in small ruminants on the basis of various factors.

Factor	Nº of Animals		Prevalence (%)	Chi-square (χ2) and *P- value*
	Examined	Positive		
Species				
Ovine	360	113	31.4	X^2cal = 0.011, p = 0.916, df =1
Caprine	226	70	31.0	
Sex				
Male	192	61	31.8	X^2cal = 0.39, df = 1, p = 0.843
Female	394	122	31.0	
Age				
< 6 Months	175	108	61.7	X^2cal = 112.651, df = 3, p = 0.00
6 M - 2 years	204	46	22.5	
2 - 4 years	75	14	18.7	
> 4 years	132	15	11.4	
Body Condition				
Poor	20	10	50.0	X^2cal = 4.136, p = 0.126, df = 2
Medium	188	53	28.2	
Good	378	120	31.7	
Management System				
Extensive	459	146	31.8	X^2cal = 0.331, p = 0.565, df = 1
Semi-intensive	127	37	29.1	
District				
Kombolcha	259	92	35.5	X^2cal = 41.324, df = 3, p = 0.000
Kalu	130	37	28.5	
Dessie	99	47	47.5	
Dessie abattoir	98	7	7.1	
Total	**586**	**183**	**31.2**	

Table 2. Prevalence of lungworm species among the four age groups of small ruminants.

Age	Total animals examined	*D. filaria* P (%)	*M.capillaries* P (%)	*P. rufescens* P (%)	DFMC P (%)	Total P (%)
< 6 M	175	56(32%)	25(14.3%)	2(1.1%)	9(5.1%)	52.6
6M-2 year	204	25(12.3%)	10(4.9%)	2(0.98%)	1(0.49%)	18.6
2-4 years	75	46(61.3%)	0(0%)	0(0%)	0(0%)	61.3
> 4 years	132	6(4.6%)	0(0%)	0(0%)	1(0.76%)	5.3

X^2=125.178, df=12, p=0.000; DFMC = mixed infection with *D. filarial* and *M. capillaries*.

with the previous report of Brook et al. (1986) (27.8%) in Assela. But it was not similar with the findings of Abdukadir (2009) in the same area who reported higher prevalence (42.96 %).

This could be due to the fact that the establishment of open air clinic in rural kebeles, increased in numbers of private veterinary pharmacies, increased farmers awareness to deworm their small l ruminants, prevailing

Table 3. The seasonal variation of small ruminants' lungworm infection.

Months	Animals examined	Positive	Prevalence (%)
November	121	24	19.8
December	102	34	33.3
January	172	69	40.1
February	99	35	35.4
March	92	21	22.8
Total	586	183	31.2

X^2cal =17.660, p = 0.001, df = 4.

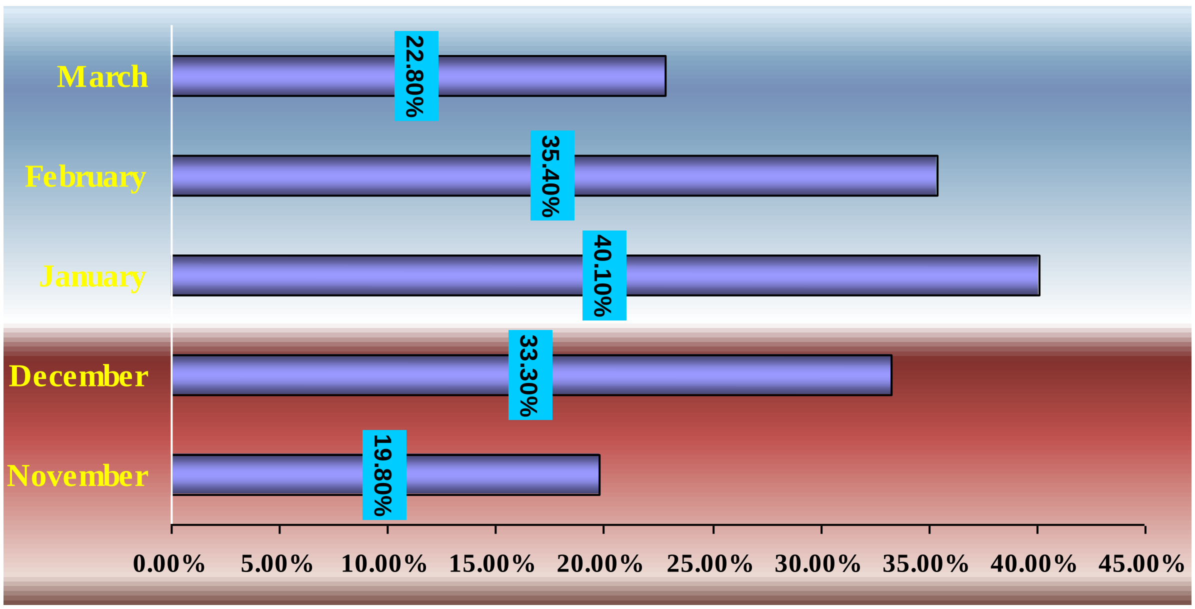

Figure 2. Monthly prevalence of small ruminants' lungworm infection.

Table 4. The prevalence of lungworm species in small ruminants by post-mortem examination.

	Adult worm burden (n=80)				Total
	D. filarial	***M. capillaries***	***P. rufescens***	**DFMC**	
Positive	7	0	0	0	7
Prevalence	7.1%	0%	0%	0%	7.1%

environmental change and differences in rain fall, humidity, temperature and altitude of kebele's included in the study. The current finding however, disagreed with the previous findings of Eyobe (2008) who reported a prevalence of 72.44% in Assela. Such variation in infection rate could be attributed to the variation in altitude, rainfall, humidity and temperature differences in different area of the country (Blood et al., 1989).

The finding of *M. capillaries* with 14.3% prevalence of the total positives in the study area disagreed with the previous reports of Mezgebu (1995) in Addis Ababa (54.9%) and Sissay (1996) in Bahir Dar (39.3%). But this result agreed with the previous reports of Paulos (2000) in Arsi Zone and Mengstom (2008) in Tigray (Atbhi) reported that *D. filaria* was the most prevalent species.

In the present study, the finding of *D. filaria* as the most prevalent when compared to the other species of lungworms in small ruminants might be due to the fact that *D. filaria* has indirect life cycle, took more time to reach the infective stage and after ingestion, larva can appear in faces after several weeks (Soulsby, 1982). The probability of infection, transmission and reinfection with a season could much more high when compared with *M. capillaries* and *P. rufescens*. These factors explained that the young (weaning) animals have higher infection rate of *D. filaria* (Mengestom, 2008).

Influence of sex on the prevalence of infection indicated that there was no significant difference (P>0.05) in susceptibility to infection with lungworms. Hence, sex dependant variation was not encountered. This result was not in agreement with the earlier study of Sissay (1996) and Alemu (1999) who reported significant variation in the infection rate of lungworm in male and female, and coincides with Netsanet (1992) in and around D. Birhan and Teffera (Wendewosen, 1992) in and around Dessie and Kombolcha who reported equal susceptibility in both sexes. This might be due to the improper distribution of sample selection between the two sexes (Paulos, 2000) or most of the samples from female sheep and goats were not in preparturient period during the study period (ILCA, 1990; Urquhart et al., 1994). In addition, most males included in the sample were uncastrated and freely mating in the field might also create stress like that of females.

The influences of management system on the prevalence of lungworms indicated that there was no statistically significant difference (p>0.05) between extensive and semi-intensive management systems. This finding was different from Sissay (1996) in and around Bahir Dar, Alemu (1999) in Wollo and Eyobe (2008) in Assela who reported that management had significant difference on susceptibility. The possible reason for the present finding could be due to the fact that grazing in the same pasture and feeding moist pastures for the small ruminants in the area attributed to similarity on susceptibility to lungworm infection between the two management systems.

The influence of body condition on the prevalence of lungworm infection revealed that there was no statistically significant association (p>0.05). The prevalence of lungworm infection on coproscopic examination was found to be higher (50%) in animals of poor body conformation than that of well confirmed ones (31.7%). This finding coincides with Mengestom (2008) who reported that the affected small ruminants, loss of weight cannot be attributed to lungworm infection alone since *Hamonchus contortus* and other GIT helminthes could be encountered. Poor body condition could be associated with failure to deworm animals or due to lack of feed or nutritional management which lead to lack of resistance to infection and contributed for increased prevalence in poorly conditioned animals.

The monthly dynamics of lung worm infection within the study periods showed that prevalence was higher in January when compared to dry season. This finding coincides with the results of unpublished report of Ferwengle (1995). The survival and development of lungworm larvae was favored by low moisture content and high humidity. For instance, infective larva on pastures minimum during the summer months but reaches peak level during the cooler autumn (Ayalew et al., 1973). Such conditions are obtained after long rainy season (September to November) in Wollo and at high altitude areas.

With regard to age, the prevalence of lungworm infection in small ruminants was found to be higher in young's (weaning) than adults and showed significant difference (p<0.05). This finding was in agreement with Schanzel (1959) who reported that young animals were found to harbor twice as many *D. filaria* than adults. However, disagree with the idea that the intensity of infection by *M. capillaris* was six times higher in adult small ruminants. This was also not in line with Thomson and Orita (1988) who found an increased infection rate in the age of the animals.

In this study, comparing the susceptibility of species of small ruminants, sheep were found slightly more susceptible to lungworm infection than goats. This finding was not in agreement with Assaye and Alemneh (2015) who reported that goats were more susceptible to both initial and challenge infections than that of sheep.

The prevalence of lung worm infection by coproscopic examination was higher in Dessie (47.5%) followed by Kombolcha (35.5%) while the lowest prevalence was recorded in Kalu (28.5%). The result showed significant difference (p<0.05). This result was due to the reasons of altitude and temperature variation in three selected areas.

Post-mortem *e*xamination

The observation of the intact lung of slaughtered small ruminants in Dessie town revealed that 7.1% overall prevalence while the prevalence of coprological finding was 31.2%. This decreased prevalence in post-mortem examination disagreed with the finding of Eyobe (2008) in Assela reported higher prevalence in post-mortem than coprological examination. But, the present finding agreed with the finding of Paulos (2000) in Arsi chilallo who reported higher prevalence in faecal than post-mortem examination.

One of the probable reasons attributed for such difference in the present finding could be those larvae which reach the lungs of small ruminant was not remain in the parenchyma and not become encysted in fibrous nodules. Because, such nodules eggs many be deposited in air passage (Rodostitis et al., 1994). Therefore, the finding of the present study strongly supports that coproscopic examination had wide value in estimating the burden of lung worm infection in small ruminants. Hence, coproscopic examination requires serious cautions. In addition, most sheep and goats brought for slaughter were from rural areas, the probability of deworming might be high. The larvae were found 50 to 100 gm only in faces/pellet of patent cases, otherwise, in the rest phase it might not be dispersed throughout the pellet (Urquhart et al., 1994).

Conclusion

The study on lung worm infection of small ruminants by faecal and post-mortem examinations in three districts of south Wollo revealed an overall prevalence of 31.2% and 7.1%, respectively. The respiratory nematodes *D. filaria, M. capillaries* and *P. rufescens* were identified. This high prevalence of verminous pneumonia as the result of these three species was considered as one of the important nematode infection in small ruminants in the study area. It was found that young (weaning) small ruminants were most affected by *D. filaria*, than adults. The prevalence of lung worm infection had no significant association with sex, species of animals, body condition and management in the study area.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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