

## Full Length Research Paper

# Study on prevalence of ovine lungworm in Guna District, Arsi Zone, South East Ethiopia

Aliy Beshir<sup>1</sup>, Birhanu Abera<sup>2</sup>, Eyob Eticha<sup>2</sup> and Diriba Lemma<sup>2\*</sup><sup>1</sup>Merti District Livestock and Fishery Resource Office, Abomsa, Ethiopia.<sup>2</sup>Asella Regional Veterinary Laboratory, P. O. Box 212, Asella, Ethiopia.

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A cross-sectional study was conducted in Guna district, Arsi zone, South East Ethiopia, from November, 2013 to March, 2014 to determine the prevalence, associated risk factors and identification of species of ovine lungworm by using coproscopic examination and questionnaire survey. A total 384 faecal samples from randomly selected sheep of different age groups, body conditions, sexes and PAs with various altitudes. The finding indicated that 217 (56.5%) were infected with different species of lungworm, namely, *Dictyocaulus filaria* (28.4%), *Muellerius capillaries* (10.7%), *Protostrongylus rufescens* (7.6%), and mixed infection (9.9%). There were statistically significant difference ( $p < 0.05$ ) in the prevalence of lungworm infection with regard to age ( $\leq 1$  year 62.0% and  $> 1$  year 51.0%) and PAs (Cire Anole 78.1%, Nano Hecho 52.1% and Re'e Amba 39.1%); however, sexes (female 59.9% and male 53.1%) and body conditions (poor 60.9%, medium 57.0%, and good 51.6%) were insignificant ( $p > 0.05$ ). Parallely, questionnaire surveys on history of antihelmintic usage, manifestation of respiratory signs, and place where animal kept were undertaken on the same animals that were sampled for coproscopic examination. Accordingly, the prevalence of lungworm infection with antihelmintic usage (none dewormed 67.5% and dewormed 44.6%), manifestation of respiratory sign (No 44.1% and yes 68.2%), and place where animal kept (forest area 38.1% and swampy 67.9%) and statistically all considered factors for questionnaire survey are highly significant ( $p = 0.000$ ). As conclusion, our work revealed that lungworm belongs to the major respiratory helminthes that affect the health and productivity of sheep in the study area; therefore, attention should be given for the control and prevention to reduce the current high prevalence.

**Key words:** Arsi, Ethiopia, Guna, lungworm, ovine, prevalence.

## INTRODUCTION

Ethiopia lies within the tropical latitudes of Africa, and has an extremely diverse topography, a wide range of climatic features and a multitude of agro-ecological zones, which

makes the country suitable for different agricultural production systems. This in turn has contributed to the existence of a large diversity of farm animal genetic

\*Corresponding author. E-mail: [diribalema@gmail.com](mailto:diribalema@gmail.com).

resources in the country (Anon, 1998a, 2004b). Ethiopia with its estimated 24.2 million sheep together with its variation in agro climatic zones represents a good reservoir of small ruminant genotypes (CSA, 2013).

Unlike the large potential of small ruminants in the country, their productivity is low. The major problems that greatly affect the economy of sheep and goat production in Ethiopia were diseases (Bekele et al., 1992). Disease alone accounts for 30% mortality in young's and 20% in adults. A loss of US\$81.8 million is reported annually due to parasite infection. In a country confronted with such enormous losses caused by parasites, it is great loss to the country (Biffa et al., 1999).

Helminth parasite of ovine is ubiquitous, with many tropical and sub-tropical environment of the world providing nearly perfect conditions for their survival and development (Hansen and Perry, 1994; Singla, 1995). Helminthosis is one of the considerable significance in a wide range of agro-climatic zones in sub-Saharan Africa and constitute one of the most important constraints to small ruminant production (ILCA, 1990). The production loss is a direct result of clinical and subclinical helminthes infections resulting in low productivity due to stunted growth, insufficient weight gain, poor feed utilization and mortality and indirect losses associated with treatment and control costs (Ayalew et al., 2011; Singh et al., 2016).

In the highland areas, infection with lungworm parasites is the common cause of high mortality and morbidity in sheep population (FAO, 2002). Lungworms are parasitic nematodes known for infection of the lower respiratory tract, characterized by respiratory distress, tracheitis, bronchitis, and pneumonia (Kimberling, 1988). Common lungworms in sheep are *Dictyocaulus filaria*, *Muellerius capillaris*, and *Protostrongylus rufescens* (Radostiis et al., 2007). These nematodes belong to two super families, Trichostrongyloidea (*D. filaria*) and Metastrongyloidea (*P. rufescens* and *M. capillaries*) (Urquhart et al., 1996; Radostiis et al., 2007). Dictyocaulidae and certain Metastrongyloidea are known to exist in East Africa (Ethiopia, Kenya and Tanzania) and South Africa (Torncy, 1989). Endoparasites, including *D. filaria*, are major cause of death and morbidity in the Ethiopian highlands. Up to half of all sheep deaths and morbidity on farms in Ethiopia highlands are caused by pneumonia and endoparasites (ILCA, 1990).

The previous findings of lungworm infection in Ethiopia (Bekele et al., 1981; Netsanet, 1992; Wondwossen, 1992; Paulos, 2000; Mihreteab and Aman, 2011; Abeje et al., 2016) are in Arsi and Bale, Wollo, Debre Birhan, Asella, Chilalo, and Tiyo respectively showing prevalence ranging from 30.74 to 73.25% which indicated the high prevalence of the infection in certain parts of the country; however, there was no research done on ovine lungworm in Guna District, Arsi Zone, Oromia Regional State, South East Ethiopia. Therefore, the objectives of this research

were to determine the current prevalence of lungworm infection and identify the circulating species and associated risk factors for its occurrence.

## MATERIALS AND METHODS

### Study area

This study was conducted in Oromia Regional State, Arsi Zone, Guna District which is located 224 km south east of Addis Ababa at altitude of 1500 to 3300 m.a.s.l. The area covers 38,398 km<sup>2</sup> in range lands. Area is comprised of sixteen peasant association (PAs) such as, Nano hecho, Re'e amba, Re'e dharayo, Walargi, Negelle, Nano jawi, Cire anole, Amuma harago, Guna genete, Samo bixana, Samo badosa, Bobe, Waqantera, Sorbo'e ertero, Andale abajema, and Dima. The area is bordered by different district such as, Merti by north, Cole by south, Golocha by west, and Su'ude by east. Topographically, it has 84% high land, 11% "weynadega", 2% low land and 3% "wurch". It receives an annual range of rainfall from 700 to 1300 mm, and the annual range of temperature from 12 to 23°C. It receives bimodal rainfall occurring from March to April (a short rainy season) and from July to October (long rainy season). It has a total of 110,610 livestock of which 8,609 were sheep (GDRAD, 2013).

### Study population

The study population comprises of indigenous Arsi-Bale sheep breed from three agro-ecological areas (highland, midland and lowland); kept under similar extensive management system; young or adult; all body conditions (poor, moderate, good); dewormed or non-dewormed by antihelmintic; kept in forest or swampy area; apparent health or not were included.

### Study design and sample size determination

Out of 16 villages of Guna District, three namely, Re'e amba, Nano hecho, and Cire anole were purposively selected considering their representation of the highland, midland and lowland of the district, respectively.

Cire anole is located at an altitude of 2700 to 3000 m.a.s.l.; Nano hecho is situated at altitude of 2200 to 2500 m.a.s.l. and Re'e amba is located at altitude of 1500 to 1800 m.a.s.l. The households and individual animals were selected using simple random sampling technique. Accordingly, equal proportions of animals were selected for the study, that is, 128 each from each selected PAs. During sampling age, sex, body conditions, antihelmintic usage, appearance of symptoms, and grazing area of the animals were recorded.

The sample size of this study was determined based on internationally set standard formula in Thrusfield (2005). Therefore, the sample size for this study was determined using standard formula indicated as follows:

$$N = 1.96^2 \cdot P_{\text{exp}} (1 - p_{\text{exp}}) / d^2$$

where N = required sample size, P<sub>exp</sub> = expected prevalence, and d = desired level of precision (5%).

There was no previously documented ovine lungworm infection in the study area.

As stated earlier, confidence level chosen is 95% so that d= 5% and expected prevalence is 50%. By substituting the value, the required sample size was 384.

**Table 1.** Prevalence of different species of lungworm in total examined sheep.

Species of lungworm	No. examined animal	No. positive	Prevalence (%)	Df	$\chi^2$	p-value
<i>D. filaria</i>	384	109	28.4			
<i>M. capillaries</i>	384	41	10.7			
<i>P. rufescens</i>	384	29	7.6	3	3.84	0.00
Mixed infection	384	38	9.9			
Total	384	217	56.5			

\*Number of examined animal = Number of examined animals; \*Df=degree of freedom; \* $\chi^2$ =Chi-square.

### Sample collection and laboratory diagnosis

Fresh fecal samples collected from the rectum of the animals were immediately transported to Guna Veterinary Clinic for processing. Five grams of faeces were weighed from each sample for extraction of L1 larvae using Modified Baerman techniques according to Anne and Gary (2006). The faeces were fully enclosed in cheesecloth fixed with metallic stick (agraph) rest on the edges of the funnel glass. The glass was filled with clean cold water until the sample became submerged making sure that the corners of the cheesecloth did not hang over the edge of the funnel. The sample was allowed to sit overnight. Larvae were collected and morphologically identified as described by (Urquhart et al., 1996; Anne and Gary, 2006).

### Questionnaire survey

Semi structured questionnaire survey was carried out to interview individual owners of 384 sheep taken for coproscopic examination in order to obtain general information about anthelmintic usage, symptoms of respiratory signs, and grazing area.

### Data management and statistical analysis

Raw data and the results of parasitological examination were entered in to a Microsoft Excel spread sheets program. Simultaneously, they were transferred and analyzed by SPSS version 16 software program. The prevalence of lungworm infection was calculated by dividing positive samples for the total number of samples examined. The association between different variables and outcome variables was evaluated using Chi-square ( $\chi^2$ ) test. For all analysis, a p-value less than 0.05 at 95% confidence level were taken as significant.

## RESULTS

### Over all prevalence of lungworm infection

Out of 384 sheep faecal examined, 217 (56.5%) (CI= 51.38 - 61.5%) were infected with different species of lungworm. Out of these, 28.4, 10.7, 7.6, and 9.9%, were due to *D. filaria*, *M. capillaries*, *P. rufescens*, and mixed infection, respectively. Thus, *D. filaria* was the dominant species followed by *M. capillaries*, then by *P. rufescens*, alone or in mixed infection. There was statistical

significance difference between *D. filaria* and other species of lungworm identified (p<0.05) (Table 1).

### Risk factors and prevalence of lungworm infection

Prevalence of lungworm infection was determined based on altitude, age, sex, and body conditions of the studied animals.

### Prevalence of lungworm infection according to PAs with various altitudes

Based on altitude and climatic condition, the prevalence were found to be to be 78.1, 52.3, and 39.1% in high land (Cire anole), mid-land (Nano hecho), and low land (Re'e amba), respectively. *D. filarial* and *M. capillaries* were most prevalent in high land, while *P. rufescens* was most prevalent in midland. Statistically, there was significant difference among different PAs with different altitudes (p<0.05) (Table 2).

### Prevalence of lungworm infection according to sex of the study animals

Prevalence of lungworm infection according sex of animals was 53.1 and 59.9% in male and female, respectively. Prevalence was higher in female than male; however, statistically there was insignificant difference between sex (p>0.05) (Table 3).

### Prevalence of lungworm infections in different age groups of animals

The prevalence of lungworm infection according to age of study animals was 62% in less than one year and 51% in greater than one year. *D. filaria* was higher in less than one year, while *P. rufescens* was slightly higher in greater than one year. The prevalence of lungworm infection between age of study animals was statistically significant (p< 0.05) (Table 4).

**Table 2.** Prevalence of lungworm infection among PAs with various altitudes.

PAs	No. examined	No. positive	Prevalence of different species of lungworm				Total P (%)
			Df (%)	Mc (%)	Pr (%)	Mi (%)	
Cire anole	128	100	53 (41.4)	20 (15.6)	8 (6.2)	19 (14.8)	78.1
Nano hecho	128	67	25 (12.5)	11 (8.6)	15 (11.7)	16 (12.5)	52.3
Re'e amba	128	50	31 (24.2)	10 (7.8)	6 (4.7)	3 (2.3)	39.1
Total	384	217	109 (28.4)	41 (10.7)	29 (7.6)	38 (9.9)	56.5

\*P= prevalence \*Df=*D. filaria*, Mc=*M. capillaries*, Pr=*P. rufescens*, Mi=Mixed infection. ( $\chi^2=42.093$ ; df =2; p=0.000).

**Table 3.** Prevalence of lungworm infection according to sex of study animals.

Sex	No. Examined	No. Positive	Prevalence of different species of lungworm				Total P (%)
			Df (%)	Mc (%)	Pr (%)	Mi (%)	
Male	192	102	48 (25)	23 (12)	15 (7.8)	16 (8.3)	53.1
Female	192	115	61 (31.8)	18 (9.4)	14 (7.3)	22 (11.5)	59.9
Total	384	217	109 (28.4)	41 (10.7)	29 (7.6)	38 (9.9)	56.5

$\chi^2=1.791$ ; df=1; p =0.181.

### Prevalence of lungworm infection in different body conditions of study animals

Prevalence of lungworm infection according to body condition of study animals was 60.9, 57.0, and 51.6% in poor, medium, and good, respectively. Thus, prevalence of lungworm was the highest in poor body condition than others. *D. filaria* was almost equal in all body condition; *M. capillaries* and *P. rufescens* were the highest in medium and poor body conditions, respectively. Prevalence of lungworm infection according to body condition conditions was statistically insignificant ( $p>0.05$ ) (Table 5).

### Questionnaire survey and prevalence of lungworm infection

Prevalence of lungworm infection during questionnaire survey was assessed based on anthelmintic usage, manifestation of respiratory signs, and grazing area.

### Prevalence of lungworm infections in relation to anthelmintic usage in study animals

Prevalence of lungworm infection in study animals in relation to dewormed by anthelmintic or non-dewormed was 44.6 and 67.5%, respectively and it is statistically significant ( $p<0.05$ ). Thus, almost prevalence of all lungworm species was higher in non-dewormed animals ( $p<0.05$ ) (Table 6).

### Association between prevalence of lungworm infection and manifestation of respiratory signs

Prevalence of lungworm infection in study animals according to manifestation of respiratory signs was 44.1 and 68.2% in apparently health and diseased, respectively and it is statistically significant ( $p<0.05$ ). Prevalence of all species of lungworm was higher in those that manifest respiratory signs (Table 7).

### Association between prevalence of lungworm infections and grazing area

The prevalence of lungworm infection in study animals according to grazing area was 67.9 and 38.1% in swampy and forest grazing animals, respectively. Thus, infection was higher in swampy grazing animals. Prevalence of all species of lungworm was higher in swampy area. The prevalence of lungworm infection according to grazing area was statistically significant ( $p<0.05$ ) (Table 8).

## DISCUSSION

The result of the present study conducted from November, 2013 to March, 2014 in three PAs of Guna District, Arsi Zone, south-east of Ethiopia indicated that lungworm infection was one of the most common respiratory diseases of sheep with an overall prevalence of 56.5%. This agrees with the research findings that

**Table 4.** Prevalence of lungworm infections in different age groups of animals.

Age	No. examined	No. positive	Prevalence of different species of lungworm				Total P (%)
			Df (%)	Mc (%)	Pr (%)	Mi (%)	
≤1 year	192	119	64 (33.3)	23 (12)	12 (6.2)	20 (10.4)	62.0
>1 year	192	98	45 (23.4)	18 (9.4)	17 (8.9)	18 (9.4)	51
Total	384	217	109 (28.4)	41 (10.7)	29 (7.6)	38 (9.9)	56.5

$\chi^2=4.673$ ; df=1; p= 0.31.

**Table 5.** Prevalence of lungworm infection in different body condition of study animals.

Body condition	No. examined	No. positive	P(%) of different species of lungworm				Total P (%)
			Df (%)	Mc (%)	Pr (%)	Mi (%)	
Poor	128	78	38 (29.7)	12 (9.4)	15 (11.7)	13 (10.2)	60.9
Medium	128	73	36 (28.1)	20 (15.6)	9 (7.0)	8 (6.2)	57.0
Good	128	66	35 (27.3)	9 (7.0)	5 (3.9)	17 (13.3)	51.6
Total	384	217	109 (28.4)	41 (10.7)	29 (7.6)	38 (9.9)	56.5

$\chi^2=2.310$ ; df=2; p=0.315.

**Table 6.** Prevalence of lungworm infection in relation antihelmintic usage in study animals with response of respondents.

Did you deworm your sheep?	No. examd with rr	No. positive	P (%) of different species of lungworm				Total P (%)	
			Df (%)	Mc (%)	Pr (%)	Mi (%)		
Responses	Yes	184	82	41 (22.3)	10 (5.4)	15 (8.2)	16 (8.7)	44.6
	No	200	135	68 (34.0)	31 (15.5)	14 (7.0)	22 (11)	67.5
	Total	384	217	109 (28.4)	41 (10.7)	29 (7.6)	38 (9.9)	56.5

$\chi^2=20.51$ ; df=1; p=0.00. \*p= prevalence, \*No. examined with rr = number of examined animals with response of respondents.

**Table 7.** Association between prevalence of lungworm infection and respiratory signs with response of respondents.

Did your sheep cough?	No.exmd with rr	No. Positive	P (%) of different species of lungworm				Total P (%)	
			Df (%)	Mc (%)	Pr (%)	Mi (%)		
Responses	Yes	198	135	67 (33.8)	25 (12.6)	22 (11.1)	21 (10.6)	68.2
	No	186	82	42 (22.6)	16 (8.6)	7 (3.8)	17 (9.1)	44.1
	Total	384	217	109 (28.4)	41 (10.7)	29 (7.6)	38 (9.9)	56.5

$\chi^2=22.658$ ; df=1; p=0.000. \*No. examined with rr = number of examined animals with response of respondents

**Table 8.** Association between prevalence of lungworm infections and grazing area with response of respondents.

Where do you keep your sheep?	No.exmd with rr	No. positive	P(%) of different species of lungworm				Total P (%)	
			Df (%)	Mc (%)	Pr (%)	Mi (%)		
Responses	Swampy areas	237	161	79 (33.3)	32 (13.5)	19 (8.0)	31 (13.1)	67.9
	Forest	147	56	30 (20.4)	9 (6.1)	10 (6.8)	7 (4.8)	38.1
	Total	384	217	109 (28.4)	41 (10.7)	29 (7.6)	38 (9.9)	56.5

$\chi^2= 32.85$ ; df= 1; p=0.00. \*No. examined with rr = number of examined animal with response of respondents.

were conducted in Asella (Bekele et al., 1981; Wondwossen, 1992; Paulos, 2000; Mihreteab and Aman, 2011; Hasen et al., 2013; Abeje et al., 2016) with prevalence of 59.4, 58.8, 52.54, 57.1, 55.10 and 57.6%, respectively. In Dessie and Kombolcha, 50% prevalence was reported (Teffer, 1993). However, the current finding was lower than the prevalence reported by Eyob and Mathios (2013) in Asella province (72.44%); by Yohannes (1989) in DebreTabor Awraja (70.7%); by Netsanet (1992) in Debre Birhan (73.75%) and by Sefinew (1999) in six district of Wollo (71.3%). The result of the current finding highly disagrees with the study conducted by Frewengel (1995) in and around Mekele (13.24%) and by Ibrahim and Degefa (2012) in Mekele town (13.4%). The possible explanation for such prevalence variation could be due to variation in altitude, rainfall, humidity, temperature difference, and season of examination on the respective study areas which favor or disfavor the survival of parasite larvae (Soulsby, 1982; Bradford, 2002).

In the current study, the prevalence of different species of lungworm was 28.4, 7.6, 10.7 and 9.9% due to *D. filaria*, *P. rufescens*, *M. capillaries*, and mixed infection with two or three species of lungworm, respectively. With regard to the species of lungworms, it was observed that *D. filaria* was the most predominant species in the area followed by *M. capillaries*, whereas *P. rufescens* was the least prevalent. This finding is supported by Alemu et al. (2006), Mihreteab and Aman (2011), Netsanet (1992) and Nemat and Moghadam (2010) who reported that *D. filaria* was the most prevalent in their study area. In contrast to these findings, Sisay (1996) in Bahirdar and Mezgebu, in Addis Ababa reported that *M. capillaries* was the most prevalent. The possible explanation for the predominance of *D. filaria* in the study area might be attributed to the difference in the life cycles of the parasites. Thus, *D. filaria* has a direct life cycle and requires shorter time to develop an infective stage, while *M. capillaries* has an indirect life cycle which needs an intermediate snail for completing its life cycle. Thus, require longer time to develop to infective stage. In the present study area, the environment may not be favorable to the intermediate host as that of Bahirdar and Addis Ababa that make *M. capillaries* and *P. rufescens* lower. According to Soulsby (1982) after ingestion the larvae *D. filaria* parasites can be shed with faeces within five weeks. Compared with *D. filaria*, the transmission of *P. rufescens* and *M. capillaries* is epidemiologically complex event involving host, parasite and intermediate host. Hence, *M. capillaries* and *P. rufescens* in sheep require slugs or snails as intermediate host which must be eaten for infection to occur; this might make them low prevalent in the present study area than *D. filaria* (Urquhart et al., 1996). Mixed infection was also observed in the current study as in previous studies (Wondwossen, 1992; Hansen and Perry, 1994; Paulo, 2000).

On attempt to know the influence of altitude on the study area, there was statistically significant difference on prevalence of lungworm infection with prevalence of 78.1, 52.3, and 39.1% at high altitude (Cire anole) (2400 to 3000 m.a.s.l), midium altitude (Nano hecho) (1800 to 2200 m.a.s.l) and low altitude (Re'e amba) (1500 to 1800 m.a.s.l), respectively. These results indicate that, prevalence of lungworm infection increase as altitude increase. This result agrees with study reported by Mihreteab and Aman (2011) who reported 66.4, 57.5, and 47.2% in high altitude (>2400 m.a.s.l), medium altitude (1800 to 2200 m.a.s.l), low altitude (1600 m.a.s.l), respectively in Tiyo district. It was also inline within Alemu et al. (2006) findings who had reported 70, 47 and 43% in high, medium, and low altitude, respectively, in north east of Ethiopia. This finding disagrees with the reports of Wondwossen (1992) who indicated absence of significant difference in different lungworm species distribution between high and mid altitude in Asella Awraja. These differences between researchers might be associated with variation in sample size, duration of study time and season of the study period. It may also be associated with climate changes every year which could help in the agro-ecological expansion of previously highlands adapted parasites to medium and low altitude. In this finding, prevalence was the highest in high altitude than others; this might be due to it has low temperature, higher moisture and humidity than other ecologies which is favorable for survival of larvae and intermediate hosts (Radostits et al., 2007).

With regard to the prevalence of lungworms in different age groups, young animals were found to be more infected than adult. The higher infection rate was observed in less than a year (62.0%) while lower infection rate was observed in greater than a year (51.0%). This shows that young were more susceptible than adult. In less than one year, *D. filaria* was higher (33.3%) than greater than one year (23.4%); however, in greater than one year *P. rufescens* (8.9%) was higher than less than one year (6.2%). This finding agrees with Mihreteab and Aman (2011), Wondwossen (1992), and Teferra (1993) who reported that young sheep were more affected by *D. filaria* than adult sheep. The reason behind this is either due to development of acquired immunity in adult animals from previous exposure or recovered animals have better immunity against re-infection. In the other way, young animals had poorly developed immunity against *D. filaria*. In this finding, *P. rufescens* was higher in adults than in young; this might be due to impaired development of acquired immunity in adult or due to young animals may not be exposed to intermediate host (Radostits et al., 2007). This may be also associated with the life cycle and infection route of the parasite which is through ingestion of infected snail (IH) which results to lower infection in young, but accumulate through long time in adults that make them more susceptible.

On attempt to know the influence of sex, on variation of prevalence of lungworm infection, the prevalence was higher in female (59.9%) than male (53.1%), but the difference was statistically insignificant. This agrees with research reported by Addis et al. (2011), Nibret et al. (2011), Eyob and Mathios (2013), Dawit and Abdu (2012) and Hasen et al. (2013), but disagree with report of Alemu et al. (2006) and Mihreteab and Aman (2011). These differences between researchers might be either due to improper distribution of sample selection between the two sexes that makes prevalence higher in female (Addis et al., 2011) or most of the sampled females are not in preparturient period during the study time that make both sexes equally susceptible to disease. In the current finding, prevalence was higher in female; this might due to certain sampled animal were lactating which suppress immunity of the animal (Urquhart et al., 1996).

With regard to assessing the influence of body condition on variation of prevalence of lungworm infection, 60.9, 57, and 51.6% in poor, medium, and good, respectively was found. Hence, prevalence was higher in poor body condition than other; however, variation among body condition was statistically insignificant. This finding agrees with study reported by Dawit and Abdu (2012) who said the difference between conditions are insignificant; however, disagrees with study reported by Mihreteab and Aman (2011) and Desta et al. (2013) who reported the variation among body condition was statistically significant. The reason why current finding insignificant among body condition, might be either due to loss of weight cannot only be attributed by the lungworm infection alone but also inappropriate management and other helminth infection (Mengestom, 2008).

In this finding, even though variation is insignificant, prevalence of lungworm infection was higher in poor body condition than other; this might be due to poorly nourished animals less competent not to be infected by lungworm than others (Kimberling, 1988).

With attempt to know influence of antihelmintic usage on prevalence of lungworm infection, questionnaire survey findings were tried to associate antihelmintic usage with the faecal examination results. Higher prevalence (67.5%) of the parasites was recorded in sheep with the respondents that said non-dewormed than dewormed (44.6%) and it is statistically significant. The observation noted in this study agreed with study reported by Eyob and Mathios (2013), Yohannes (1989), Netsanet (1992) and Sefinew (1999). In these mentioned authors, their findings indicate that the prevalence of the parasite was found high in animals that were non-dewormed than dewormed. In the current study, even though the dewormed sheep revealed low infection prevalence compared to non-dewormed groups, about 44.6% of them were infected with lungworm. The reason why dewormed sheep infected might be either due to the

antihelmintic used in the area for the treatment only temporarily suppress egg production of the adult worms or parasite may become resistance to antihelmintic used. It may also be related to the poor quality of antihelmintic used in the country. In contrast, 32.5% of none dewormed animals were not infected by lungworm; this might be due to development of acquired immunity from previous exposure (Radostitset et al., 2007; Urquhart et al., 1996) and it may also be due to none exposure to the infective stages of *D. filaria* or to intermediate host of the other species of the lungworms of sheep throughout their life.

With regard to know appearance of symptoms of respiratory sign with lungworm infection, questionnaire survey findings were tried to associate manifestation of respiratory sign with the faecal examination results. Higher prevalence (68.2%) of the parasites was recorded in sheep with the respondents that said yes (it shows clinical respiratory signs) than that said no (did not show signs) (44.1%).

Hence, the variation was statistically significant. This finding agreed with the study reported by Paulos (2000), Eyob and Mathios (2013) and Hasen et al. (2013). In these mentioned authors, their findings indicate that the prevalence of the parasite was found high in animals which showed symptoms of respiratory signs than apparently healthy.

In current finding, even though apparently healthy sheep show low infection compare to those showing clinical respiratory signs groups, about 44.1% of them were infected with lungworm.

The reason why apparently health sheep appeared with lungworm might be due to the parasites in pre-patent stage, due to small adult worm burden in sheep which could not produce eggs and hence larvae, or as a result of immunity developed due to exposure to a few lungworms which is not associated with clinical sign, but animal shed larvae (Soulsby, 1982). 21.8% of these animals manifesting respiratory signs appeared negative on coproscopic examination; this might be due to bacterial or viral diseases that causes occurrence of respiratory signs (Gelagay et al., 2004).

Lastly, in this study, questionnaire survey findings tried to relate the grazing area with the faecal examination results. Higher prevalence (67.9%) of the parasites was recorded in sheep with the respondents that said they were kept in swampy area than forest (38.1%) and it is statistically significant.

Thus, the variation of lungworm infection according to grazing area may be due to antihelmintic effects of some trees and shrubs browsed from the forest that caused prevalence of lungworm infection low in forest grazing sheep (Rahman and Seip, 2006); prevalence in swampy area was high which might be due to the presence of moisture which is favorable for survival of larvae and intermediate host (Urquhart et al., 1996).

## Conclusions

The present study revealed that prevalence of ovine lungworm was high in Guna district, Arsi zone. The major lungworm species identified in the area were *D. filaria*, *M. capillaris*, and *P. rufescens*. *D. filaria* was identified as the most dominant lungworm species. Coproscopic examination and questionnaire survey revealed that young, none dewormed, clinically diseased, swampy grazing animals, and animals from high and medium altitude harbor more infection than their counter parts; however, body conditions and sexes does not have much influence on variation of lungworm infection. In view of these facts, the following recommendations are forwarded: regular deworming with effective antihelmintic should be routinely practiced, sheep should be forbidden to graze swampy areas, young age groups should be isolated during the season when pasture contamination is expected and emphasis should be given to the control and prevention in order to reduce the prevalence from the current high finding.

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## CONFLICT OF INTERESTS

The authors have not declared any conflict of interest.

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