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Prevalence and Financial Losses of Lungworm Infection in Sheep in South Wollo Zone, Ethiopia

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ABSTRACT

This cross-sectional study was conducted between November 2013 and March 2014 to determine the prevalence of lungworms in sheep in two districts of South Wollo zone, Amhara region, Ethiopia. Alongside the financial losses encountered due to lungworm infection in sheep during retrospective study in Dessie municipal Abattoir was also assessed. A total of 477 fecal samples collected from sheep were examined using modified Baerman technique. Out of which 218 were found to be positive (45.71%). The lungworm species were *Muellerius capillaris 212(*23.48%), *Dictyocaulus filaria* 39(8.18%), *Protostrongylus rufescens 28*(5.87%) and mixed infection *39(8.18%)* either with two or three species. The prevalence of lungworm infection was significantly different between sexes (χ^2=32.2, P= 0.000), age groups (χ^2=72.561, p=0.000) and body conditions (χ^2=113.66, p=0.000). Prevalence was significantly higher in female sheep (57.94%), sheep of above 3years of age (69.01%) and poor body condition (89.62%) than males, sheep of less than 3years of age (<1 year, 1-3years) and medium/good body conditions, respectively. Moreover, sheep showing respiratory clinical syndromes, kept under extensive management system and sampled during wet season showed statistically significant variation ($p<0.05$) when compared with those sheep without respiratory syndrome, kept under semi-intensive management system and sampled in dry season, respectively. The mean annual financial losses by organ condemnation and carcass weight reduction due to lungworm infection in sheep slaughtered at Dessie municipal abattoir were estimate to be 7445549.6 ETB, equivalent to 402462.1USD.

Keywords: Baermann technique, dessie, kombolcha, lungworms, prevalence, risk factors

Ethiopia is believed to have the largest livestock population in Africa. This livestock sector has been contributing considerable portion to the economy of the country (CSA, 2009). According to CSA (2009) report, sheep constitute about 16.1% of the total livestock population of the country. Unlike the large population and importance of sheep in the country their productivity is low. This low productivity is a reflection of diseases, poor nutrition, poor animal production system and general lack of veterinary care (Sissay, 2007). Studies in central highlands of Ethiopia have shown that respiratory diseases caused by *Dictyocaulus filaria*, *Muellerius capillaries* and *Protostrongylus rufescens* are a major problem in small ruminants and cause reduction of weight gain, high mortality as well as impairing reproductive and growth performances and substantial production losses (Gelagay *et al.* 2005; Tony, 2006).

Therefore, the present study was designed to determine the prevalence and the risk factors associated to the occurrence of sheep lungworm infection as well as the financial loss encountered due to lung worm infection in the study area.

MATERIALS AND METHODS

Study area

The study was conducted in two sheep rearing districts (Kombolcha, Dessie) of South Wollo zone, Amhara region, Ethiopia. The Study area (Kombolcha and Dessie) is located in the North east highlands of Ethiopia on altitude between 1500-2600 meter above sea level at a longitude of 11º 84’ 49” N and 0.39º’46’E. Kombolcha, one of the study areas is situated 376 km North of Addis Ababa. It has an annual average rain fall of 750-900 mm and the

mean annual temperature ranging from 11.7ºC to 26.7ºC. Dessie, the other study area is situated 401 km North of Addis Ababa, It has a mean annual rainfall of 1100 – 1200 mm and the mean annual minimum and maximum temperatures are 12.5ºC and -23-9ºC respectively.

Study Animals

The study was undertaken on local indigenous sheep having different sex, age, body condition score, health status and kept under different management system that were selected randomly from the total population of sheep.

Study Design

The type of the study was cross-sectional with simple random sampling technique conducted between November 2013 and April 2014 to establish the prevalence and associated risk factors of lung worm infection and its financial loss in sheep in the study area.

Sample Size Determination

The desired sample size for this study was determined using the following formula (Thrusfield, 2005):

$$n = \frac{1.96^2 P_{ex}(1 - P_{ex})}{d^2}$$

Where, n = required sample size

P_{ex} = expected prevalence

d = desired absolute precision

1.96^2 = z-value for the 95% confidence level

Study Methodology

A total of 477 fecal samples were collected directly from the rectum of each sampled animal with strict sanitation, and placed in air and watertight sample vial, while collecting fecal samples, necessary parameters (date of sampling, sex, age, body condition, health status, altitude, season and the management system) were properly recorded, and brought to Kombolcha Veterinary Regional Laboratory in ice pack box. In the laboratory, the samples were examined using modified Baermann technique to identify L_1 larvae (Charles and Robinson, 2006).

Financial Loss Assessment

In this study, a five-year (2008-2012) retrospective abattoir data survey conducted in Dessie municipal abattoir were used to determine the annual financial losses due to lungworm infection in slaughter sheep by taking average number of condemned lungs and carcass weight loss due lungworm infection using the following formula.

AFLLI = (ANCL *ACL) + (NSSLW * AMPM *Z)

Where,

AFLLI = Annual Financial Loss due to Lungworm Infection

ANCL = Average number of condemned sheep lungs at Desssie municipal abattoir

NSSLW = No of slaughter sheep identified with lung worm infection

ACL = Average cost of one sheep lung in Dessie town

AMPM = Average market price (cost) of 1 kg meat in Dessie town

Z = carcass weight loss in individual animal because of lungworm infection (6 kg) (FAO, 1993)

Using the above formula, the direct (lung condemnation) and indirect (carcass weight reduction) financial loss due to lungworms were estimated by summation of average annual condemned lung and carcass weight reduction by average cost for each items.

The annual average number of condemned lungs and weight reduction due to lungworms in sheep was 12137 and 72822kg respectively. The current market retail price of 1 lung and 1 kg of sheep meat was 0.16 and 5.5 USD respectively.

Data Analysis

All collected data were entered and managed in MS -Excel Soft ware program and analyzed using SPSS 20.0 soft ware version. Descriptive statistics was used to summarize the data. Prevalence was calculated as the number of positive sheep harboring the worms divided by the total sheep examined. Chi-square statistics were used to test the association between variables. At $P< 0.05$ was taken as statically significant.

RESULTS AND DISCUSSION

Lung worm infection is a chronic and prolonged nematodiosis affecting the lungs of Animals. In sheep, this disease is caused by *D. filaria, M. capillaris* and *P.rufescens* in most part of Ethiopia. It causes a significant financial loss through morbidity, mortality, carcass weight loss and high treatment costs.

Table 1: Prevalence of lung worm infection in study sites

Study site	No sheep examined	Positive	Prevalence	χ^2-value	P value
Dessie	223	117	52.5%	7.721	0.005
Kombolcha	254	101	39.8%		
Total	477	218	45.7%		

The result of the present study conducted in two districts (Dessie, Kombolcha) of South Wollo zone, Amhara region, Ethiopia disclosed an overall prevalence of 45.71% lungworm infection in sheep as shown in Table 1. Similar findings have been reported by other workers in different part of Ethiopia *viz*; 39.79% in Assela (Wondwossen 1992), 48% in Addis Ababa (Mezgebu 1995), 53.6% at Dessie and Kombolcha (Sefinew 1999), 40.4% in North east Ethiopia (Alemu *et al.* 2006), 43.3% in Dessie and Kombolcha districts (Regassa *et al.* 2010), 42% in Dessie Zuria (Basaznew *et al.* 2012) and 50% in North Gonder Zone (Yitagel *et al.* 2013).

Table 2: Identified lungworm species in the study area

Identified lung worm Species	No of animals examined (n =477)	
	No of positive animals	Prevalence (%)
D.filaria	39	8.18
M. capillaries	112	23.48
P. rufescens	28	5.87
Mixed infection	39	8.18
Total	218	45.71

In contrary to the present finding, high prevalence rates were reported by different authors *viz*; 67.69% in wogera, Northern Ethiopia (Nibret *et al.* 2011), 57.1% in South east Ethiopia (Mihreteab and Aman, 2011) and 72.44% in Assela ,central Ethiopia(Eyob and Matios, 2013). However, the result of the present study is higher than the results of Mekonnen *et al.* (2011) at Gonder, Mersha *et al.* (2012) at Deneba, North east Ethiopia, Desta *et al.* (2013) at Ambo, Oromia Ethiopia, Kassa and Abdu (2013) at Bahr-Dar, Ethiopia and Gebreyohannes *et al.* (2013) at Mekdela, Ethiopia. This could be attributed to the variation in altitude, rain fall, humidity and temperature which favor the survival of parasite larvae in general and/or the presence or absence of snail intermediate host in case of *P. rufescens* and *M. capillaris* in the study sites. The variation could be also due to time of sampling, methods followed to detect the parasitic larvae, nutritional status, level of immunity of sampled animals and expansion of veterinary services and the intensification of nearby veterinary drug shop, which enable the farmers (animal owners) to have an access to control most prevalent small ruminant parasitic infection including lung worm parasites.

Table 3: Prevalence of sheep lungworm infection based on various risk factors

Risk factors	animals examined	Positive animals	Prevalence (%)	χ^2-value	P-value
Sex					
Male	225	72	32.00	32.22	0.000
Female	252	146	57.94		
Age					
<1year	126	25	19.84		
1-3 years	180	75	41.67	72.561	0.000
>3 years	171	118	69.01		
Management					
Extensive	408	209	51.23	34.67	0.000
Semi-intensive	69	9	13.04		
Seasons					
Wet	200	113	56.5	16.181	0.000
Dry	277	105	37.91		

In this study, *M. capillaris* was the most identified lung worm species (23.48%) followed by *D. filaria* (8.18%) and *P. rufescens* (5.87%) in sampled sheep (Table 2). The result agrees with the previous findings of Mezgebu (1995) in Addis Ababa, Sisay (1996) in Bahir Dar, Yitagel *et al.* (2013) in North Gonder Zone and Basaznew *et al. (2012)* in and around Dessie zuria, North east Ethiopia but it disagrees with the findings of Netsanet (1992) in and

Table 4: Prevalence of sheep lungworm infection based on body conditions and respiratory symptoms

Risk factors	Examined animals	Positive	Prevalence%	χ^2-value	P-value
Body conditions					
Poor	106	95	89.62		
Medium	183	74	40.44	113.66	0.000
Good	188	49	26.06		
Respiratory symptoms					
with respiratory syndrome	225	182	80.89		
without respiratory syndrome	252	36	14.29	212.48	0.000

around Debre Berhan, Alemu *et al.* (2006*)* in North west Ethiopia*,* Mihreteab and Aman (2011) in Tiyo, South east Ethiopia and Eyob And Matios (2013) in Assela province, Central Ethiopia who reported higher prevalence of *D. filaria*. The reason for the predominance of *M. capillaris* in the study area might be attributed to the presence of favorable environmental conditions for the breeding and development of the snail intermediate hosts and the parasite larvae (Taylor *et al.* 2007).

The investigation result revealed higher prevalence of lung worm in female animals (57.94%) than male animals (32.00%). The difference was statistically significant (P<0.05) (Table 3). The result is in coherent with the findings of Desta *et al.* (2013) , Mekonnen *et al.* (2011), Nibret *et al.* (2011), Mihreteab and Aman (2011) and Basaznew *et al.* (2012) who reported high prevalence rates in female than in male animals in different agro-ecological zones of Ethiopia. This difference could be due to the fact that female animals' resistance to infection decreases at the time of parturition and during early lactation and the period of collection of samples. As preparturient relaxation resistance may result in the female inability to expel adult worms which cause higher level of larvae detection (Radostits *et al.* 2007; Taylor *et al.* 2007).

With regard to age, highest prevalence (69.01%) was observed in animals above three years of age while the lowest prevalence 41.67% and 19.84% was observed in age groups of 1-3 years and in age groups less than 1 year, respectively with statistically significant difference (P<0.05) as shown in table 3. This finding is in line with the findings of Besaznew *et al.* (2012). This might be associated with the fact that the apparent mobility of the host to develop acquired immunity, so that adult animals have the heaviest infection and highest prevalence (Urquhart *et al.* 1995).

In this study, an attempt was made to elucidate the prevalence of lung worm infection in sheep kept under different management systems. It was found that 51.23% prevalence in extensive and 13.02% in semi intensive management system with statistically significant difference (P<0.05) (Table 3). The result is in accordance with the findings of Sisay (1996), Alemu *et al.* (2006), Mekonnen *et al.* (2011), Eyob and Matios (2013) and Yitagel *et al.* (2013). This could be due to the fact that sheep in extensive management system have a chance to ingest intermediate host for *P. rufescens* and *M.capillaris* in large number; or are they possibly infested with larvae as well as easily obtained *D. filaria* from the herbage while they are grazing in contaminated fields (Soulsby, 1982; Radostits *et al.* 2007).

The seasonal dynamics of lung worm infection in the study periods showed higher prevalence in the wet season (56.5%) than dry season (14.29%). The was statistically significant difference (P<0.05) (Table 3). The reason for high prevalence rate in the wet season might be due to the fact that survival and development of lung worm larvae and its intermediate host are favored by available moisture and high humidity (Taylor *et al.* 2007)

In this study, an attempt was carried out to know whether body condition influence or not on prevalence of ovine lungworm infection; and it was found that 89.62%, 40 .44% and 26.06% prevalence in poor, medium and good body

condition score, respectively as shown in Table 4. This finding is in line with the findings of Mihreteab and Aman (2011), Desta *et al.* (2013) and Kassa and Abdu (2013). The reason for high prevalence of lung worm infection in poor body condition animals might be due to immune suppression in sheep and malnutrition (Taylor *et al.* 2007). Poorly nourished sheep appear to be less competent in getting rid-off lungworm infection (Radostits *et al.* 2007).

In the present study, the level of prevalence was higher in sheep showing clinical respiratory signs (80.89%) than those apparently health sheep (14.29%) with statically significant difference. ($p< 0.05$). This finding is in line with the findings of Eyob and Matios (2013), Desta *et al.* (2013) and Hasen *et al* (2013). The reason for high prevalence in animals with respiratory infection might be due to the fact that during the pre-patent phase, patent phase and post patent phase immature and adult lungworm in the air ways cause parasitic pathological lesions and this is responsible for clinical respiratory sign (Blood and Radostits 1989; Bradford 2002).

The total direct and indirect annual financial losses due to lungworm infection in sheep slaughtered in Dessie municipal abattoir was estimated to be 7445549.96 ETB (402462.16, USD (1USD=18.50 ETB). The result showed that lungworm infection causes significant financial losses in the study area. This finding was higher than the findings of Yehualashet *et al.* (2013) and Helina *et al.* (2012) at Addis Ababa abattoir enterprise and Ezana (2008) at the export abattoirs in and around Debre Zeit who reported the total annual financial loss 8760, 5438 and 78791 USD per annum in small ruminants due to different major parasitic diseases, respectively. This is probably due to the fact that their total annual financial losses was calculated only by considering the losses from organ condemnation (direct loss) whereas in present study the total mean annual financial losses was calculated by considering the losses from organ condemnation (direct loss) and carcass weight reduction (indirect loss).

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