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Lungworm infection in sheep: Prevalence and associated risk factors in North West Ethiopia

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ABSTRACT

Aim: The aim of this study was to determine lungworm prevalence, risk factors associated with lungworm infection and identification of species of lungworm in sheep in Dangla district, Northwestern Ethiopia
Method and Materials: Faecal samples were randomly taken from 384 heads of sheep for examination of first stage larvae (L1) of lungworms using a modified Baerman technique.
Results: The overall prevalence of lungworm infection was 14.8% (57 of 384). The lungworm species identified were Dictyocaulus filaria (D. filaria), Muellerius capillaris (M. capillaris) and Protostrongylus rufescens (P. rufescens) as single and mixed infection. The proportions of infection by D. filaria, M. capillaries, P. rufescens and mixed were 6.3%, 3.9%, 2.9% and 1.8% respectively. There was an infection rate of 15.6% in males and 14.3% in females but this difference was not statistically significant ($p>0.05$). The Lungworm infection observed in different body conditions was statistically significantly ($P<0.05$) in which higher prevalence was observed in sheep those have poor body condition. The infection rate of D. filarial, M. capillaries and P. rufescens infection did not show significant difference ($p>0.05$) among young (15.6%), adult (16.4%) and old (13.6%) age groups.
Conclusion: This study revealed that there was high prevalence of lungworm infection which impairs the productivity of sheep in the study area.

Keywords: Dangla, Ethiopia, Lungworm, Prevalence, Sheep.

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Introduction

Sheep are the most numerous of man's domestic livestock and are especially important in the more extreme climates. Their small size, high productive capacity and rapid growth rate make sheep a more flexible short term form of investment than cattle (ILCA, 1990). Of the world's 1,614 million or 65% of sheep are located in developing countries. In Africa they are noted for their ability to convert low opportunity meat, milk, fiber, manure and hides (FAO, 1986; Wilsmore, 2006).

In Ethiopia, agriculture is the mainstay of the country and also the major resources of employment and income, about 80% of the population live in the rural areas and are primarily engaged in agriculture and related activities. Thus, agriculture directly or indirectly forms an important component of the livelihood of more than 60 million people in the country. In Ethiopia, livestock contribute about 30-35% of the agricultural gross domestic product (GDP) and more than 85% of farm cash income (Benin et al., 2002).

In terms of livestock population, Ethiopia stands first in Africa and 10th in the world in livestock population. The domestic animal population of

the country is estimated to be more than 38,749,320 cattle, 18,075,580 sheep, 14, 858,650 goats, 456,910 camels, 5,765,170 equines and 30,868,540 chickens with livestock ownership currently contributing to the livelihoods of an estimated 80% of the rural population (CSA, 2009).

In Ethiopia, sheep are the dominant livestock providing up to 33% of cash income and 23% of food substance value obtained from livestock production. Sheep play a vital role as sources of meat, milk and wool for smallholder keepers in different farming systems and agro-ecological zones of the country (FAO, 2009). They are also sources of foreign currency. Sheep and goat contribute a quarter of the domestic meat consumption; about half of the domestic wool requirement, 40% of fresh skins and 92% of the value of semi- processed skin and hide exports to abroad. It is estimated that 1,078,000 sheep are used in Ethiopia for domestic consumption annually. There is also a growing export market for sheep meat in the Middle Eastern Gulf States and some African countries. At optimum off take rates, Ethiopia can export 700,000 sheep's meat annually, and at the same time supply, 1,078,000 sheep's for the domestic market (Alemu and Markel, 2008).

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). Livestock diseases are widely distributed and are one of the major causes of livestock mortality and sub-optimal productivity in all agro-ecological zones of the country. Respiratory diseases resulting from helminthes parasites are of great economic concern in sheep production in the low lands and highlands of Ethiopia where sheep are important livestock units (EARO, 2000).

Dictyocaulidae and certain Metastrongylidae are known to exist in East Africa (Ethiopia, Kenya and Tanzania) and the South Africa. In lowland and highlands area of Ethiopia, respiratory lungworm parasites are the most common cause of high morbidity and mortality rates of sheep (FAO, 2006; Alemu et al., 2006).

Lungworm infection is infection of lower respiratory tract, resulting in bronchitis or pneumonia or both. Any of several parasitic nematode including; Dictyocaulus viviparous in cattle; Dictyocaulus arnifieldi in donkeys and horses; Dicyocaulus filaria, Protostrongylus rufescence and Mullerius capillaris in sheep and goats; Metastrongylus apri in pigs; filriodes (oslerus osleri) in dogs and Aelurostrongyllus abstrusus in cats; other lung worm infection occur but less common (Chaun and Agarwal, 2006). These lungworms particularly Dictyocaulus filaria can suppress the immunity of the respiratory tract and causes death, poor weight gain or loss of body weight as well as greatly affects the potential productivity of sheep in the areas where it is prevalent (Gelagay et al., 2005). Prevention and Control of these parasites is therefore essential for releasing the potential of sheep production.

For proper control to be carried out knowledge of parasitic diseases and their dynamics must be understood 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 (Radostits et al., 2005). In order to investigate a lungworm control strategy at local and regional level, further and detailed investigation on epidemiology and importance of lungworm infections with respect to associated risk factors is necessary. but there are very limited studies that have been conducted so far by Sisay, (1996) with Prevalence of 13%, Kassa & Abdu, (2012) with 20%, and Yifat, (2013) with 17.5% in and around Bahir-Dar which has the same agro-ecological climate with Dangla where research have not been done on the prevalence of lungworm infections in sheep.

Methods and Materials

Study area

The study was conducted in Dangla woreda of Awi zone in Amhara region, Ethiopia. The study area is located in the Northwestern parts of Ethiopia, in Amhara region at Dangla town which is located at 78 kms away from Bahir Dar and 485kms away from Addis Ababa at 11.2670 North latitude and 36.8330 East longitudes. The altitude of the area ranges from 1809-2137 meters above sea level. The mean annual minimum and maximum temperatures are 14 and 31°C respectively, with a minimum and maximum annual rainfall of 1500-2200mm. Generally, the climate of the area is characterized by woyna dega climatic condition. In the area, there are four main seasons in a year. Namely, the dry season winter ("Bega") from December to February, spring ("Tsedey") from March to May, summer ("Kremt") from June to Augest and autumn ("Meher") from September to November. The farming system in the area is mixed farming and sheep are the dominant animal species kept by farmers. The grazing land comprises waterlogged areas, forest margins, mountainsides, stony land and roadsides (NMSA, 2013).

Study population

The study population included in this study was sheep having different sex, body condition score and age category and kept under extensive and semi extensive management system.

Study design and sampling method

Cross-sectional type of study was conducted from November 2014 to April 2015 to determine the prevalence of lungworm infection in sheep and associated risk factors in the study. For selecting PAs within the district, purposive sampling was employed for logistic reasons. Simple random sampling technique was the principal sampling method followed for sampling household and individual sheep for the study.

The sample size desired for this study was determined by using the formula given by Thrusfield, (2005).

Where:

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

n= required sample size

Pexp= expected prevalence

d= desired absolute precision

1.962 = z-value for the 95% confidence level

Accordingly the sample size was n =

$$= \frac{(1.96)2\times0.5\ (1-0.5)}{0.052} = 384$$

Study methodology

Fecal samples (384) were taken from randomly selected sheep. Fecal samples from the selected animals were collected directly from the rectum by two fingers after wearing disposable gloves in a universal bottle and then transported to Dangla veterinary clinic as soon as possible and each sample was processed by modified Bearmann technique (Charles and Robinson, 2006). All samples were clearly labeled with the date of sampling, sex, age and body condition score. Age of animal was gathered from the owners and dentations.

The Laboratory work was done using Barman technique. 25 grams of fresh feces was weighed from each sample. The larvae and enclosed gauze fixed on to astringe rode were submersed in a clean glass tube which was filed with warm water left for 24 hours and the sediments were transferred to Petri dish for examination of L1 under lower power of microscope after siphoning off the supernatant. a drop of 1% iodine solution was added to the slide to immobilize the larvae were examined under microscope to identify the species of the larvae by morphological features of the larvae. Those not identified under microscopes, the examined samples were registered as negative for lungworm infection. In both cases, the result that was obtained for each sample was recorded to their corresponding specific animals (Fraser, 1991; Urquhart et al., 1994; Anne and Gray, 2006).

Data analysis

The data was entered and managed in MS-Excel. All the data analysis was done by Statistical Package for Social Science (SPSS) software version 20. Descriptive statistics such as percentages and frequency distributions were used to describe the nature and the characteristics of data. The prevalence of lungworm infection was analyzed using percentages. The association of different risk factors with the disease were computed by using Chi-square (x2) test.

Results

Of the total 384 sheep examined, 57 (14.8%) were found to be infected by one or more of the lungworm species. The lungworm species encountered during the study period were Dictyocaulus filaria, Muellerius capillaries and Protostrongylus rufescens as single and mixed infections with a prevalence of 24 (6.3%), 15 (3.9%), 11 (2.9%) and 7 (1.8%) respectively. The sex of animals did not show statistically significant association with lungworm infection ($x2 = 0.112$, $p=0.738$) (Table 1). Infection by body condition was found non-significant (Table 2) and age wise lungworm infection rate was observed higher in adult as compared to other age groups, but it was not statistically significant ($P>0.05$) (Table 3).

Table 1. Prevalence of ovine lungworm infection in relation to sex

Sex	No. of animals examined	Prevalence n (%)	X^2 (Chi-square)	p-value
Male	154	24 (15.6)	0.112	.738
Female	230	33 (14.3)		
Total	384	57 (14.8)		

Table 2. Prevalence of ovine lungworm infection by body condition.

Body condition	No. animals examined	Prevalence n (%)	Chi-square (X^2)	p-value
Good	113	8 (7.1)		
Medium	176	24 (13.6)	15.483	.001
Poor	95	25 (26.3)		
Total	384	57 (14.8)		

Table 3. Prevalence of ovine lungworm infection in relation to age.

Age	No. animals examined	Prevalence n (%)	Chi-square (X^2)	p-value
Young (<1 year)	64	10 (15.6)		
Adult(1-3 years)	122	20 (16.4)	0.491	0.782
Old (>3 years)	198	27 (13.6)		
Total	384	57 (14.8)		

Discussion

The overall prevalence of lungworm infection in sheep in the present study, 14.8% is in agreement (the same or nearly the same) with the works of Teffera, (1993) 15.07%, at Dessie and Kombolcha districts, Ibrahim and Degefa, (2012) 13.4% at Mekelle town and Yifat, (2013) 17.5% in and around Bahir-Dar town.

The overall prevalence rate (14.8%) of the present study was considerably lower than the works of the following authors. These are Serkalem et al. (2014) 60.8% at Dale farm and abattoir, Yitagele et al. (2013) 46 and 56.3% by coproscopic and postmortem examinations respectively in North Gondar zone, Basaznew et al. (2012) 43.33% in Dessie Zuria District, Mekonnen et al. (2011) 33.83 and 32.6% based on coproscopic and postmortem examination respectively around Gondar and Tewodrose et al. (2012) 25.24% in and around Jimma town and. The grounds of low prevalence in this study could be attributed to the development of open-air clinic, careful management and increasing awareness

of farmers to deworm their sheep against parasitic infections in the study area apart from geographical variations. But the result of the present work was higher than the observations of other works; Frewengel, (1995) at Mekele town in different restaurants who reported 11.24%, Sisay, (1996) in Bahir Dar abattoir with a value of 13% and Ibrahim and Degefa, (2012) at Mekelle town who reported 13.4%. The differences in the prevalence of lungworm of sheep between this study and the above studies might be associated with nutritional status, level of immunity, method used for the detection of the larvae, management and regular deworming practices of the animal, rainfall, humidity, temperature and altitude differences, or difference in the study areas of topography, which has conducive environment for the survival of larvae and intermediate hosts, slug or snails which can influence the larvae in the respective study areas (http://www.esgpip.org; Thomson and Orita, 1988).

In the present finding both sexes showed equal susceptibility (they have equal chance of infection to the disease when they are allowed to graze at the same pasture) to infection with lungworms, hence sex dependent variation was not encountered. Alemu et al., (2006) and Dawit and Abdu, (2012) have also reported the same finding but Craig, (1998), Alemu et al. (2008) and Mihretab, (2011) have reported different result.

The lungworm infection prevalence was found to be significantly associated with the body condition of the study animal ($X2 = 15.483$, $p = 0.001$). A higher infection rate was observed in animals having poor body condition as compared to other body condition groups. Statistically significant difference was also observed in the infection rate among poor (26.3%), medium (13.6%) and good (7.1%) body condition in both single and mixed species infection. This is because of heavy parasitic loads, stress due to infections, disease which can cause sheep to lose conditions because they are not eating or the nutrients they eat are being diverted to parasites (http://www.esgpip.org).

The findings of the present study was in line with Mihretab, (2011), who reported that the prevalence was statistically significantly higher in animals with poor body conditions than medium or good body conditions in her survey. The achievable explanation for this observation could be due to immune-suppression in sheep with poor and medium body conditions, concurrent infection by other parasites including GIT helminthes and/or malnutrition (Thomson and Orita, 1988). Poorly nourished sheep appear to be less competent in getting rid of lungworm infection. Evidently, the infection with a parasite by itself might result in progressive emaciation of the animals (Radostits et al., 2007). Well nourishment and watering of sheep lead to less risk of helminthes infection as reported by Anne et al., (2006).

Regarding age, higher prevalence of lungworm infection was observed in the groups of adult (16.4%) as compared to age groups of young (15.6%) and old (13.6%). The difference was not statistically significant ($p > 0.05$). This might be associated with the frequent grazing behavior of adult animals those

graze continuously following weaning from suckling of their dam by which natural immunity obtained from their mother becomes reduced and the appropriate environmental climatic conditions can also contribute to higher rate of infection when sheep are sold to or bought from different agro-climatic conditions (Dar, 2012). This finding is however disagree with Muluken, (2009) and Tigist, (2009) findings in North and South Gondar zones and Tewodros, (2012) in and around Bahir Dar that they have founded the prevalence of lungworm infection is higher in ages of younger sheep than those of other age groups.

Three major important respiratory nematodes were identified by coproscopic examination of the sheep in the area. Dictyocaulus filaria was the most predominant lungworm species with a prevalence rate of 6.3% followed by M. capillaris 3.9%, P. rufescens 2.9% and mixed infections with two or three of the species, which accounted 1.8% and finally, the least prevalence was P. rufescens. This finding was in line with the studies of Nemat and Moghadam, (2010) in Tabriz, Dawit, (2012) around Jimma and Nuraddis and Yared, (2012) in Mekele.

In contrast to this finding, Sissay, (1996) conducted research in Bahir dar and Mezgebu, (1995) in Addis Ababa reported that M. capilaris was the most prevalent species. 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 to an infective stage. After ingestion, the larvae of these parasites can be shed with feces within 5 weeks (Soulsby, 1982). Unlike to D. filaria, the transmission of P. rufescens and M. capillaris is epidemiologically complex event involving host, parasite and intermediate host. Because, P. refescens has indirect life cycle that requires longer time and wet or rainy warmer season to complete their complex life cycle in the presence of suitable intermediate hosts that create favorable condition for sporadic distribution it stands to the least prevalent rank. On the other hand, the low prevalence rate of M. capilaris and P. rufescens in the study area might be contributed to the fact that the study was done at the bigining of Autumn to the end of winter (November-March) which was short and erratic rainy and dry season) which does not favours the development of the snail intermediate hosts (Kahn, 2005).

Conclusion

The result of the present study indicated that lungworm is one of helminthosis of sheep in the study area. Higher prevalence rate of lungworm infection was observed in animals with poor body condition. The prevalence of lungworm infection was higher in those sheep with poor body conditions than in those with medium and good body conditions. The prevalence of infection in adult animals is higher than other age groups and D. flaria is the dominant lungworm species in the study area. It can also be concluded that the infections caused by lungworms are significantly common in the study area and are important health problems of sheep which is speculated to cause heavy economic loss.

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