Lungworms in small ruminants in Burie district, Northwest Ethiopia

*Andargachew Tenaw and Wudu T. Jemberu**

College of Veterinary Medicine and Animal Sciences, University of Gondar, P.O. Box 196, Gondar, Ethiopia

**Corresponding author email: wudutemesgen@gmail.com, Wudu.temesgen@UoG.edu.et*

Abstract

About half of small ruminant mortality and morbidity in Ethiopian highlands is caused by endoparasites including lungworms. The updated epidemiology of these parasites in different parts of the country is important to adopt local control measures. The objectives of this study were to estimate the prevalence of small ruminant lungworms, identify associated risk factors and the species of lungworms involved in small ruminants infection in Burie district, in the northwest Ethiopia. The study involved a cross-sectional coproscopic examination of 384 small ruminants randomly selected from the district from December 2016 to March 2017. An overall prevalence of 23.4% lungworms in small ruminants was recorded. The prevalence was significantly higher in goats (36.3%) than in sheep (15.5 %) (OR=3.1, 95% CI=1.95.0; $p<0.05$), and in young animals (35.6%) than in adults (14.7%) (OR=3.2, 95% CI=2.0-5.2; $p<0.05$). *Dictyocaulus filaria* was relatively the most prevalent species (38.9%) in the study area followed by *Muellerius capillaries* (26.7%), mixed infections (17.8%) and *Protostrongylus rufescens* (16.5%). The study revealed a high prevalence of lungworms in Burie district that needs attention of farmers and animal health service providers. Awareness of farmers about the problem and appropriate herd health management including strategic deworming of small ruminants that make use of risk factors identified in this study is suggested. Due to its high prevalence and severe pathogenicity, *Dictyocaulus filaria*, should be the primary target of control in the study area. Further study on seasonality of the parasite is needed to get more accurate information that helps for designing appropriate control strategy.

Keywords: *Dictyocaulus filaria;* Lungworm*; Muellerius capillaries; Protostrongy lusrufescens;* Risk factor*;* Small ruminants

Introduction

Ethiopia has a large small ruminant population which is estimated at around 30 million sheep and 30 million goats (CSA, 2017). Small ruminants provide 33% of meat consumption, 14% of milk consumption and accounts for 40% of cash income in the central high lands of the country where mixed crop-livestock production system is practiced (Asfaw, 1997). Small ruminants also contribute about half of the domestic wool requirement, 40% of fresh skins and 92% of the value of semi proceeded skin and hide export trade in Ethiopia (Yami and Merkel, 2008). Despite the significant contribution of small ruminants to the livelihood of millions of households and to the national economy, the productivity is much less when compared with the potential of the resource due to various constraints such as prevailing diseases, feed scarcity, and poor animal husbandry.

In the highlands of Ethiopia about half of all small ruminant mortality and morbidity are caused by endoparasites including lungworms (ILRI, 2000). Small ruminant lungworm infections (also called Verminous Bronchitis or Verminous Pneumonia) are caused by *Dictyocaulus filaria, Protostrongylus rufescens*, and *Muellerius capillaries* (Taylor *et al*., 2007; Elsheikh and Khan, 2011). Verminous pneumonia is a chronic and prolonged infection of small ruminants caused by any of these parasitic nematodes, characterized clinically by respiratory distress and pathologically by bronchitis and bronchopneumonia due to infection of the lower respiratory tract, resulting in bronchitis or pneumonia or both (Taylor *et al*., 2007).

Infection with lungworm parasites is prevalent in small ruminants in many parts of Ethiopia (Alemu *et al*., 2006; Regassa *et al*., 2010). The prevalence varies from place to place depending on ecological and management factors. There is no published information about the epidemiology of lungworm in small ruminants in Burie district of Amhara regional state in the Northwest Ethiopia that can be a basis for locally adapted control. This study was done with objectives to estimate the prevalence of lungworms in small ruminants, identify associated risk factors and species of lungworms involved in Burie district of Amhara Regional State in the Northwest Ethiopia.

Materials and methods

Study area and population

The study was conducted in Burie district of Amhara Regional State in the Northwest Ethiopia (Fig. 1). Burie district is located at 10°17' – 10°49' North latitude and 37°00' – 37°11'East longitude. The landscape is flat with some small hills to the South and Southwest. The average elevation is about 2100 meters above sea level with temperate ('Weina Dega') type agro-ecology. Burie district covers an area of about 58,795 hectare. The area experiences an average annual rainfall of 1200 mm and a temperature ranging from18°C-27°C. The study area has a livestock population of 99,537cattle, 34,500 sheep, 12,400 goats, 43,117 poultry, 8,295 donkeys, 647 horses and 536 mules (BWOARD, 2015). The study population was the small ruminant population (sheep and goats considered together) in the district. The small ruminants in the study area were all local breeds and kept under extensive management system.

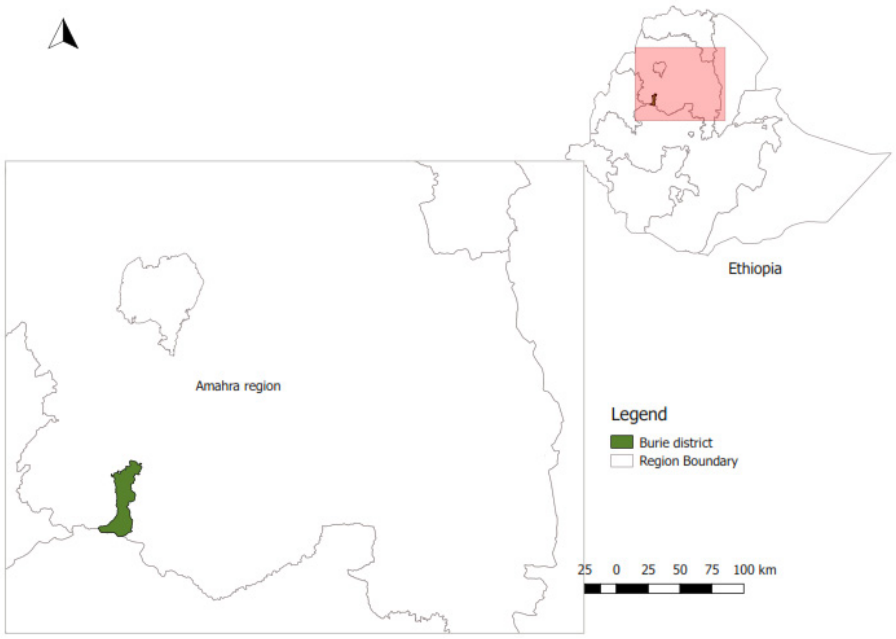

Figure1. Map of Burie district within Amhara regional state

Study design, sampling method and sample size

The study employed a cross sectional study design in which study animals were sampled only once to estimate the prevalence and identify species of lungworms involved in the infection. As it was difficult to employ strictly probability sampling methods due to lack of sampling frame, the sampling was done by haphazardly selecting animals from grazing fields that mimic random sampling.

The desired sample size was calculated according to the formula for prevalence estimate given by (Thrusfield, 2005) as:

$n = [Z\alpha^2 P\ exp\ (1 - P\ exp)]/\ d^2$

Where: n = required sample size; $Z\alpha^2$ standard normal distribution value for the required confidence level,P exp = expected prevalence; and d = desired absolute precision.

A 95% confidence level and 5% desired absolute precision for the estimate were considered for determining the sample size. An expected prevalence of 50%, which enable to take the largest possible sample size for the confidence and precision levels considered, was assumed as there was no previous estimate of the prevalence of disease in the study area. Based on this consideration a sample size of 384 small ruminants was calculated.

Sample and data collection

Fecal sample was collected from each selected animal for coproscopic examination for lungworm detection and species identification from December 2016 to March 2017. The fecal samples were collected directly from the rectum using disposable gloves and placed in sample vials which was properly labeled and transported to the laboratory immediately. Animal factors that could affect the risk of lungworm infection were recorded for each sampled animal. These include species, sex, and age and body condition score categorized as poor, medium, good. The age was determined using dentition (Yami and Merkel, 2008). Later animals having the age of less than or equal to one year were categorized as young and those animals greater than one year were categorized as adults. Body condition scoring was made according to Yami and Merkel, (2008).

Laboratory examination

Fecal samples were processed in the laboratory on the day of collection by using modified Baermann techniques (Charles and Robinson, 2006). Fresh feces were weighed and wrapped with gauze, fixed on to a string in a beaker filled with water. The modified Baermann apparatus was left for 24 hours. The larvae in the feces migrate to the gauze and settle at the bottom of the glass. After siphoning off the supernatant, the sediment was examined under low power microscope.

During identification of the larvae, the presence of *Dictyocaulus filaria* was confirmed by the finding of the first stage larvae (L_1) with an anterior knob and black to brown granular intestinal inclusions. The larvae of *Protostrongylus rufescens* and *Muellerius capillaries* were differentiated by their characteristic features at the tip of their tail. Larva of *Muellerius capillaris* has characteristic tapering, a wavy outline tail and a dorsal spine whereas larva of *Protostrongylus rufescens* has tapering tail and a wavy outline but without dorsal spine (Charles and Robinson, 2006; Elsheikh and Khan, 2011).

Data management and analysis

Data was first entered and managed in to Microsoft excel worksheet and analyzed using statistical package for social science (SPSS) software version 20. The prevalence was summarized by using descriptive statistics and association of lungworm prevalence with different potential risk factors such as age, sex, species and body condition score was analyzed by logistic regression. A p value of 5% was used as cut off for statistical significance.

Results

Overall prevalence of lungworms

Out of a total of 384 small ruminants examined for lungworms, 23.4% (90/384) were found to be positive for one or more species of lungworms. The prevalence was different with respect to different categories of small ruminants as described in the next sections.

Animal level risk factors for lungworm in small ruminants

The analysis of the prevalence of lungworms with respect to different animal level putative risk factors showed that some of these factors were acting as risk factors influencing prevalence of infection. The results of these analyses are shown in Table 1.

Table1. Logistic analysis of prevalence of lungworms in small ruminants with respect to putative risk factors

Putative risk factor	No. of examined animals	No. of positive	Prevalence (%)	OR (95% CI)	P value
Species					
Caprine	146	53	36.3	3.1(1.9-5)	<0.001
Ovine	238	37	15.5	Ref.*	
Sex					
Female	243	58	23.9	1.1(0.7-1.7)	0.794
Male	141	32	22.7	Ref.*	
Age					
Young	160	57	35.6	3.2(2.0-5.2)	<0.001
Adult	244	33	14.7	Ref.*	
Body condition score					
Poor	101	45	44.5	5.3 (2.7- 10.5)	<0.001
Medium	177	31	17.5	1.4 (0.7-2.8)	0.338
Good	106	14	13.2	Ref.*	

*Ref = reference category

Relative frequency of species of lungworms

During the study period *Dictyocaulus filaria* 38.9%(35/90), *Protostrongylus rufescens* 16.7% (15/90), *Muellerius capillaris* 26.7% (24/90) and mixed infections 17.8% (16/90) were species of lungworms identified in small ruminants (Table 2).

Table 2. Relative frequency of the species of lungworms in different categories of small ruminants

Variable	Lungworm species (frequency (percent))					Total positive
	* Df	Pr	Mc	Df,&Mc	Mc&Pr	
Species						
Caprine	18(34.0)	9(17.0)	15(28.3)	7(18.9)	4(7.5)	53
Ovine	17(46.0)	6(16.2)	9(24.3)	2(5.4)	3(8.1)	37
Sex						
Female	25(43.1)	11(19.0)	14(24.1)	3(5.1)	5(8.6)	58
Male	10(31.2)	4(12.5)	10(31.2)	6(18.8)	2(6.2)	32
Age						
Young	26(45.6)	8(14.0)	12(21.1)	7(12.2)	4(7.0)	57
Adult	9(27.3)	7(21.2)	12(36.4)	2(6.1)	3(9.1)	33
Body condition						
Poor	17(37.8)	7(15.6)	15(33.4)	4(8.9)	2(4.4)	45
Medium	10(32.2)	6(19.3)	8(25.8)	4(12.9)	3(9.7)	31
Good	8(57.1)	2(14.3)	1(7.1)	1(7.1)	2(14.3)	14
Total	35(38.9)	15(16.7)	24(26.7)	9(10.0)	7(9.8)	90

Df= Dictyocaulus filaria, Pr= Protostrongylus rufescens and Mc=Muellerius capillaris

Discussion

The study provided a preliminary information about the lungworms of small ruminants in the Burie district of Amhara region, Northwest Ethiopia. The study indicated an overall lungworm prevalence of 23% in small ruminants of the study area. This prevalence, which affects about a quarter of the population, could be a significant burden for the small ruminant production in the district.

High level of prevalence was observed in goats (36.3%) compared to sheep (15.5%) which was a statistically significant (OR=3.1, 95% CI, 1.9-5;$p<0.05$). Previous studies on the difference of prevalence of lungworms between sheep and goat are not consistent. Some reported higher prevalence in goats similar to this study (Alemu *et al*., 2006; Domke *et al*., 2013) while others reported a higher prevalence in sheep (Regassa *et al*., 2010; Borji *et al*., 2012). Controlled experimental study indicated goats are more susceptible to *Dictyocau-*

lus filaria (Sharma, 1994). Despite this experimentally observed susceptibility, goats are naturally browsers in their feeding behavior and their exposure to lungworms is expected to be lower than that of sheep which mostly graze and consequently expected to have lower prevalence of lungworms. This was not observed in the present study probably because goats are forced to graze due to shortage of browsing forages in the study area and that might have increased their exposure to lungworms.

The prevalence of lungworms was also found different in different age groups. Young sheep and goats were found to be more affected by lungworms (OR=3.2, 95% CI, 2-5.2; $p<0.05$). This result agrees with findings of Alemu *et al* (2006) (particularly for *Dictyocaulus flaria*) and Borji *et al* (2012), who reported higher prevalence of lungworms in young small ruminants than in adults. Difference in prevalence with age groups might be associated with the inability of young small ruminants to develop strong acquired immunity as compared to adults in which after primary infection, rapid solid immunity is developed (Urquhart *et al.,* 1996). The observed difference in prevalence with respect to age was noted only in *Dictyocaulus filaria*. For other species development of immunity in adults seems limited (Elsheikha and Khan, 2011).

A significantly higher prevalence of lungworm was observed in poor body conditioned animals as compared to animals with good body condition (OR=5.3, 95% CI, 2.7-10.5; $p<0.05$). This result agrees with, Regassa *et al* (2010) in Dessie and Kombolcha, who reported that poor conditioned animals were more affected by lungworms than animals with medium and good body condition. However,with this cross-sectional design it would be difficult to conclude which is the cause and which is the effect. It can be possible that poor body condition mighthave exposed animals for infection because of weak immunity or it may be the case that the animals have got poor body condition because of the effect of the parasite.

Dictyocaulus filaria was the most prevalent species in the study area followed by *Muellerius capillaris*, and *Protostrongylus rufescens*. Alemu *et al* (2006) had also similarly reported *Dictyocaulus filaria* as the most prevalent lungworm species in small ruminants in Northeastern Ethiopia. This most prevalent species, *Dictyocaulus filaria,* is also unfortunately the most pathogenic of all species and hence it should be the main target in the control of lungworms in small ruminant, for example in case of use of vaccine.

Conclusion

The current study revealed a significant prevalence of lungworm infections that warrants attention of farmers and animal health service providers in the area. Enhancing awareness of farmers about the problem and appropriate herd health management including strategic deworming of small ruminants with special attention to risk factors identified in this study is suggested. If species specific control measures like use of vaccine is envisaged, *Dictyocaulus filaria* which was found to be the dominant species as sole or mixed infection and which also is known for its pathogenicity, should be the primary target of the control. Further study on seasonality of the parasite is needed to get more accurate information that helps for designing appropriate control strategy.

Conflict of interest

The authors declare that there is no conflict of interest.

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