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Lungworm Infection in Ovine: Prevalence and Associated Risk Factors in Debre Birhan Town Ethiopia

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Abstract

Cross-sectional study was conducted from October, 2013 to April, 2014 with the aim of estimating the prevalence of ovine lungworm infection, to assess associated risk factors and identify lungworm species in Debre Birhan town. A total of 371 fecal samples and relevant data were collected. L1 larvae identified using modified Baerman technique and association was analyzed against different risk factors. The overall prevalence recorded was 209(56.3%). The proportion of infection by *Dictyocaulus filaria*, *Muellerius capillaris* and mixed infection were 78.5%, 16.3% and 5.3%, respectively. Protostrongylus rufescens was not recovered. Animals in medium and good body condition (OR= 44.6, 95% CI (8.1, 284.2); OR=282.9, 95% CI (44.9-1779.4)) and de-wormed groups of animals (OR=25.6 95% CI (8.2, 78.6)) had higher odds ratio as protective factors. Though there was minor prevalence difference among age groups and sex, the difference was insignificant (p>0.05). However, Menze breed and exotic cross breed had significant difference in univariable (P<0.05) but insignificant (P>0.05) in multivariable logistic regression analysis. Therefore, breed considered as confounding factor. The study revealed that lungworm is very important and high prevalence of verminous pneumonia was due to two lung worm species. Regular and strategic de-worming has significant impact in controlling parasite infection. The situation dictates' that prompt action has to be implemented by organizing stakeholder in the area particular and in the country in general.

Keywords: Lungworm; Prevalence; Sheep; Risk factors; Debre Birhan; Ethiopia

Introduction

Sheep are among the most important livestock species kept by highlanders' in Ethiopia; used for meat production and immediate cash income next to poultry. Sheep breed around Debre brihan known as Menz breed; they are high wool producers. Farmers in the area have experienced and getting benefit from wool production; consequently, sheep remain a source of wool for the last fifty years to Debre birehan textile factory. Wool production as source of income has immense contribution in livelihood of the community. Considering their economic value government and breeders have attempted to improve the existing local breed using Awasi exotic sheep breed. However, various challenging factors including infectious diseases have severely hampered productivity. Among the diseases incriminated lungworm infection is known to affect wool production through unthriftiness and loss of weight.

A lungworm infection is known as verminous pneumonia. It is a chronic and prolonged infection of sheep, is characterized by respiratory distress, bronchitis and bronchopneumonia; which is caused by nematode parasites under family Dictyocaulidae and Protostrongylidae species include: *Dictyocaulus filaria* (*D. filaria*), Protostrongylus rufescens (*P. rufescens*) and Muellerius capillaris (*M. capillaris*) are affecting sheep and goats [1]. The parasite gradually damages the airways or lung tissue by inducing an inflammatory reaction inside, where it survives and reproduces in the respiratory tissues [2,3]. The pathogenesis of infection is associated with inflammatory process spreads to the surrounding peribronchial tissues and the exudates, causing atelectasis and catarrh or pneumonia [4,5].

Verminous bronchopneumonia due to *Dictyocaulus filaria* is a major parasitosis in sheep, which has considerable economic repercussions all over the world; heavy infection causes unthriftness, cough, loss of weight and respiratory system damage which can lead to death [6,7] followed by Protostrongylus rufescens is the second most pathogenic species, where exudates and development of local lobular pneumonia and exposure for secondary infections are common[6]. *Muellerius capillaris* although appears to be relatively innocuous [8].

Several pilot studies indicate that among the respiratory diseases endoparasites such as *Dictyocaulus filaria* are a major cause of death and morbidity in Ethiopian highlands [9]. Up to half of sheep deaths and morbidity on farms in Ethiopian highlands are caused by pneumonia and endoparasites [10]. Thus, complete data should be available on the epidemiology of the parasite in different parts of the country to implement a sound lungworm control strategy at national level. The objective of this study was therefore to estimate the prevalence, identify etiological species involved and assess possible risk factors that contribute for infection in area.

Materials and Methods

Study area

The study was conducted from October 2013 to April 2014 in and around Debre Birhan town. It is located at a distance of 130 kms from Addis Ababa north east direction; situated at an altitude of 2800 m.a.s.l. The area has a bimodal rain fall consisting of long and short rainy season. The average annual rain fall and temperature of the area are 1728 mm and 15.84˚C, respectively. Livestock population

comprises of 144,638 bovine, 97,815 sheep, and 47,970 goats, 39,038 equine and 96,821 poultry [11].

Study animals

Sheep of both local (Menz) and cross breeds (Hawassi vs Menze/Horro) were kept under traditional management system where animals allowed grazing freely at daytime and stay in the pen at night. Three hundred seventy one sheep were selected randomly for the purpose of study; of these 179 and 192 were males and females, respectively while 93 sheep were cross breed and the rest local. The age was categorized into three groups as <1 year, 1-3 years and >3 years.

Sample size determination

The sample size was determined using a formula Thrusfield M [12]. Therefore, expected prevalence was taken from Netsanet B [13] 73.25% prevalence, 95% confidence interval and 5% absolute precision was used to calculate sample size. Accordingly, the required sample size was 260 sheep. However, to increase the level of precision 371 sheep were sampled. Individual study animals were sampled by lottery system in selected villages and sampling were continued until the sample size attained.

Study methodology

Fecal samples were collected directly from the rectum and put into screw capped universal bottles and transported to the Debre Birhan Agricultural Research Center veterinary laboratory. In the laboratory, fecal examination for the presence of L1 larvae was conducted using Modified Baermann technique [5]. Then the finding and all information during sampling were recorded.

Data analysis

The data generated entered into Microsoft excels spread sheet and summarized using descriptive statistics. Logistic regression analysis (both univariable and multivariable analysis) was employed using STATA 12 statistical software to analyze the association between individual as well as group risk factors against lungworm infection regardless of species parasite identified. The assumed risk factors considered as significant when p-value is less than 0.05.

Results

Prevalence of lungworm infection

The prevalence of lungworm infection was 56.3% and the proportion of 78.5, 16.3, 0 and 5.3, were *D. filaria*, *M. capillaris*, and mixed (*D. filaria+M. capillaris*) infection, respectively as shown in Table 1. There was significantly ($p<0.05$) high prevalence due to *D. filaria* lung worm infection than *M. capillaris*.

Species	Observation	Proportion (%)	(95% CI)	X^2	P-value
D. filaria	164	78.47	72.53 ,83.71	192.2	0.000
M. capillaries	34	16.27	11.68,22.14		
Mixed (DF+MC)	11	5.26	2.79 , 9.47		
Total	209	100 %	-	-	-

Table 1: Proportion of species of lungworm based on L1 larvae morphological identification during study period. DF: *Dictyocaulus filaria*, MC: *Muelleurius capillaris*.

Assumed risk factors analysis

Different potential risk factors were evaluated in relation with the prevalence of lungworm infection regardless of species of parasite identified, with univariable logistic regression analysis in order to assess association between individual risk factors and lungworm infection. Multivariable logistic regression used to find out the confounding factor, where all factors included in the test to see adjusted odds ratio. Hence in both univariable and multivariable logistic analysis, risk factor like body condition score and de-worming showed significant difference ($p<0.05$), whereas, breed found to be non-significant in multivariable logistic regression; which seems a confounding factor. In those significant factors, prevalence found to be higher in poor body condition score and non-de-wormed sheep. There was no significant ($p>0.05$) difference between sex and age group as shown in Tables 2 and 3.

Risk factors		n	Positive(%)	OR (95% CI)	P-value
Age	<1 year	96	47 (48.96)	1	1
	1-3 years	163	99 (60.74)	1.61 (0.96, 2.68)	0.066
	>3 years	112	63 (56.26)	1.34 (0.77, 2.32)	0.294
Sex	Female	192	100 (52.1)	1	1
	Male	179	109 (60.89)	1.43 (0.95, 2.16)	0.088
Breed	Local	278	201 (72.3)	1	1
	Cross	93	8 (8.6)	27.74 (12.83, 56.96)	0.000
BCS	Poor	64	62 (96.88)	1	1
	Medium	245	132 (53.88)	26.54 (6.35, 110.92)	0.000
	Good	62	15 (24.2)	97.13 (921.17, 445.57)	0.000
De-wormed	No	251	196 (78.1)	1	1

	Yes	120	13 (10.83)	29.33 (15.33, 56.11)	0.000

Table 2: Univariable logistic regression analysis of risk factors against lungworm infection.

Risk factors		n	Positive (%)	OR (95% CI)	P-value
Age	< 1 year	96	47 (48.96)	1	1
	1-3 years	163	99 (60.74)	1.7 (0.79, 3.45)	0.19
	3 years	112	63 (56.26)	1.2 (0.52, 2.53)	0.73
Sex	Female	192	100 (52.1)	1	1
	Male	179	109 (60.89)	1.1 (0.60, 2.1)	0.72
Breed	Local	278	201 (72.3)	1	1
	Cross	93	8 (8.6)	3.2 (0.87, 11.56)	0.08
BCS	Poor	64	62 (96.88)	1	1
	Medium	245	132 (53.88)	44.6 (8.05, 248.21)	0.000
	Good	62	15 (24.2)	282.9 (44.98, 1779.36)	0.000
De-wormed	No	251	196 (78.1)	1	1
	Yes	120	13 (10.83)	25.6 (8.18, 78.62)	0.000

Table 3: Multivariable logistic regression analysis of risk factors against lungworm infection.

Following multivariable analysis, backward-stepwise analysis was made step by step after dropping the highest p-value risk factor to see the interaction and confounding factor among risk factors. The result indicates that body condition score and de-worming showed consistently significant against lungworm infection; which means these two risk factors significantly contribute for lung worm infection ($p<0.05$) as shown in Table 4.

Risk factors	n	Positive (%)	OR (95% CI)	P-value
BCS - medium	245	132 (53.88)	47 (8.9,247.9)	0.000
Good	62	15 (24.2)	319 (53.2,1923.1)	0.000
De-wormed group	120	13 (10.83)	52.9 (22.5-123.8)	0.000

Table 4: Stepwise analysis of risk factors following multivariable analysis.

Discussion

Lungworm disease is overlooked health problem in small ruminants, which causes significant economic losses due to unthriftness, loss of body condition and poor skin quality. The current study revealed the importance of lungworm parasites in and around Debre Birhan in both local and cross breed sheep. The prevalence 56.3% in agreement with previous report of 58% by Wondwosen[14] around Bahir-dar but it is relatively lower than 73.35% reported by Netsanet [13]. Studies made in other parts of Ethiopia have also revealed the importance of this disease in small ruminants, 48.2% by Regassa [15] around Dessie and Kombolcha and 50% prevalence of lungworm infection was reported by Teffera [16] in the same area. Alemu [17] also reported prevalence of 53.6% north-east Ethiopia. Similar report revealed by other researchers in different parts of Ethiopia. For instance, Brook [7] in four selective sites of Ethiopia and Sissay [18] in Bahir-Dar reported prevalence of 64.4% and 44%, respectively. However, according to the report by Marshet [19] in Wukro, Ethiopia, Kouidri [20] in Algeria and Melese [21] in Awi, Ethiopia has shown 25.69%, 22% and 25.78% prevalence, respectively. This low prevalence might be due to season of the study and/or the nature of the environment in which the parasite exist.

Proportional difference between parasite species observed, the finding agrees with the previous report of Netsanet [13] around Debre Birhan, Uqubazgi [22] in Hamase Awraja and Denbarga et al. [23] around Bahir-Dar; but it disagree with the report of Sissay [18] in Bahir-Dar and Mezgeb [24] in Addis Ababa who reported *M. capillaris* is the most prevalent than *Dictyocaulus filaria*. *M. capillaris* and *P. rufescens* have indirect life cycles, with land snails and slugs acting as intermediate hosts [3] the presence of intermediate host could contribute for high prevalence of *M. capillaris* in the area [2]. High prevalence of *M. capillaris* also reported in Algeria conducive environment might have contribution for the occurrence [20].

There was no significant variation among age groups. This finding agrees with Mesfin [25] who reported insignificant difference between age groups. But Alemu [17] reported significant difference among age groups. The difference might be cut point for age classification or other unforeseen factor.

The study showed insignificant difference ($P>0.05$) in prevalence between sex group. The finding is not in agreement with the earlier study of Sissay [18] around Bahir-Dar and Sefinew [26] they have reported significant variation between sex. The difference may be due to the fact that improper distribution of sample selection between the

two sexes as observed by Addis et al. [27], where almost all female sheep were sampled.

De-worming and medium and good body condition score showed significant difference in lungworm infection in both univariable and multivariable logistic regression analysis. This is due to the fact that good management accompanied with regular de-worming and proper feeding can reduce the presence of lungworm in the animals, which results in low prevalence. On the other hand, breed showed as insignificant on multivariable logistic regression and following backward step wise analysis rejected ($p>0.05$), the test indicates that breed act as confounding factor whereas, de-worming and body condition score could be indicative to develop model. The odds of animals with medium and good BCS, and de-wormed group (OR=47, 95% CI (8.9, 247.9); OR=319, 95% CI (53.2, 92); OR=52.9, 95% CI (22.5-123.8)), respectively; less likely to be infected with lungworm than poor and non-de-wormed group of animals. The finding was in agreement with the report of Marshet et al. [19], Melese et al. [21] in Ethiopia and Thomson and Orita [28] in North-west Syria. This may be due to, immuno-suppression in sheep with poor body conditions, concurrent infection by other parasites including GIT helminthes and/or malnutrition [1]. Management like nutrition plays a major role for defense mechanism to rid of lungworm infection as well as other diseases Lopez et al. [29] and [2,30]. The infestation by itself might results in progressive emaciation of the animals.

Conclusion and Recommendation

The present study revealed that lungworm infection is an important problem in the area that should be considered when sheep production practiced. Moreover, factor like de-worming and body condition score are important putative factors for sheep production. Two species of lungworms namely: *D. filaria* and *M. capillaris* were identified, which indicates that there is a conducive factors' for both direct and indirect life cycle in the area. Therefore, the following recommendations are forwarded: Strategic ante-helmenthic drug treatment should be implemented and daily feed supplement according to the requirement should be exercised so as to improve body condition and immune-resistance.

Conflict of Interest

There is no conflict of interest

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