International Journal of Advanced Research in Biological Sciences
ISSN: 2348-8069
www.ijarbs.com
(A Peer Reviewed, Referred, Indexed and Open Access Journal)
DOI: 10.22192/ijarbs Coden: IJARQG (USA) Volume 10, Issue12-2023

Research Article

DOI: http://dx.doi.org/10.22192/ijarbs.2023.10.12.003

Prevalence and Risk Factors of Lung Worm Infection in Small Ruminants in Selected Kebeles of Edja Woreda, Gurage Zone, Central Ethiopia

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Abstract

A cross sectional study was carried out from November 2015 to April 2016 in selected areas of EdjaWoreda, Central Ethiopia to estimate the prevalence of lungworm infection and to investigate some of the risk factors associated with small ruminant lungworm infections. The prevalence, species, age, sex and seasonal variation of lungworm infection in small ruminants were studied using coproscopic and postmortem examinations in three kebeles of EdjaWoreda: Desene, Agena and Kokera. Faecal samples were collected from 384 sheep and goats of all age groups (below 6 months, 6 months to 2 years, above 2 years) and both sexes. Modified Baermann technique was used for extraction of L1 larvae from the faeces. Post-mortem examination had also been done on 98 animals in Agena abattoir, EdjaWoreda during the study period. An overall prevalence of 27.34% and 17.95% were detected by faecal and post-mortem examinations, respectively. Significant difference ($p<0.05$) observed among sex, management system and body condition score of animals. Due to its impact on production, emphasis should be given for the control and prevention of lungworm infection in the areas.

Keywords: EdjaWoreda,Lungworm, Prevalence, Small ruminants

1. 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 croplivestock production system is practiced (Asaye and Alemneh, 2015). 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 (Sissay*et al*., 2007).

The prevalence of lungworm infection of small ruminants depends on different factors like, the climate of area, altitude, intermediate hosts and favorable ecological conditions such as rain fall, humidity, temperature, and marshy area for grazing, sheep and goat management system for the development of lungworm species (Kebede*et al*., 2014). Infections of lung worm parasites of small ruminants are ubiquitous and prevalent within many tropical and sub-tropical environments of the world providing nearly perfect conditions for their survival and development. The pathogenic effect of lungworms depends on their location within the respiratory tract, the number of infective larvae ingested and the immune system of the animals (Gebreyohannes*et al*., 2013).

Small ruminant lung worm parasites are extremely common, one of the biggest production bottlenecks, and prominent in many tropical and subtropical locations around the world, where conditions are almost ideal for their survival and growth (Zeryehun and Degefaw, 2017). *Dictyocaulusfilaria*, *Protostrongylusrufescens*, and *Muellerius capillaries* are the culprits behind small ruminant lungworm infections, which are also known as verminous bronchitis or verminous pneumonia (López and Martinson, 2017). Sheep and goats can get a chronic and protracted infection called verminous pneumonia. As a result of an infection in the lower respiratory tract, which can cause either bronchitis or pneumonia or both, it is clinically defined by respiratory discomfort and pathologically by bronchitis and bronchopneumonia (Miller *et al*., 2012; Chakrabort*et al*., 2014).

In the highland areas, infection with lungworm is the common cause of high mortality and morbidity in sheep and goats population (FAO, 2002). Lungworms are commonly found in sheep and they are an important problem for sheep breeders though out the world (Girigin*et al*., 2008). These lungworms particularly *Dictyocaulusfilaria* 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 and goat industry in the areas where it is prevalent Addis *et al*., 2011)..

In temperate region the severity and incidence of the parasite including respiratory helminthes in most livestock farms is now minimized through the seasonal use of anthelminthic and pasture management, the problem still persists in the vast majority of the tropical and sub topical regions. Although environmental conditions are conducive for lungworm infection in the high lands of Ethiopia and lungworm infection is considered as an important disease in this region. Very limited studies have been conducted so far. It is important to assess the type and level of respiratory helminthes in small ruminant livestock in order to be able to determine the significance of parasitic infections and to recommend the most beneficial and economically acceptable control measures. The determination of the associated risk factors associated with parasite occurrence can be used to design an effective control strategy (Ng'ang'a*et al*., 2004; Odoi*et al*., 2007). Therefore, the present study was aimed to estimate the prevalence and associated risk factors of lungworms, and to identify predominant species of lungworm in small ruminants in selected kebeles of EdjaWoreda, Central Ethiopia.

Materials and Methods

2.1. Description of the Study Area

The study was conducted in selected kebeles of Edjaworeda, Central Ethiopia, which is located 197 kms south west of Addis Ababa. It lies in an altitude range of 2000-2200 meter above sea level. The average temperature ranges of the year ranges from 11-24°C. The total annual rainfall is 579 mm-650 mm. The weather condition is hot and humid. The livestock population of the area includes a total of 36,516 cattle; 8,442 shoats; 800 horses; 200 mule; 3,080 donkey; 100 camel; 53,796 poultry.

2.2. Study Animal Population

In this study, sheep and goats were kept under extensive and semi-intensive management systems consisting of different ages, sexes and body conditions and they were selected from 3 selected rural kebeles.

2.3. Sampling method and Study Design

The study employed was 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.

2.4. Sample Size Determination

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

$n = [Z\alpha_2 \text{ P exp } (1 - \text{P exp})]/ d^2$

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.

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.

2.5. Sample Collection

Fecal sample was collected from each selected animal for coproscopic examination for lungworm detection and species identification from December 2015 to March 2016. 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).

The lungs were palpated for presence of metastrongyloid nodules, which are usually grayish white in color. If present, they are trimmed of and worms extracted from the tissue by gentle compressing a small non calcified nodule or part a large nodule between two glass slides, and then teasing the worms away from the tissue with thumb forceps. To collect all worms at the bottom of the beaker added with that of the previous and transferred to glass beakers containing saline. The air passages were opened starting from the trachea down to the small bronchi with fine blunt pointed scissors to detect parasites; visible worms were then removed from the opened lungs and transferred to glass beakers containing saline. The worms collected were identified and recorded (ILCA, 1991; Fraser, 1991).

2.6. Data Analysis

The results were analyzed in relation to sex, species of animal, age, management, origin, body condition, species of lungworms and season. The data obtained were coded for the above factors and entered in to excel. Then Chi-square was used to compare the prevalence of small ruminants' lungworm infection for possible significance difference. The differences were regarded as significant if p-value is < 0.05 using SPSS.

3. Results

3.1. Coproscopic Examination

Out of the total 384 collected faecal samples, 27.34% (105/384) were positive. Respective to species of lungworms among positivesamples prevalence were 34.3% (36/105), 22.9% (24/105), 20% (21/105) and 22.9% (24/105) for *Dictyocaulus filaria*, *Muellerius capillaris*, *Protostrongylus rufescens* and mixed infections respectively.

Table 1: Proportions of single and mixed lung worm species of small ruminants

Lung worm species	Number of observation	Relative percentage
D. filaria	36	34.3%
M.capillaries	24	22.9%
P.rufescens	21	20%
Mixed infection	24	22.9%
Total	**105**	**100**

There was significant difference on the prevalence of lungworm infection of small ruminants in different kebeles of Edjaworeda (X^2 = 7.84; P<0.05). The highest prevalence was recorded in Kokera (35.82%) followed byAgena (24.44%) while the lowest in Desene (20.87%).There was no significant difference(X^2= 0.09; p>0.05) on the prevalence of lungworm infection on the basis of speciesof small ruminants. However, the prevalence was slightly higher in caprine (28.33%)as compared to that of ovine (26.89%).

There was significant difference (X^2 = 4.79; p<0.05) on the prevalence of lungworms between sexes of small ruminants. The higher prevalence was in found in females (31.4%) than in males (21.3%). There was significant difference (X^2 = 16.67; p<0.05) on the prevalence of lungworms among the three age groups of small ruminants. The highest prevalence was in age groups of less than 6 months of age (42.7%) and the lowest was in age groups of greater than 2 years of age (15.8%).

There was significant difference (X^2 = 18.42; p<0.05) on body condition score of the animals. The highest prevalence was noticed in poor (39.58%) and the lowest prevalence in good (10.39%) body condition score of the small ruminants. Similarly, there was significant difference (X^2 = 13.93; p<0.05) of lungworm infection under different management system. The higher prevalence was found in extensive management system (31.56%) while the lower prevalence in semi-intensive management system (10.39%).

Table 2: The prevalence of lungworm infectionon the basis of various factors

Factor	Examined	Positive	Prevalence	Chi square (X^2)	p-value
Species					
Ovine	264	71	26.89%	0.086	0.77
Caprine	120	34	28.33%		
Sex					
Male	155	33	21.3%	4.79	0.028
Female	229	72	31.4%		
Age					
<6 months	96	41	42.7%	16.689	0.00023
6-24 months	231	55	23.8%		
>2 years	57	9	15.79%		

Body condition					
Young	96	38	39.58%	18.42	0.0001
Medium	211	59	27.96%		
Good	77	8	10.39%		
Management					
Extensive	307	97	31.59%	13.934	0.00018
Semi-intensive	77	8	10.39%		
Kebeles					
Desene	115	24	20.87%	7.844	0.019
Kokera	134	48	35.82%		
Agena	135	33	24.44%		

3.2. Postmortem Examination

Out of the total slaughtered animals, 17.9% (21/117) were positive for lung worm infection. The prevalence of infection was higher in sheep (19.7%) than in goats (14.6%). However, there was no statistical significant difference between sheep and goats (X^2=0.47; p > 0.05).

4. Discussions

The study provided preliminary information about the lungworms of small ruminants in the selected kebeles of EdjaWoreda, Central Ethiopia. The study indicated an overall lungworm prevalence of 27.34% 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 study area.

The current study revealed that the presence of three nematode species parasitizing the respiratory tract of small ruminants with an overall infection rate of 27.34%. These parasites had also been reported in sheep from different climatic areas of the world and from different regions of Ethiopia (Thomson *et al*., 1988). A similarly high prevalence (50%) was recorded in previous study conducted at Kombolcha and Dessie by Teffera 1993. Studies made in other parts of Ethiopia had also underlined the relative importance of this disease in small ruminants. For instance, Wondewosen (1992) had reported 58% in Assela, Assaye and Alemneh (2015) reported 22.7% in and around Bahir Dar and Muluken (2009) had reported a prevalence of 18.16% in Bahir Dar.

High level of prevalence was observed in goats (36.3%) compared to sheep (15.5%) which was a statistically significant (X^2 = 0.086; 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).

The sex wise prevalence in this study revealed that prevalence of lungworm infection was numerically higher in female (31.4%) than males (21.3%), and was statistically significant difference (p<0.05). This result disagrees with the report of previous study by Teffera (1993) in Dessie and Kombolcha, and by Netsanet (1992) in and around Debre-Birhan. However, it agrees with other reports done elsewhere (Sisay, 1996; Alemu *et* al., 2006; Mekonen *et al.*, 2011). He numerically higher prevalence in female in the present study might be due to decrease in immunity during pregnancy, parturition and lactation stage in case of female animals. But male are free from those stress which are resistant to the parasite as compared to females as well as they might kept for fattening in order to be sold and for breeding which was supplied with enough and palatable feeds which improves its resistance to disease, lungworm infection (Alemu*et al*., 2006).

In the current study, higher cases of lungworm were found in young animals (<6 months old) than in adults (6-24 months and > 2 years old)which was a statistically significant (X^2 = 16.69; p<0.05. This finding was in concomitant with Asaye and Alemneh (2015) who documented higher prevalence of lung worm infection in young animals than adults in and around Bahir Dar City;Amhara Regional State, Ethiopia; Negash*et al*. (2018) who reported 53.3% in young and 36.3% in adult in GedebAsasa district West Arsi Zone, Ethiopia. However, this finding was not in line with findings reported by Kadi*et al*. (2017) who found 47.80% in young and 51.50% in adult in Asela, Arsi Zone, Southeast, Ethiopia, and Regassa*et al*. (2010) who reported 22.5% in young and 77.5%% in adult in Dessie and Kombolcha districts, northeastern Ethiopia. Because an animal's vulnerability to lungworm infection declines with age, young animals are more likely to have the infection than young adults. This indicates that due to previous exposure to lungworm infection, mature animals have developed immunity. Because they are exposed less frequently than older animals, young animals are much more vulnerable (Abdeta and Degefa,2020). Furthermore, the difference could be explained by the proportion of young and adult animals sampled in each study; since the study was conducted outdoors, more adult animals were sampled than young animals.

Body condition score was the other factors with significant association of the parasites (p<0.05). The parasites were more common in poor body condition than in medium or good body conditions (p <0.05). This finding agrees with the reports of Thomson and Orita (1988) in North West Syria. The possible explanation for this observation could be due poor body conditions of small ruminants appear to be immuno-suppressed which might be due to the effects of other parasites or malnutrition. Moreover, poorly nourished sheep and goats appear to be less competent in getting rid of lungworm infection (Radostits*et al*., 2007; Kimberling, 1998; Paulos, 2000).Concerning age, all age groups were found to be affected by the infection of lungworms without any significant differences (p>0.05).

With regard to the management system, the prevalence of lungworm infection was numerically higher in extensive (31.56%) than in the semi intensive (10.39%) management system. This is in agreement with the results of Eyob (2008) in Asella, who reported numerically higher prevalence of lungworm infection in extensive (34.4%) than in semi intensive (30.9%) management system. Similarly Dawit and Abd (2012) reported that the prevalence of lungworm infection was higher in extensive (28%) than semi intensive (26.6%) management system in Jimma town. This implies that animals kept under extensive management system have higher chance of getting infection than those under semi-intensive management system for the very reason that animals under extensive management systems repeatedly graze on the pasture, which increase the chance of getting infection, but in case of semi intensive management system animals have low chance of pasture contamination hence leading to low exposure to lungworm infection (Soulsby, 1982). Additionally, animals under semi-intensive management practice were supplied with well enough, palatable and nutritious feeds which increase their immunity against lungworm infections unlike those kept under extensively managed animals which do not get enough feeds which compromise their immunity and favors the growth of the parasites that allows the animals for continuous larvae exposure (Soulsby, 1986).

5. Conclusion and Recommendations

In this study, lungworm infection in small ruminants was highly prevalent. The findings confirm the most important respiratory nematode of small ruminants in the study area was lungworm. Moreover, this study indicated sheep and goats with non-de- worming history, poor body condition and examined at November were at higher risk of acquiring lungworm infection than those sheep and goats with deworming history, good body conditions and examined in January. The species of lungworms identified in the study area were *D.filaria*, *M.capillaries* and *P. rufescensas* both single and mixed infection. Hence, due to its impact on sheep and goats,

health and productivity, emphasis should be given for the control and prevention of lungworm infection.

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Subject: Veterinary Sciences

Quick Response Code

DOI:10.22192/ijarbs.2023.10.12.003

How to cite this article:
Yeshiwas Seifu Fanda. (2023). Prevalence and Risk Factors of Lung Worm Infection in Small Ruminants in Selected Kebeles of Edja Woreda, Gurage Zone, Central Ethiopia. Int. J. Adv. Res. Biol. Sci. 10(12): 21-29.
DOI: http://dx.doi.org/10.22192/ijarbs.2023.10.12.003