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Prevalence of Ovine and Caprine Lungworm Infection in and Around Kombolcha

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Abstract: This study was conducted from November 2013 to April 2014 in and around Kombolcha. The aims of this study were to determine the prevalence of ovine and caprine lungworm infection, to assess some of the risk factors associated with sheep and goats lungworm infection and to identify species of parasites involved by coprological examination. Examinations were conducted in 384 small ruminants (246 sheep and 138 goats) and an overall prevalence of 38.80% was observed. *Muellerius capillaris* was found to be the highest in prevalence (16.15%) followed by *Dictyocaulus filaria* (9.89%); while *Protostrongylus rufescens* was found the lowest prevalence (3.90%) among the different species identified. There was no significant difference ($\chi^2 = 0.114$, $p > 0.05$) in the prevalence of lungworms between species of animals. The highest prevalence was observed in sheep (39.43%) as compared to the prevalence in goats (37.68%). The infection rate between male and female animals also showed non significant difference ($\chi^2 = 0.018$, $p > 0.05$) with prevalence rate of 38.4% and 39.0%, respectively. Regarding to age, the highest prevalence (40.32%) was observed in adult animals while the lowest prevalence (35.88%) was observed in young animals. The prevalence between the age groups was not statistically significant ($\chi^2 = 0.716$, $p > 0.05$). Different prevalence rates were observed among poor (58.62%), medium (42.19%) and good (27.12%) body conditioned animals and the difference was statistically significant ($\chi^2 = 12.728$, $p < 0.05$). In terms of management system, the highest prevalence (42.20%) was observed in animals kept under extensive management system and the lowest prevalence (19.29%) was seen in those kept under semi-intensive management system. The prevalence between the management systems was also statistically significant ($\chi^2 = 10.723$, $p < 0.05$). Due to its impact on production, emphasis should be given for control and prevention of lungworm infection in the study area.

Key words: *Dictyocaulus filarial* Kombolcha · Lungworm · *Muellerius capillaris* · Prevalence · *Protostrongylus rufescens* · Small ruminants

INTRODUCTION

Ethiopian's livestock population is often said to be the largest in Africa and 10th in the world. Excluding the Afar and Somali regions there were approximately 45.57 million cattle, 26.1 million sheep, 21.7 million goats, 2.1 million horses and mules, 5.6 million donkeys, 1 million camels. For the Afar and Somali regions, estimated numbers vary greatly between conventional and aerial censuses, but total less than 15 percent of the non nomadic regions. Ethiopia has great potential for increased livestock population, both for local use and for export. However, expansion was constrained by inadequate nutrition, diseases, lack of support services and inadequate information on how to improve animal breeding, marketing and processing [1]. Small ruminants are especially important in the more extreme climates of the world. Their small size, high productive capacity and rapid growth rate make small ruminants a more flexible short term form of investment than cattle [2]. Small ruminants in Africa are noted for their ability to convert low cost feed into high value products, namely: meat, milk, fiber, manure and hides [3].

Small ruminants are important contributors to food production in Ethiopia, providing 33% of meat consumption and 14% of milk consumption. In the central highlands of Ethiopia where mixed crop livestock production system is practiced, small ruminants account

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for 40% of cash income and 19% of the household meat consumption [4]. Sheep and goats 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 - proceed skin and hide export trade. It is estimated that 1, 078, 000 sheep and 1, 128, 000 goats are used in Ethiopia for domestic consumption annually. Ethiopia can export 700, 000 sheep and 2 million goats annually and at the same time supply, 1, 078, 000 sheep and 1, 128, 000 goats for the domestic market [4].

Small ruminants are important components of the Ethiopian farming system, their contribution to food production, rural income and export revenue are far below than their expected potential. This is because small ruminant production is constrained by the compound effects of disease, poor feeding and poor management [5]. These constraints include parasitic diseases like helminthosis which is caused by different helminth parasites. Parasites are widely prevalent, they can be less obvious than signs of other livestock diseases. Partly for this reason, infection with helminthes parasites are among the most established that high prevalence rates of the infection with less obvious signs are associated with poor production [6].

In Ethiopia, farm animals are kept on pasture throughout the year and climatic conditions are favorable for the development and survival of infective stages or vectors. Helminthe parasites are therefore a major cause of economic loss. Major factors that contribute to the multiplication and sustainability of parasites are climate, ecology and systems of animal production [7]. The production loss due to helminthosis is also associated with direct consequences of clinical and subclinical infections resulting in low productivity due to stunted growth, reduced weight gain, poor feed utilization or loss due to mortality or indirect loss associated with cost of treatment and control measures [8]. The incidence of parasitic diseases, including respiratory helminthes varies greatly from place to place depending on the relative importance of the factors. Verminous pneumonia due to various lung worm species has been reported to exist in sheep and goats particularly in the high land areas of Ethiopia [9].

Verminous pneumonia is infection of the lower respiratory tract resulting in bronchitis or pneumonia or both, by any of several parasitic nematodes including *Dictyocaulus viviparous* in cattle, *Dictyocaulus arnfieldi in* horses and donkeys*, Dictyocaulus filaria*, *Muellerius capillaris* and *Protostrongylus rufescens* in sheep and goats [10]. Dictyocaulidae and certain Metastrongylidae are known to exist in East Africa including Ethiopia. The three respiratory parasites that cause a significant damage in small ruminant production are Dictyocaulus filaria, Protostrongylus rufescens and Muellerius capillarius. 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 industry in the areas where it is prevalent [11].

Studies in the central highland of Ethiopia have shown that lungworm parasites are a major problem in small ruminants and cause disease, increase mortality and production losses [5]. Prevention and control of these parasites are, therefore, critical to enhance the economic benefit from these species of livestock [9]. There is 53.6% report about the prevalence of lungworm infection in sheep and goats in northeastern Ethiopia as previously done by Sefinew *et al*. [12]. However, there is no current report that indicates the prevalence and occurrence of lungworm infection in ovine and caprine species. Therefore, the objectives of this paper were to determine the prevalence of ovine and caprine lungworm infection and identify species of parasites involved based on faecal examination and to assess some of the risk factors associated with sheep and goats lungworm infection in and around Kombolcha.

MATERIALS AND METHODS

Study Area: Kombolcha is located at a distance of about 375km from Addis Ababa; at11° 4’ 37’’ North and 39° 44’ 42’’ East. The altitude of the area ranges from 1500-1840 meters above sea level. The topography of the zone generally is marked by the presence of numerous mountains, plateaus, hilly and sloppy area with three topographic category including 14% of high altitude, 34% mid-altitude and 52% of low altitude. The study area experiences a mean annual rainfall of 750-900mm. the recorded temperature in the area ranges from 23.9°C during short rainfall and 11.7°C during long rainfall; the relative humidity of the region varies from 23.9% to 79% [1]. The livestock population of the area comprises of 100381 cattle, 12975 sheep, 31043 goats, 2540 horses, 634 mules, 7758 donkeys, 1865 camels and 119347 poultry [13].

Study Population: The study populations were local breed sheep and goats (246 sheep and 138 goats) in and around Kombolcha. Small ruminants (Sheep and goats) in the study area were kept under extensive traditional management system.

Study Design and Sample Size Determination: The study was a cross sectional study design to determine the prevalence of ovine and caprine lungworm infection. The study animals were selected using simple random sampling method. The desired sample size was calculated using the standard formula described by Thrusfield [14]. Since there was a previous work done on this area by Regassa *et al*. [15] with a prevalence of 36.9%, so that the sample size was calculated by using 36.9% prevalence using the formula given by Thrusfield [14]. 358 small ruminants were examined but to increase precision, the number of examinee animals were reached to 384(246 sheep and 138 goats).

Sample Collection and Faecal Examination Technique: 384 faecal samples were examined from randomly selected small ruminants coming to the Kombolcha Town veterinary clinic and sometimes from the field. Faecal samples were collected directly from the rectum of selected sheep and goats using plastic gloves, put in screw capped glass bottles and transported to the Kombolcha regional veterinary laboratory. The Baermann apparatus was left for 24 hours (overnight).. After discarding the supernatant, the sediment was examined under low power microscope according to Charles [16].

During collecting faecal samples date of sample collection, species, breed, sex, age, body condition scores and management systems of the animals (sheep and goats) were properly recorded on the prepared sample and result recording sheet. Sampled animals were categorized into two age groups as group one = less than or equal to 6 months and group two = greater than 6 months of age based on owner information and from incisor teeth as described by Gatenby [17]. Body conditions were also determined by observation and through palpation according to Alemu and Merkel [18]. The larvae of *M. capillaris* have undulating tip at their tail and a dorsal spine, the larval tail of *P. rufescens* has undulating tip but lacks the dorsal spine as indicated in Hendrix and Robinson [19].

Methods of Data Management and Analysis: The data were first entered and managed into Microsoft excel work sheet and analyzed using Statistical Package for Social Science (SPSS) soft ware version 16. The significance difference between the prevalence of lungworm was determined using descriptive statistics. Chi- square test (χ^2) and $P < 0.05$ is considered as statistically significant.

RESULTS

Coproscopic Examination: A total of 384 small ruminants (246 sheep and 138 goats) were examined by modified Baerman technique from Kombolcha regional veterinary laboratory. The identification results showed 38.80% (149/384) an overall prevalence of lungworm infection. Identification of the lung worm species were done based on the morphology of the larvae by viewing the faecal samples with a microscope. *M. capillaris* was found to be the highest prevalence (16.15%) followed by *D. filaria* (9.89%) and mixed infections (8.85%); while *P. rufescens* was found the lowest prevalence (3.90%) among the different species identified. The identification result showed that there was no significant difference ($p > 0.05$) among the species of lungworms in small ruminants.

Prevalence of Lungworm Infection Based on Species: The specific prevalence was found to be 39.43% (97of 246) and 37.68% (52 of 138) in sheep and goats, respectively. In this study the prevalence of lungworm infection was found to be higher in sheep than in goats but this difference was not statistically significant ($\chi^2 = 0.114$, $p>0.05$) (Table 1).

Prevalence of Lungworm Infection Based on Sex: The investigation result revealed higher prevalence of lungworm infection in female animals 39.0% (86 of 220) than male animals 38.4% (63 of 164). However, this difference was not statistically significant ($\chi^2 = 0.018$, $p>0.05$) (Table 2).

Prevalence of Lungworm Infection Based on Age: Comparison of the overall prevalence of lungworm infections in the different age groups showed relatively higher prevalence in age group of > 6 months (40.32%) and lower prevalence was observed in animals ≤ 6 months (35.88%). There was no significant difference ($\chi^2 = 0.716$, $p>0.05$) between these proportion of lungworm isolates in the different age groups of animals examined during the study (Table 3).

Prevalence of Different Species of Lungworms in Different Age Groups of Small Ruminants: The species of lungworms with different prevalence rates were identified in different age groups of sampled animals. The prevalence of *D. filaria* were highest in age groups ≤ 6 months, followed by *M. capillaris* (12.98%) and (10.69%)

Table 1: Prevalence of lungworm infection in Sheep and Goats

Species	No of animals examined	Positive (%)
Ovine	246	97(39.43)
Caprine	138	52(37.68)
Total	384	149(38.80)

(χ^2-value = 0.114, P-value = > 0.05)

Table 2: Prevalence of lungworm infection on the basis of sex

Sex	No of animals examined	Positive (%)
Male	164	63(38.4)
Female	220	86(39.0)
Total	384	149(38.80)

(χ^2-value = 0.018, p-value = > 0.05)

Table 3: Prevalence of lungworm infection based on age groups

Age	No animals examined	Positive (%)
≤ 6 months	131	47(35.88)
> 6 months	253	102(40.32)
Total	384	149(38.80)

(χ^2-value = 0.716, p-value = > 0.05)

Table 4: Prevalence of different species of lungworms in different age groups of small ruminants

		Lungworm Species Identified			
Age	No animals examined	*D.filaria*	*M.capillris*	*P.rufescens*	Mixed infection
≤ 6 months	131	17(12.98%)	14(10.69%)	7(5.34%)	9(6.87%)
> 6 months	253	21(8.3%)	48(18.97%)	8(3.16%)	25(9.88%)
Total	384	38(9.89%)	62(16.15%)	15(3.90%)	34(8.85%)

(χ^2 -value = 7.790, p-value = > 0.05)

Table 5: Prevalence of lungworm infection based on body condition scores

BCS	No of animals examined	Positive (%)
Good	118	32(27.12)
Medium	237	100(42.19)
Poor	29	17(58.62)
Total	384	149(38.80)

(χ^2-value = 12.728, p-value = < 0.05)

Table 6: Prevalence of lungworm infection under different management systems

Management systems	No of animals examined	Positive (%)
Extensive	327	138(42.20)
Semi-intensive	57	11(19.29)
Total	384	149(38.80)

(χ^2 -value = 10.723, p-value = < 0.05)

respectively, While the prevalence of *M. capillaris* was highest in age groups > 6 months (18.97%), followed by mixed infection (mostly *D. filaria* and *M. capillaries*) (9.88%) (Table 4). There was no a statistically significant difference (χ^2 = 7.790, P>0.05) among different lung worm species identified from different age groups of small ruminants.

Prevalence of Lungworm Infection Based on Body Condition Scores: The prevalence of lungworm infections in the different body conditions showed relatively the highest prevalence in animals with poor body condition (58.62%), high in animals having medium body condition (42.12%) and relatively low in animals with good body condition (27.12%). The infection in animals with different body conditions was statistically significant (χ^2 = 12.728, p<0.05) (Table 5).

Prevalence of Lungworm Infection under Different Management Systems: In the study the prevalence of lung worm was found to be higher in the extensive management system (42.20%) when compared to the semi-intensive management system (19.29%). This difference was statistically significant (χ^2 = 10.723, p<0.05) (Table 6).

DISCUSSION

In the present study the overall prevalence of lungworms of small ruminants was found to be 38.8% based on Coproscopic examination. The specific prevalence of lungworms was 39.43% (97 of 246) and 37.68% (52 of 138) in sheep and goats, respectively. This level of prevalence was in agreement with previous studies conducted by Tigist [20] in North Gondar Zones (39.6%), Mekonnen *et al*. [21] in Gondar Town (33.83%) and Regassa *et al*. [15] in Dessie and Kombolcha districts, northeastern Ethiopia (36.9%). However, the finding was lower than prevalence's reported by Sefinew *et al*. [12] and Alemu *et al*. [9] in North east Ethiopia, Yitagele *et al*. [5] in North Gondar Zone, Amhara National Regional State, Ethiopia and Netsanet [22] in Debre Birhan who reported prevalence of 53.6%, 46.0% and 73.25%, respectively. The present report was higher than Mengestom [23] in Tigray (Atsbi), Muluken [24] in and around Bahir Dar, Tewodros *et al*. [4] in and around Jimma Town, South West Ethiopia and Dawit and Abdu [25] in Jimma Town who reported prevalence of 21.5%, 18.16%, 25.24% and 26.7%, respectively.

The differences in the prevalence of lungworms of small ruminants in the above studies might be associated with differences in the methods followed in the detection of larvae of lungworms, the difference in the study areas which favors the survival of the larvae of the lungworm or the snail intermediate host in case of *M. capillaris* and *P. rufescens* and the different sample sizes used by the researchers. It might also be associated with nutritional status, level of immunity, management practice of the animal, rainfall, humidity and temperature differences of examination on the respective study area.

The prevalence of lungworm infection was relatively higher in sheep (39.43%) than goats (37.68%) without any significant difference ($p > 0.05$). This result concedes with Regassa *et al*. [15] who reported that sheep were more susceptible to lungworm infection than goats with prevalence of (40.4%) and (31.7%), respectively. However, it contradicts with the earlier study of Alemu *et al*. [9] reported that goats were more susceptible to lungworm infection. According to Wilsmore [3] goats appear to be more susceptible to helminthes than sheep as they appear to develop less immunity. Sheep predominantly graze; pick up more parasites so, have higher acquired resistance than goats which mostly consume browse. Goats with their browsing behavior consume uncontaminated matter with parasite larvae, so being less exposed to infective larvae, therefore have lower acquired resistance than sheep. But in this particular study, the sample may be taken from goats which have been consumed contaminated matter with parasite larvae and have gotten more acquired resistance or from sheep which have been consumed uncontaminated matter with parasite larvae and consequently with lower acquired resistance. Disparity might also be associated with the number of samples examined; in the current study, large numbers of sheep were examined which might cause the higher prevalence.

In the current study relatively higher level of prevalence was observed in female (39.0%) animals compared to male animals (38.4%). This result agrees with the study conducted by Yitagele *et al*. [5] who reported 48.0% and 43.2% prevalence in female and male animals respectively. However, it does not concede with study conducted by Tewodros *et al*. [4] who reported approximately equal prevalence of lungworm infection was observed in male (25.09%) and the female (25.44%) animals. This difference in prevalence's between female and male animals could be due to the fact that resistance to infection decreases at the time of parturition and during early lactation. This per parturient relaxation of resistance result in the females inability to expel adult worms which cause higher level of larvae detection [26]. The way that males and females treated in terms of nutrition may also contribute for such differences. Males are kept for fattening to be sold later, except some which are kept for breeding and receive more attention by small ruminant producers. Crop leftovers and remnants after human consumption, for instance, are provided primarily for males ([9].

With regard to age, generally, the highest prevalence (40.32%) was observed in animals of > 6 months old while the lowest prevalence (35.88%) was observed in animals of age groups ≤ 6 months with no statistically significant difference ($p>0.05$) between the prevalences of the different age groups. This finding is however, do not agree with Gebreyohannes *et al*. [27] in Mekedella woreda who reported higher prevalence (33.7%) in young and lowest prevalence (24.4%) in adult animals. This difference in prevalence of lungworm infection might be associated with methods in which researchers' grouped animals according to age as well as methods of determining age. The probable reason attributed for such difference could be the stage of the parasites during faecal sampling. For example, in the prepatent and pospatent phases it is imposible to detect the parasite larvae by faecal examination [28]. Thus, according to Fraser [28] this low prevalence might be due to the prepatent phase of the parasites in animals < 6 months of age.

In the study, of the identified species of lungworms of small ruminants, *Muellerius* capillaris was found to be the highest prevalence (16.15%) of the total samples examined in the study area. This result agrees with the previous report of Sissay [29] in and around Bahir Dar (39.3%) but it disagrees with the report of Mekonnen *et al*. [21] in Gonar town who reported *Dictyocaulus filaria* was the most prevalent (15.86%). This could be associated with the difference in the life cycles. The reason for this high prevalence of Mullerius compared with Dictyocaulus could be partly attributable to its wide range of intermediate host and the ability of larvae to over winter in the mulluscs. Additional factors which play a part in ensuring the endemicity of the worm are, first, the ability of L1 to survive for months in faecal pellets and secondly, the persistence of the L3 in the intermediate host for the life time of the mollusks [30]. On the other hand, the longevity and development of free larvae of Dictyocaulus are known to be dependent on humidity and temperature condition.

Dry seasons are characterized by high mortality of larvae in the pasture [31], where dry and more of hot summer was the climatic condition of the study area. Specifically The prevalence of *D. filaria* is higher in animals ≤ 6 months of age (12.98%) and that of *M. capillaris* (18.97%) in animals > 6 months old. *D. filaria* infection decreases with increasing age of the animal. This might be associated with the apparent developed acquired immunity of the host so that adult animals have the lowest infection and the lowest prevalence [23]. However, the prevalence of *M. capillaris* and *P. rufescens* is higher in adult animals than younger ones. This might be due to the long period of potency and the apparent inability of the final host to develop acquired immunity, so that adult sheep and goats have the heaviest infection and the highest prevalence [32].

The prevalence of lungworm infection in this study was higher in poor body conditioned (58.62%) than those of medium body conditioned (42.19%) and good body conditioned (27.12%) animals. This agrees the prevalence studied by Kassa and Abdu [33] around Bahir Dar, who reported prevalence of 24%, 19.8% and 19.6% in poor, medium and good body conditioned animals respectively. Animals of good body condition are more able to resist lungworm infection than others. The reason for this could be due to the fact that poorly nourished animals appear to be less competent in getting ride off infection although it is unusual for well fed animals *to* succumb to the disease provided that the right environmental conditions are made available [34].

In the study, the prevalence rate of lungworm infection in extensive management system was (42.20%) which is higher than semi-intensive (19.29%). The results of the present study was in line with Mekonnen *et al*. [21] who reported prevalence of 34.40% and 30.90% in extensive and semi-intensive management systems respectively. But it disagrees with the result of Dawit and Abdu [25] who reported low prevalence (26.0%) in extensive management system than in semi-intensive (28.6%) management systems. The reason for high prevalence of lungworm infection in extensive farming system could be due to the fact that the degree of pasture contamination in the extensive system of production increases the degree of exposure that could result in high prevalence [35]. Furthermore, the reason for this could be management practice such as provision of ample nutrition increases the resistance of the host under the semi-intensive system, contrary to this mal-nutrition which reduces the host-parasite response and favors the fecundity of the parasites that allows the animals for continuous larvae exposure under extensive system [36].

CONCLUSION AND RECOMMENDATIONS

A cross sectional study on lungworm infection in sheep and goats in and around Kombolcha revealed an overall prevalence of 38.80%.. The respiratory nematodes; D. *filaria, M. capillaris* and *P. rufescens* were the species of lungworms identified affecting small ruminants in the study area. *M. capillaris* had the highest prevalence (18.97%) in animals of greater than 6 months of age followed by mixed infection (9.88%); while in those animals less than or equal to 6 months of age *D. filaria* contributed the highest prevalence (12.98%).

In the study area there is high prevalence of lungworm infection; therefore, animal owners should aware for the proper control and prevention of this disease by application of strategic deworming. Sheep and goats should be kept under semi-intensive and intensive management systems than the traditional extensive production system in order to minimize occurrence of lungworm infection. The use of dry feed, in racks designed to prevent contamination with droppings and provision of uncontaminated water should be practiced by all owners to minimize the acquisition of parasites. The use of wet areas for pastures should be avoided as they are favorable habitats for the development of the larvae of *Dictyocaulus filaria* and the intermediate hosts of *Muellerius capillaris* and *Protostrongylus rufescens*. In rainy weather conditions, at the morning and evening

the intermediate hosts (snails and slugs) become active. Therefore, there should be prohibition of sheep and goats to graze in rainy weather conditions, early in the morning and evening.

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