Study on Prevalence of Lungworm Infection and Associated Risk Factors of Cattle and Sheep Slaughtered at Gondar Elfora Abattoir, North West Ethiopia

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Abstract

Background: Lungworms are parasitic nematode round worms that infest the lungs of ruminants. The infections have wide distribution in the world including Ethiopia. Epidemiological distribution of lung worm depends more on pasture contamination by carrier animals. Diagnosis is based on clinical signs, postmortem findings and laboratory testing (detecting lungworm larvae in faces). The aims of this study were to determine the current prevalence, identifying the species and assess the possible risk factors of lung worm infection in cattle and sheep at Gondar Elfora abattoir.

Result: Out of 500 animals (240 cattle and 260 sheep) both coprological and postmortem examination were conducted. The overall occurrence of lungworm infection in both cattle and sheep were 3.75% and 7.31% respectively. The prevalence of lung worm in cattle and sheep in ante mortem inspection with respiratory problem was 8.00% and 19.51% respectively. Coprological prevalence of infection: in young and adult age groups of cattle was 7.04% and 2.37% and in sheep 6.8% and 7.9% respectively. With regard to body condition (poor, medium and good) having the prevalence of 13.64%, 3.3% and 0.00% in cattle and 16.2%, 5.35% and 7.33% in sheep respectively. It has significant difference with body condition score of cattle and sheep ($p < 0.05$). The occurrence of identified lung worm in cattle was *Dictyocaulus viviparus* (3.75%); in sheep *Dictyocaulus filaria* (52.63%) higher than *Muellerius capillaries* (36.84%) followed by *Protostrongylus rufescens* (10.53%). Over all prevalence in cattle and sheep were 1.67% and 8.08% respectively. Finding with respect to young and adult age groups of cattle was 4.23%, 0.59%, and in sheep 7.48% and 8.85%. The identified lung worm species in sheep, mixed infection (42.85%) was higher than *Dictyocaulus filarial* (28.57%) followed by *Muellerius capillaries* (19.05%) and *Protostrongylus rufescens* (9.52%).

Conclusions: Generally lungworm infection has a great effect on animal health and production. It needs emphasis to prevent and control to overcome this problem.

Background

Ethiopia possesses the largest livestock population, being the first in Africa and tenth in the world, with an estimated population of about approximately 57.8 million cattle, 28 million sheep, 28.6 million goats, 1.23 million camels and 60.5 million poultry [1].

Meat inspection as part of the veterinary public health activities acts in abattoir to ensures the delivery of hygienically processed meat for public consumption while preventing the transmission of infectious and zoonotic diseases to humans [2]. As meat is the main source of protein to population, it should be clean and free from diseases of particularly importance to the public health as tuberculosis, hydatidosis, cysticercosis and fasciolosis among other abnormalities [3].

Lungworm parasites that infect domestic ruminants are roundworms (nematode) that belongs to the phylum Nematelminths and grouped under Metastrongyloidea and Trichostrongyloidea super family. Of these round worms, *Dictyocaulus* and *Protostrongylus* are causes of lungworm infection in ruminants [4].

Epidemiological distribution of lung worm depends more on pasture contamination by carrier animals. Signs of lungworm infection can range in many cases from moderate coughing with slightly increased respiratory rates to severe persistent coughing and respiratory distress and even failure. Reduced weight gains, reduced milk yields, and weight loss accompany many infections in cattle and sheep, patent subclinical infections can occur in all species [5].

Diagnosis is based on clinical signs, postmortem findings and laboratory testing (detecting lungworm larvae in faeces). Although control measures to prevent infestation of the animals are difficult due to the continuous exposure of the animals to contaminated pasture, there are three strategies for controlling lungworm such as management, vaccination and suppression with regular deworming. Anthelmintic drugs are used to combat nematode infections but resistance of the worms to the drugs is increasing and limits the efficacy of this approach. So far the prevalence of cattle and sheep lung worm and its associated risk factors were not well recorded or published at Gondar Elfora abattoir. The aims of this study were, to determine the current prevalence of lung worms in cattle and sheep at Gondar Elfora abattoir, to identifying the species lung worm in cattle and sheep that found at the study area and to assess the possible risk factors of lung worm infection in cattle and sheep in the study area.

Result

Coprological Examination

Prevalence of lungworm infection in cattle and sheep

In this study, a total of 500 cattle and sheep (240 cattle and 260 sheep) fecal sample were collected from Gondar Elfora abattoir after the animal come for the purpose of slaughtering. The overall lungworm prevalence of cattle and sheep recorded was 3.75% and 7.31% respectively. Out of the total 500 animals examined for the prevalence of lungworm infection in cattle, with age group (young and adult) was 7.04%, and 2.37%, and body conditions (poor, medium and good) was 13.64%, 3.3% and 0% were recorded respectively. Whereas, in sheep, with regard to age group, young 6.8% and 7.9% and with body conditions, poor 16.2%, medium 5.35% and good 8.33% positive for lung worm infection. In this study age has a significance variation ($p < 0.005$) in cattle. The study reveal a statistically significant ($p < 0.05$) variation in the prevalence of lung worm infection was observed among the two age groups of cattle. But in body condition categories of cattle and in age group and breed of sheep, there is not statistically significance ($P > 0.05$) (Table 3).

Table 3
Prevalence of cattle and sheep lungworm in different age groups and body conditions

Species	Risk factors		Total no. Examined	Total no. of Positive (%)	Total Prevalence(%)	χ ²	P-value
Bovine	Age	Young	71	5(7.04%)	9(3.75%)	3.03	0.08
		Adult	169	4(2.37%)			
	Body condition	Poor	22	3(13.64%)	7.46	0.02	
		Medium	182	6(3.3%)			
		Good	36	0(0%)			
Ovine	Age	Young	147	10(6.8%)	19(7.31%)	0.13	0.72
		Adult	113	9(7.9%)			
	Body condition	Poor	37	6(16.2%)	5.45	0.06	
		Medium	187	10(5.35%)			
		Good	36	3(8.33%)			

Respiratory sign wise prevalence of bovine and ovine lung worm infection

A total of 500 cattle and sheep (240 from cattle and 260 from sheep) were examined, in animals that are coming to Gondar Elfora abattoir for the purpose of slaughtering, visual examination were applied for the presence of clinical respiratory sign. The overall respiratory wise prevalence of infection in cattle and sheep (3.75%, 7.31%) were recorded respectively. In cattle, the higher prevalence was found in animals that have clinically respiratory sign than apparently healthy with the prevalence of 8% and 2.63% respectively. Sheep that have clinically respiratory sign has high prevalent than apparently healthy animals (19.51% and 1.96%) respectively.(Table 4).

Table 4
Respiratory sign wise prevalence of cattle and sheep lung worm infection

Species	Respiratory signs	No.of animals examined	No. of positive	Prevalence (%)	χ^2	p-value
Bovine	Absent	190	5	5(2.63)	0.19	0.67
	Present	50	4	4(8.00%)		
	Total	240	9	9(3.75%)		
Ovine	Absent	178	3	3(1.69%)	6.13	0.03
	Present	82	16	16(19.51%)		
	Total	260	19	19(7.31%)		

The overall prevalence of lung worm species in sheep

Under coprological examination, the overall prevalence of lungworm species in sheep recorded in this study were *D. filarial*, *M. capillaries* and *P. rufescens* with prevalence of 52.63%, 36.84% and 10.53% of positive animals respectively in decreasing order. (Table 5).

Table 5
Prevalence of sheep lung worm species

Lung worm spp.	No. of positive	Prevalence (%)	χ^2	P-value
<i>D.filaria</i>	10	52.63	69.8	0.026
<i>M. capillaries</i>	7	36.84		
<i>P. Rufescens</i>	2	10.53		
Total	19	100.00		
Spp. = Species				

Abattoir Survey (Post mortem Examination)

Out of a total of 240 cattle examined both coprologically and postmortem examination over the study period, 3.75 % (9/240) and 4(1.67%) respectively were positive for *D. viviparous* lung worm species infection.

Prevalence of cattle and sheep lungworm infection

A total of 500 cattle and sheep (240 cattle and 260 sheep) were examined. The overall prevalence of lung worm infection in cattle with respect age group were young 4.23% than adult 0.59%. Concerning the body

condition score the finding were recorded in poor, followed by medium and good body condition (4.55%, 1.65% and 0.00%) respectively. In ovine species the age wise prevalence was higher in adult than young with the percentage of (7.48% and 8.85%) respectively. Regarding to body condition, higher good body condition score followed by poor and medium (13.89%, 8.11% and 6.95%) respectively. (Tables6).

Table 6
Prevalence of cattle and sheep lungworm in different age groups and body conditions

Spp.	Risk factors		Total no. Examined	Total no. of Positive (%)	Total Prevalence(%)	χ ²	P-value
Bovine	Age	Young	71	3(4.23%)	4(1.67%)	4.028	0.045
		Adult	169	1(0.59)			
	Body condition	Poor	21	1(4.55%)	1.72	0.42	
		Medium	179	3(1.65%)			
		Good	36	0(0.00%)			
Ovine	Age	Young	147	11(7.48%)	21(8.08%)	0.16	0.69
		Adult	113	10(8.85%)			
	Body condition	Poor	37	3(8.11%)	1.96	0.38	
		Medium	187	13(6.95%)			
		Good	36	5(13.89%)			

Relative percentage of adult lung worm species extracted from sheep

Under postmortem examination, the overall prevalence of lungworm species in sheep recorded in this study were *D. filarial*, *M. capillaries* and *P. rufescens* with prevalence of 28.57%, 19.05% and 9.53% respectively in decreasing order. Mixed infection was higher with the observed prevalence of 42.85% of positive animals (Table 7).

Table 7
Relative percentage of adult lung worm recovered from sheep

Lung worm spp.	No. of positive	Prevalence (%)	χ^2	P-value
<i>D. filaria</i>	6	28.57	72.05	0.025
<i>M. capillaries</i>	4	19.05		
<i>P. Rufescens</i>	2	9.53		
Mix + 1ed infections	9	42.85		
Total	21	100.00		

Discussion

Lung worm infection (verminous bronchitis, verminous pneumonia) is a chronic and prolonged infection caused by nematodes that affects the lungs of cattle and sheep. This disease results in substantial economic losses due to the reduction of growth rate, morbidity and mortality as the disease exposes animals to secondary bacterial infection [6].

In the current study, the overall prevalence of lungworm infection, under coprological examination were 7.31% in sheep and 3.75% in cattle. The Overall prevalence of cattle lungworm infection (3.75%) found in this study was very low as compared to the previous studies conducted by [7] in Kembibit District with the prevalence of 10%, but this study was high as compared to the previous published researches reported by [8] in Gondar town with the prevalence of 3.1%.

The Overall prevalence of sheep lungworm infection (7.31%) found by coprological examination was very low as compared to the previous studies conducted by [7] in Kembibit District with the prevalence of 42%, [9] in North Gondar Zone with the prevalence of 39.8% and [10] in Gondar town with the prevalence of 33.83%. And also this finding was not high as compared to the previous published research. The possible reason in low prevalence in this study for both cattle and sheep could be attributed to the development of open-air clinic, careful management and increasing awareness of farmers to deworm their animal against parasitic infections in the study area apart from geographical variations.

The overall prevalence of lungworm in cattle, under postmortem examination (1.67%) found in this study was high as compared to the previous studies conducted by [8] with the prevalence of (0%) and (1.5%) reported by [11] in Addis Ababa abattoir. In sheep, under postmortem examination, the overall prevalence of lungworm infection (8.08%) was low as compared to the previous studies conducted by [10] in Gondar town from different restaurant with the prevalence of 20.74%. The possible reason for such prevalence variation in both cattle and sheep might be due animals purchased for slaughtered purpose comes from different market places and agro ecological zones which favors the survival of the larvae of the lung worms, the methods used for the detection of the larvae, differences in humidity and

temperature, season of examination, treatment condition and veterinary services altitude, probability of deworming, rainfall difference in study type, that might be affect the abundance of lungworm [12]; [13].

The prevalence of lung worm both in cattle and sheep was compared between animals of different age groups, under coprological examination. Though the age group result was not statistically significant different prevalent rates in different age groups was found ($p > 0.05$). Under coprological examination, the prevalence of lung worm infection with regarding to age group, higher in young cattle (7.04%) than adult (2.37%). This result agrees with the previous reports conducted by [7] in Kembibit District, < 2 year higher than 2–4 year and > 4 year with the prevalence of 61.5%, 20.5% and 37.5% respectively, [8] in Gondar town, 1–5 years and > 5 years with the prevalence of 5.6% and 0% respectively.

The current result in sheep was higher in adult (7.9%) than young (6.8%), this result agrees with the previous result conducted in Kembibit District > 3 years higher than 1–3 years with the prevalence of 37.5% and 20.5% respectively, [14] in and around jimma, 6–24 months of age higher than sheep in the age of < 6 months with the prevalence of 27.0% and 23.0% respectively, [15] in Dangle District adult(1-3years) higher than young(< 1 year) with the prevalence of 16.4% and 15.6% respectively, [16] in south Wollo zone > 3 years higher than 1-3 years and < 1 year with the prevalence of 69.01%, 41.67% and 19.84% respectively, [9] in North Gondar zone > 4 years higher than 6 months – 4 years followed by ≤ 6 months with the prevalence of 31.5%, 30.8% and 11.6% respectively, [10] in Gondar Town > 4 years higher followed by 6 months – 2 years and 2-4 years with the prevalence of 37.75%, 32.93% and 28.57% respectively.

But this result disagree with the previous reports conducted by [7] in Kembibit District with the prevalence of < 1 year higher than followed by > 3 years and 1–3 years with the prevalence of 61.5%, 37.5% and 20.5% respectively, [14] in and around jimma 6-24 months higher than > 24 months with the prevalence of 27.0% and 18.3% respectively and < 6 months higher than > 24 months of age with the prevalence of 23.0% and 18.3% respectively, [9] North Gondar Zone 6 months – 2 years (30.8%) higher than 2–4 years (26.5%). The prevalence difference among the different age groups of the cattle and sheep might be associated to the development of acquired immunity in adult animals from previous exposure which makes them to have the lowest infection, lowest prevalence and this might be related to the variation for disease exposure among study groups in the different study areas, which is also supported by [17]

An attempt was made to see the influence of body condition on the overall prevalence of lung worm infection in cattle was found statistically significant ($p < 0.05$) but in sheep not statistically significant ($p > 0.05$). Under coprological examination, the prevalence of cattle lung worm infection in poor body condition (13.64%) was found to high when compared with animals of medium (3.31%) and good body conditions (0.00%). This result agrees with the previous reports conducted by [7] in Kembibit district poor (20%), medium (10.34%) and good (4.35%), [14] in and around Jimma poor (29.9%), medium (22.7%) and good (13.6%) [18] in and around jimma poor (48%), medium (32%) good (19%). This difference might be due to poor body conditioned animals are easily exposed to infectious and non-infectious diseases than medium and good body conditioned animals. Because of these and other related reasons their immune system becomes suppressed and less competent in getting ride- off lungworm infection, increased the

degree of pasture contamination in extensive system of management which increases the degree of exposure. Furthermore, the response of lungworm infection varies widely depending on the nutritional status, age of host, and the number of larvae ingested. And also the possible reason could be due to immune suppression in poor body condition concurrent infection by other parasites, means of examination and GIT helminthes simultaneously as reported by [19].

In the current study, in cattle, the only lung worm species, *D. viviparous* was detected, in both under coprological and postmortem examination. But in sheep, under coprological examination, *D. filarial* was the most prevalent (52.63%) of the total positive samples examined followed by *Muellerius capillaries* (36.84%) and *Protostrongylus refuses* (10.53%). This result agrees with the previous report conducted by [20] in selected area of Dale District, with the prevalence of (26%, 18% and 10%), [21] in and around Hawassa, with the prevalence of (6.77%, 3.71% and 4.69%), [14] in and around jimma were (59.7%, 25.4% and 0%), [22] with the prevalence of (35.42%, 7.55% and 0%) respectively. But this result disagrees with the previous report conducted by [7] in kembibit district, *Protostrongylus rufescens* higher than *Muellerius capillaries*, having the prevalence of (9.4% and 6.5%) respectively. But under post mortem examination, mixed infection was higher followed by *Dictyocaulus filarial*, *Muellerius capillaries* and *Protostrongylus rufescens* with prevalence of 42.85%, 28.57%, 19.05% and 9.53% respectively. This result agrees with the previous studies conducted by [20] in Yirgalem Municipal abattoir with the prevalence of (26.6%, 18%, 7.1% and 5.3%) respectively. But this result disagrees with the previous report conducted by [16] in Dessie municipal abattoir, *M. capillaries* was higher infection followed by mixed infection with two or three species, *D. filarial*, and *P. rufescens* with the prevalence of (23.48%, 8.18%, 8.18% and 5.87%) respectively.

The variation might be in the life cycle of the lungworm species for instance *D. filarial* has a direct life cycle and takes less time to reach the infective stage and after ingestion larvae can appear in feces within 5 week [23]. Whereas *P. rufescens* and *M. capillaries* 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 *P. Rufescens* whose intermediate host range is restricted to certain species of snail has lower prevalence of the rest through its geographic rage is just wide like [19].

Conclusions

The result of the current study revealed that, lungworm is one of the major parasites of cattle and sheep at Gondar Elfora abattoir. The current finding also indicates that high prevalence of lungworm was recorded in cattle and sheep with the presence of respiratory problem. The prevalence of lung worm infection was higher in those cattle with poor body conditions than in those with medium and good body conditions. *Dictyocaulus viviparous* in cattle and *Dictyocaulus filarial* in sheep was the dominate lung worm species in the study area. It can also be concluded that the infection caused by lungworms was common in the study area and it was an important health problems of cattle and sheep to cause serious economic loss. Therefore, appropriate control and prevention measure should implement and the

continuous existence of lungworm in the study area should alarm different stakeholders to look and improve methods to control and prevent the disease.

Methods

Study Design

A cross sectional study design was conducted from November 2019 up to April 2020 to estimate the prevalence and risk factors of lung worm infection at Gondar Elfora abattoir, Amhara regional state, North West Ethiopia. A total of 500 cattle and sheep were examined both coprological and post mortem of which (240 cattle and 260 sheep) were examined. The body condition of studied sheep was determined by using the 5 point scale (1 = very thin to 5 = very fat), based on the criteria set by [25]. In this study the body condition score were categorized in to poor, medium and good. The score from 0 to 1 categorized as poor, 2 to 3 categorized as medium whereas the body condition score from 4 to 5 grouped as good body condition. Whereas Body condition score determination for cattle were Poor (Emaciated, Very thin, Thin), Medium (Borderline, Moderate), Good (Good, Very good, Fat, Overweight), based on the criteria set by [26].

Sample Size Determination and Sampling Method

The sampling method applied in this study was simple random sampling, from those animals coming to Gondar Elfora abattoir from in and around Gondar town so as to determine the prevalence of lungworm infection and associated risk factors of cattle and sheep. Since the prevalence of lung worm infection of cattle and sheep at Gondar Elfora abattoir was limited study in the earlier (before). So to calculate the total sample size, the following parameters were used: 95% Level of Confidence (LC), 5% desired level of precision, 3.1% prevalence of lung worm in cattle in Gondar district and 20.74% prevalence of lung worm in sheep in different restaurant of Gondar was used in the expected prevalence. The sample size was determined based on the formula given by [27].

Study Methodology

Ante mortem examination

Anti-mortem examination of the study animals were done before slaughtered, to assess body condition, disease condition, breed, age, sex and clinical examination of the animals. However all the slaughtered animals were male and almost local breed. For cattle the age grouping was based on dentition, for those which have not erupted permanent incisor teeth, are classified as young, and while those with pair or more permanent incisor teeth erupted were classified as adult. Body condition score determination for cattle were poor, medium and good, based on the criteria set by [26].

Determination of age every sampled cattle was determined based on dentition. For sheep the age grouping was based on dentition, those which have not erupted permanent incisor teeth, were classified as young, while those with one pair or more permanent incisor teeth were classified as adults [28] and whereas body condition scoring of each animal was determined based on the criteria set by [25], Using

the 5 point scale (1 = very thin to 5 = very fat). Animals were visually assessed followed by palpation of the area around the lumbar vertebrae between the back of the ribs and the front of the pelvic bones. After randomly selecting animals, visual examination was applied for the presence of clinical signs that include coughing, rapid breathing, nasal discharge and ill thrift and/or reluctant to move, stand with head down and neck extended were assessed although these are not restricted to only for the presence of lung worm.

Faecal/Coprological examination

Faecal samples were collected directly from the rectum of all selected animals using disposable gloves and stored in universal bottles. During sample collection the date, age, body condition and species was properly recorded. Each bottle or glove containing the sample was properly labeled corresponding to the animal identity. The samples were shipped to college of Veterinary Medicine, University of Gondar and were processed in the parasitological laboratory. In the laboratory, following conventional method of modified Bearmann technique for detection of lung worm larvae, a minimum of 10gm of fresh faces was weighed from each sample for the extraction of L1 larvae for bovine and ovine respectively. Each sample was enclosed with double layered gauze fixed on to a string rod and submersed in a clean glass beaker filled with luck water. The whole apparatus was left in place for 24 hours during which time larvae actively move out of faces and ultimately collect by gravitation in the glass beaker and then after discarding the supernatant, the sediment was examined under stereo microscope by putting it on to the Petri dish and the sediment was examined under the lower power of the microscope. If larvae were present under stereomicroscope, small amount of specimen transferred to low power magnification of the compound microscope for morphological identification of lungworm larvae [29]; [30].

Post mortem examination

The lungs were palpated for presence of metastrongyloid nodules, which were usually grayish white in color. If present, using scissors cut down the trachea extending along the major bronchi into the lungs. Check for the presence of lung worms. They was 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 removed from the opened lungs and transferred to glass beakers containing saline. The collected worms were identified and recorded. Microscopic examination and identification of lungworms was performed using the features. *D. filaria* was occurred in the trachea, bronchi and bronchioles of sheep. This lungworm is slender, thread like nematodes, white in color with knob on head. *Muellerius capillaries* were occurred in the lung (bronchi, bronchioles and alveoli). This lungworm is small hair like with bent tail. *Protostrongylus rufescens* adults were found within the bronchioles, grey reddish in color and have wavy tail. The collected Parasites were examined using a compound microscope [31].

Data Management and Analysis

All collected data were entered and coded to Microsoft office excel Software program and analyzed using SPSS version 20. Descriptive statistics was used to summarize the data. Chi-square statistics were used to test the association between variables. Statically significant at $P < 0.05$ was taken to determine whether there were significant differences between the parameters.

Declarations

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Authors' contributions

Baye wodaje and Samrawit melkamu have conceived study, collected samples and processed in laboratory, analyzed data and wrote the draft manuscript. Both have read and approved the final manuscript.

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Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests.

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Tables

Tables 1 and 2 are not available with this version.