European Journal of Experimental Biology
ISSN: 2248-9215

Open Access Research Article

Prevalence of Bovine Lungworm in and Around Gondar and Debark Town, Gondar, Ethiopia

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ABSTRACT

A cross sectional study was conducted from November 2017 up to April 2018 in and around Gondar town with the objectives of determining the prevalence and assessing the possible risk factors of lungworm infection in cattle. Fecal samples were collected from a total of 323 animal with the age of <2, 2-6 and >6 years old which were included in the study randomly. After collection, the samples were transported to the laboratory and examined for the presence of lungworm by baermann techniques. The overall prevalence of lungworm infection in the study was 2.8% (9 of 323) were found to be positive for lungworm. Age, gender, breed, body condition, origin and management systems were taken as risk factors for the occurrence of lungworm infection. There was statistically significant difference (P<0.05) in the prevalence of lungworm infection to different age of animals, breed or management system. However, the difference was not statistically significant (P>0.05) between lungworm infection and gender, body condition or origin. Prevalence of 3% and 2.6% were observed in female and male respectively. Highest prevalence was observed in extensive management system (7.1%) as compared with semi-intensive (2.1%) and intensive (0%) management systems. In extensive (OR=2.228, CI=1.125-4.416) had higher odds of infection prevalence than intensive. Prevalence of 5.6%, 1.8% and 0 were observed in animals of <2 years of age, between 2-6 years and animals of above 6 years respectively. Animals less than two years (OR=1.811, 95% CI=1.061-3.092) had higher odds of infection prevalence than age group >6 years. In assessing the prevalence between breeds, it was found to be higher in cross breeds (4.8%) than local breeds (1.1%). In conclusion, prevalence of bovine lungworm in the study area is more associated with young stock in extensive and semi-intensive management systems. Therefore, integrated efforts towards good animal husbandry and animal health care, grazing management and regular strategic deworming of the whole herd with anthelimenthics rather than treating infested individuals are recommended.

Keywords: Baermann technique; Cattle; Coproscopic; *D. viviparous*; Lungworm; Prevalence

Received:	26-June-2023	**Manuscript No:**	EJEBAU-23-16757
Editor assigned:	29-June-2023	**PreQC No:**	EJEBAU-23-16757 (PQ)
Reviewed:	13-July-2023	**QC No:**	EJEBAU-23-16757
Revised:	25-August-2023	**Manuscript No:**	EJEBAU-23-16757 (R)
Published:	01-September-2023	**DOI**	10.36648/2248-9215.13.5.41

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Citation: Wodaje A, Birhan Z (2023) Prevalence of Bovine Lungworm in and Around Gondar and Debark Town, Gondar, Ethiopia. Eur Exp Bio. 13:41.

Abbreviations: AOR: Adjusted Odds Ratio; BCS: Body Condition Score; CI: Confidence Interval; CSA: Center of Statistical Agency; L1: Larvae Stage One; MLs: Macrocyclic Lactones; NADIS: National Animal Disease Information Service; SPSS: Statistical Package for the Social Sciences; X^2: *Chi-square*

INTRODUCTION

Ethiopia has the largest livestock inventories in Africa, including more than 38,749,320 cattle, 18,075,580 sheep, 14, 858,650 goats, 456,910 camels, 5,765,170 equines and 30,868,540 chickens with livestock ownership currently contributing to the livelihoods of an estimated 80% of the rural population. However, the economic gains from these animals remain insignificant when compared to their huge number. This low productivity is a reflection of disease, limited genetic potential and husbandry standard. The morbidity of animals generally estimated to be in the range of 8% to 10% of national cattle herd per annum and 14% to 16% and 11% to 13% of national sheep and goat flock respectively with average live weight loss of 70 kg for cattle and 6 kg for sheep and goat.

Parasitic nematode infections are a burden for animal husbandry. In general, the infections do not cause a high mortality but morbidity can be high with concomitant loss of production. *Dictyocaulus* is a genus of very harmful parasitic roundworms that infects cattle, sheep, goats, horses and many other domestic and wild mammals. It is found worldwide, particularly in regions with temperate or cold climate.

Lungworm infection in cattle is caused by the nematode parasite *Dictyocaulus viviparus*, the only lungworm found in cattle and is characterized by bronchitis and pneumonia. While the documentation on bovine lungworm is vast in the temperate, it is very sporadic and limited in the tropics.

D. viviparous is a trichostrongylid nematode whose adult stages inhabit the main stem bronchi and tracheae of cattle. During coughing the eggs are swallowed by the host. Hatching of eggs takes place in air passages or the digestive tract. Larvae are passed in the faeces. Infections with this parasite may occur in all ages of cattle, but the disease is mainly seen in calves during their first season at grass and the challenge may be sufficient to cause clinical disease in cattle which have not developed adequate immunity. Outbreaks in adult dairy cattle nearly always occur because either cattle have not been exposed to sufficient parasitic challenge in earlier life to provide adequate immunity or immunity has been lost as a result of a lack of reinfestation.

Although lungworm disease most commonly occurs from July to November, outbreaks have been recorded in every month of the year. The parasite causes a severe pulmonary disease in cattle commonly called as parasitic bronchitis, dictyocaulosis, or husk. Affected herds usually indicate high disease prevalence and mortality depending on the degree of pasture contamination.

Clinical signs in naturally affected animals are: Loss of appetite, reduced growth, increase respiratory rate and coughing. *D. viviparous* has been implicated as a parasite that causes high mortality in cattle. Healthy animals get infection through intake of contaminated grass. Chronic inflammatory changes in infected lungs were in the form of ciliated epithelial cells loss, peribronchiolitis, eosinophilic bronchiolitis, and atelectasis.

Diagnosis is based on clinical signs, postmortem findings and laboratory testing (detecting lungworm larvae in feces. Although control measures to prevent infestation of the animals are difficult due to the continuous exposure of the animals to contaminated pasture, there are two strategies for controlling lungworm; vaccination and suppression with regular deworming. Anti-helminthic drugs are used to combat nematode infections but resistance of the worms to the drugs is increasing and limits the efficacy of this approach. Several drugs are available for the treatment of *D. viviparus* infection, including Macrocyclic Lactones (MLs), Levamisole and Benzimidazols. So far the prevalence of bovine lungworm and associated risk factors had been studied since 2011 in the study area. But there are very limited studies have been conducted so far so, hence, it would be essential to have up to date information on the importance of the prevalence of bovine lungworm in these areas to provide an option to develop and implement control strategies in the study area. Therefore, the study was designed with objectives of:

- To estimate the present prevalence of bovine lungworm in and around Gondar town and Debark.
- To assess the possible risk factors associated with this problem.

MATERIALS AND METHODS

Study Area

The study was conducted in and around Gondar town and Debark **Figure 1,** which is found in central Gondar zone and North Gondar of Amhara regional state. The town is located at 728 km from Addis Ababa at an elevation of 2220 meters above sea level (m.a.s.l). Rain fall of the area varies from 880 mm to 1172 mm and an average annual temperature of 19.7°C. The area is characterized by two seasons, the wet season from June to September and dry season from October to May. The livestock population of the area comprises of 2,407,544 cattle, 31,456 horses, 272,655 donkeys, 13,612 mules, 979,800 sheeps, 1,382,655 goats, 3,286,769 poultry and 223,690 beehives.

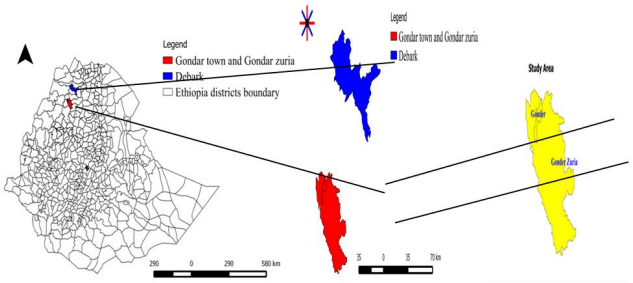

Figure 1: Map of Ethiopia with study area.

Study Population

The study animals were include randomly selected samples from cattle in and around Gondar town and Debark and gender, age, breeds, origins and body condition of animals were recorded during sample collection. These animals were from three kinds of management systems intensive, semi-intensive and extensive type of management. All cattle in the area were considered in the study.

Study Design and Sampling Method

A cross-sectional study type were conducted from November 2020 to April 2022 to determine the prevalence of lungworm infection in bovine and to identify associated risk factors like breed, gender, age, body condition, management system and origins. Simple random sampling was implemented to select the study animal in the area.

Sample Size Determination

The sample sizes of the present study were determined by using the single population proportion formula given by Thrusfeld, et al.

$N=(1.96)^2P_{exp}\ (1-P_{exp})/d^2$

Where,

N=Total number of sample size.

P_{exp}=Expected prevalence.

d=Absolute precision.

Since there had been previous work reporting the prevalence of bovine lungworm in the study area, expected prevalence of 3.1% and 5% absolute precision at a 95% Confidence Interval (CI). Therefore, $N=1.96^2(0.031(1-0.031)/(0.05)^2=46$. The sample size calculated was 46. However, more samples were added to improve the precision, a total of 323 samples were considered for carpological examination due to easily accessible for sample and laboratory facility.

Study Methodology

Sample collection: Faecal samples were collected directly from the rectum of all selected animals using disposable gloves **Figure 2** and were stored in universal bottles or by the glove itself after it was turned the inside out until reached to the laboratory as soon as possible and each sampled was process by modified Baermann technique. During sample collection age, gender, breed, body condition, management system and origin were properly record. Each bottle or glove containing the sample were properly labelled corresponding to the animal identity.

Figure 2: Faecal sample collection directly from the rectum.

Laboratory technique: Following conventional method of Baermann technique for detection of lungworm larvae, 25 gm of fresh faces were weighed from each sample for the extraction of larvae stage one (L1). Each sample was enclosed with double layered guaze fixed on to a string rod and submersed in a clean glass beaker filled with Luck water. The whole apparatus were 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 were examined under stereo microscope by putting it on to the petridis as depicted.

Data Management and Analysis

The data collected from the study animals during coprological examinations were recorded on specially designed formats. The data were then coded and entered to computer Microsoft excel spread sheet and all the data analysis was done by Statistical Package for Social Science (SPSS) software version 20. The prevalence was computed as the number of animals affected by the lungworms divided by the total number of animals tested multiplied by 100%. The association of the prevalence of lungworm infection with potential risk factors such as: Age, gender, breed, body condition, management system and origin were analyzed by using Pearson *chi-square* (X^2) test for possible significant difference. The differences were regarded as significant if ($p<0.05$) and strength of association were analyzed by logistic regression.

RESULTS

Coprological Examination

A total of 323 bovines were examined for investigation of the prevalence of lungworm in and around Gonder town and Debark from November 2017 to April 2018. Out of this a total of 9 samples (2.8%) tested positive for lungworm as shown in **Table 1** and from my result microscopic appearance of lungworm (L1) were as shown in **Figure 3**.

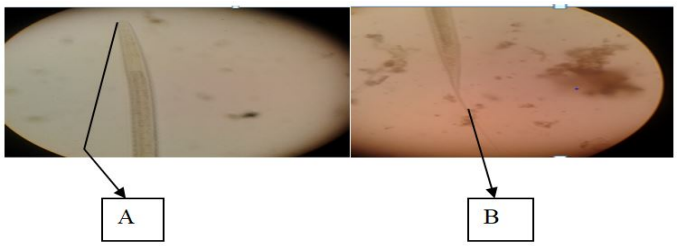

Figure 3: Head part (A) and tail part; (B) Of *D. viviparous* (L1) under compound microscope (40X).

Analysis of the potential risk factor for the occurrence of bovine lungworm has revealed that there were a significant association (P<0.05) with age, breed and management of the bovine. However, there is no significant association (P>0.05) with gender, body condition and origin of the animal and bovine lungworm (**Table 1**).

Association of Risk Factors with Lungworms

Accordingly, analysis of the risk factors with lungworm **Table 1**, has revealed that; there is a significant association (P<0.05) between age, breed and management system and lungworm infestation. So we use logistic regression to know the strength of association between lungworm and risk factor.

Table 1: Prevalence of lungworm based on different risk factors.

Risk factor		No. of animals examined	No. of positive with prevalence (%)	X^2	P-value
Gender	Female	167	5 (3%)	0.088	0.957
	Male	156	4 (2.6%)		
Age	<2 years	126	7 (5.6%)	6.417	0.04
	2-6 years	112	2 (1.8%)		
	> 6 years	85	0		
Breed	Local	178	2 (1.1%)	4.047	0.044
	Cross	145	7 (4.8%)		
Body conditions	Poor	93	5 (5.4%)	3.45	0.178
	Medium	140	3 (2.1%)		
	Good	90	1 (1.1%)		
Management system	Extensive	84	6 (7.1%)	8.84	0.012
	Semi-intensive	146	3 (2.1%)		
	Intensive	93	0		
Origin	Tanka	28	0	8.543	0.664
	Blagic	38	2 (5.3%)		
	Tseda	35	0		
	Kaha	18	1 (5.6%)		
	A. giorgis	26	1 (3.8%)		
	Debark	21	0		
	G. mariam	12	1 (8.3%)		
	Maraky	34	0		

	Lideta	36	1 (2.8%)
	Fentir	19	0
	Defecha	26	1 (3.8%)
	Ayira	30	2 (6.7%)
Total		323	9 (2.8%)

From the **Table 1** there was insignificant relation between gender of animals and occurrence of lungworm ($p>0.05$), however the prevalence is high in female animals (3%) as compared with male animals (2.6%). There was a significant association ($x^2=6.417$, $p<0.05$) between age of the animal and lungworm. A significantly higher prevalence of infection with lungworm was recorded in <2 years old animal (5.6%) followed by 2-6 years old (1.8%) and >6 years old (0 %) and <2 years old animal was 1.811 times odds or more likely (OR=1.811, CI=1.061-3.092) than that of >6 years old as depicted in **Table 2**.

Table 2: The strength of association between lungworm and risk factor by multi variable logistic regression.

Risk factor		No. of animals examined	No. of positive with prevalence (%)	AOR	95% CI
Age	<2 years	126	7 (5.6%)	1.811	1.061-3.092
	2-6 years	112	2 (1.8%)	1.084	0.562-2.093
	>6 years*	85	0		
Breed	Local	178	2 (1.1%)	0.223	0.092-0.539
	Cross*	145	7 (4.8%)		
Management system	Extensive	84	6 (7.1%)	2.228	1.125-4.416
	Semi-intensive	146	3 (2.1%)	1.433	0.712-4.721
	Intensive*	93	0		
Total		323	9 (2.8%)		

As shown in the **Table 1** body condition of animals have insignificant relation with presence of lungworm ($p>0.05$), however highest prevalence was recorded in poor (5.4%) as compared to medium (2.1%) and good (1.1%). There was a significant association ($x^2=4.047$, $p<0.05$) between breeds of the animal and lungworm. A significantly higher prevalence of infection with lungworm was recorded in cross breed (4.8%) than local breed (1.1%), local breeds was 0.223 times less likely (OR=0.223, CI=0.092-0.539) than that of cross breeds. As shown in the **Table 1** management system of animals have significant relation with presence of lungworm ($p<0.05$), highest prevalence was recorded in extensive (7.1%) as compared to semi-intensive (2.1%) and intensive (0%), extensive management system of the animals was 2.228 times odds or more likely (OR=2.228, CI=1.125-4.416) than that of intensive management system as depicted in **Table 2**. There was insignificant association ($p>0.05$) on the prevalence of lungworm and origin of the animal (**Table 1**) however, the prevalence is high in Gebre mariam (8.3%) followed by ayira (6.7%), kaha (5.6%), blagic (5.3%), defecha (2.8%) and maraky (0%).

DISCUSSION

Lungworm infection (verminous pneumonia) is a chronic parasitic disease that affects the respiratory system of animals. This disease results in substantial economic losses due to the reduction of growth rate, morbidity and mortality by predisposes the animal to secondary infection.

A cross-sectional study was conducted from November, 2017 to April, 2018 to determine the prevalence and risk factors of bovine lungworm. The current overall prevalence was 2.8% in coproscopical examination. Association of the prevalence of lungworm infection in bovine with different risk factors was also assessed and analyzed.

The prevalence of lungworm infection was 2.8% in carpological examination. This finding was closely agreed with previous study done by Awoke, et al., who reported 3.1% in Gondar town, Northwest, and Ethiopia. The possible explanation for such infection rate variation could be attributed due to variation in management system, regular strategic deworming program and season of examination in

the respective study areas, which favor or disfavor the survival of parasite larvae.

In this study regarding the gender of the animal it was not statistically significant association (P>0.05), between male and female of the animals and lungworm infection, these indicate that gender does not have influence on the occurrence of lungworm infection, this could be due both gender of animals do have similar environmental exposure. However, lungworm prevalence was higher in females, 3% (5 of 167) than male animals 2.6% (4 of 156), this result was in agreement with previous work done by Awoke, et al., in Gondar town, female 4.2% and male 2.5%. This difference in prevalence between female and male animals might be due to difference in the number of samples in both genders. This might be also due resistance to infection is abrogated at the time of parturition and during early lactation. This preparturient relaxation of resistance results in the female is inability to expel adult worms which cause higher level of larvae detection Crawing, et al.

The prevalence of lungworm infection in extensive management system was 7.1% which is highest in comparison with the prevalence observed in semi-intensive (2.1%) and intensive (0%) management systems with statistically significant difference (p<0.05).This result was in agreement with previous work done by Awoke and Debeb (2012) in Gondar town, extensive management system 7.2% , semi-intensive 2.4% and intensive (0%). This might be because of the reason that cattle are infected by ingesting grass contaminated with larvae through faecal transmission, Glundj, et al., and lungworm infection in extensive farming system could be due to the fact that poorly nourished animals appear to be less competent in getting ride off lungworm although it is not unusual for well feed animals scumb to the disease provided the right environmental conditions are made available.

In the current study higher level of prevalence was observed in cross breeds, 4.8% (7 of 145) as compared to local breeds, 1.1% (2 of 178) of cattle with statistically significant difference (p<0.05). This result was in agreement with previous work done by Aweke, et al., in Gondar town, cross breed 4.8% and local breed (2.8%). This might be due to the reason that local breeds have innate resistance to infection than cross breed. In relation to age of the animals younger were found to be significantly affected (p<0.05) by the infection of lungworm than adults and older. This might be due to the reason that young animals were found to harbor as many lungworms as compared with adult and older animal, this might be the acquired immunity developed in adult and older animals due to previous exposure and animals that recovered from the infection have better immunity against re-infection.

In the current study, from different surrounding village, the highest prevalence of bovine lungworm was recorded in Gebre mariam (8.3%), Ayira (6.7%), kaha (5.6%), blagic (5.3%), A. giorgis (3.8%), Defecha (3.8%) and lideta (2.8%) whereas the lowest was in Maraky, debark and tseda (0%). This variation might be due to the topological location difference and difference in the management system practices. It might be swampy as compared to the other area and cattle's are freely grazed on the pasture which favors the survival of larvae and exposures of the animals for free living infective stage larvae.

In this study regarding the body conditions of the animal it was not statistically significant association (P>0.05), between good, medium and poor body condition of the animals and lungworm infection; these indicate that body condition does not have influence on the occurrence of lungworm infection. This is due to either the level of infection, sampled size or most of the affected animals harbor the disease without showing clinical signs. However, lungworm prevalence was higher in poor 5.4% (5 of 93) than animals that have medium and good body conditions 2.1% and 1.1% respectively. This, partly, may be attributed to the nutritional status of the animals, it is well known that poor nutrition lowers both the resistance (ability to resist the parasites) and resilience (ability to tolerate or ameliorate the effects of the parasite) of the animal thus enhancing the establishment of worms and increasing the prevalence in poorly conditioned animals.

CONCLUSION

In conclusions, a cross-sectional study was conducted on lungworm infection in bovine in and around Gondar town and Debark, North Ethiopia through coproscopic technique to determine the prevalence of lungworm infection in bovine, to lay out the associated risk factors with the occurrence of infection. The result of study indicated that overall prevalence in the study was 2.8% (9 of 323) were found to be positive for lungworm. Different risk factors were found affecting the prevalence. Age, gender, breed, body condition, origin and management systems were taken as risk factors for the occurrence of lungworm infection. There was statistically significant difference (P<0.05) in the prevalence of lungworm infection to different age of animals, breed or management system. Animals <2 years of age, animals kept in the extensive management system and cross breeds were highly prone to lungworm infection. However, the difference was not statistically significant (P>0.05) between lungworm infection and gender, body condition or origin. Prevalence of bovine lungworm in the study area is more associated with young stock in extensive and semi-intensive management systems. In line with above conclusion and in view of the results obtained from this study, it is important to forward some general and specific recommendations to the realities of the study area as follows:

- Animal health workers should create awareness for animal owners to practice regular deworming of their animals and improving the husbandry practices.
- Regular strategic deworming treatment using broad spectrum anti-helmintic once at the beginning and at the end of long rain season is effective to reduce pasture contamination Therefore, farmers should be well informed.
- Animals should not be allowed to have access to graze in moist and swampy pastures.

CONFLICT OF INTEREST

There is no conflict of interest with any financial, personal, or other relationships with other people or organization related to the material discussed in the manuscript.

ACKNOWLEDGEMENTS

Above all, I would like to praise my Almighty God, Allah, for supporting me health, wisdom and strength in my work and for his perfect protection and guidance of my life. I would like to express my deep sense of indebtedness to Dr. Atakklti and Dr. Yasine my advisor for their scholarly guidance, correction of this paper and unreserved encouragement. Finally, it is time to express my deepest gratitude and respect to my family for their great parenthood especially my uncle son, Hussen Seid, for his support in all my learning process and encouragement throughout my life.

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