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Original Article

Prevalence of *Dictyocaulus viviparous* in Cattles of Jimma Town, Ethiopia

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Abstract

Introduction: Lungworm infection in cattle is caused by the nematode parasite called *Dictyocaulus viviparous,* which is the only lungworm, found in cattle and is characterized by bronchitis and pneumonia. It can significantly reduce production, cause death, and increase treatment costs. Therefore, this study was designed to determine the prevalence of bovine lungworm infection, identifying risk factors associated with the disease in Jimma Town, Ethiopia. A cross-sectional study was conducted in Jimma town from December 2023 to April 2024.

Methods: A total of 384 cattle fecal samples were collected randomly and Bearmann technique was employed for detection of lung worm larvae. Age, sex, breed, body condition and management systems were considered as risk factors for the occurrence of the disease in this study. SPSS version 20 was used to summarize the data and chi-square statistics were used to test the association between variables as well as the statistical significance.

Results: The overall prevalence of lungworm in cattle was 10.15% in the study area. Based on analysis the associated risk factors, age ($P=0.018$, OR=2.479, 95% CI=1.172-5.244), body condition score ($P=0.001$, OR=3.168, 95% CI=1.903-5.281), and breed ($P=0.001$, OR=4.519, 95% CI=2.261-9.032), were statistically significant with lung worm. During the study period, the highest prevalence of lungworm was recorded in female 12.28% than in 8.29% male cattle; even though there is difference in prevalence of lungworm between the sexes, it was statistically insignificant ($P=0.121$, 95% CI=0.870-3.293). In current study, the highest prevalence was observed in extensive management systems (12.31%) as compared with semi-intensive (10.37%) and intensive (7.21%) management systems. However, the difference was statistically insignificant ($P=0.635$, 95% CI=0.730-1.675).

Conclusion: The study concluded that the prevalence of bovine lungworm in the study area was more associated with young stock in extensive and semi-intensive management systems, which needs great attention when designing the control programs of the parasite.

Keywords: Prevalence, *Dictyocaulus viviparous*, Cattles, Jimma town, Ethiopia

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Introduction

Ethiopia is one of developing countries in Africa, which is predominantly an agricultural country with over 85% of its populations engaged in agricultural activity (1). According to recent estimates, Ethiopia has 56.71million cattle, 29.33 million sheep, 29.11 million goats, 1.16million camels and 56.87 million poultry (2) An increase in large ruminant could contribute to the attainment of food self-sufficiency in the country especially in requirement for the growing human population and to increase export earnings (3).

Cattle supply traction power for 95% of grain production in the highlands, where more than 75% of the livestock population dwells. Ethiopian livestock and animal products exports make a substantial contribution to foreign exchange earnings (4). It is distinguished, therefore, by lower output as a result of morbidity and death brought on by various parasite illnesses. Lungworms are implicated in one of the most prevalent and serious parasite infections affecting ruminants worldwide (5).

Bronchitis and pneumonia are the hallmarks of lungworm infection in cattle, which is caused by the nematode parasite *Dictyocaulus viviparous*. The host swallows the eggs when coughing. Eggs hatch in the digestive tract or in airways (6). Although lungworms are found all throughout the world, they are more prevalent in temperate regions, the highlands of tropical and subtropical nations, and Ethiopia (7). Lungworm epidemiological distribution is primarily influenced by pasture contamination by carrier animals, and pasture infectivity is correlated with rainfall, which increases snail and larval activity (8). Numerous factors, including the local climate, intermediate hosts, and favorable ecological conditions, influence the occurrence of lung worms in ruminants (9). With two average live weight losses of 70

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kg for cattle and 6 kg for sheep and goats, respectively, the morbidity of animals is typically projected to be between 8% and 10% of the national cattle herd annually and 14%–16% and 11%–13% of the national sheep and goat flocks, respectively (10).

While bovine lungworm infection in temperate locations is known to be caused by *D. viviparous*, little is known about the disease's prevalence and risk factors in tropical highlands like Ethiopia (11). About the exact prevalence of the disease in Ethiopian cattle, little is known. Additionally, current management options for lungworm control and other contributing variables in Ethiopian cattle have not been adequately studied. Therefore, this study sought to fill these gaps by determining the risk factors linked to the disease and examining the incidence of bovine lungworm infection in Jimma Town, Ethiopia. Objectives of this study:

- To estimate the prevalence of bovine lungworm based on fecal examination.
- To assess potential risk factors associated with lungworm infection in and around Jimma Town, Ethiopia.

Materials and Methods

Study Area

The study was conducted from November 2023 to April 2024 in Jimma town which is located in Oromia Regional State, Ethiopia. Geographically, Jimma town is located at the altitude and longitude of 7°40′N 36°50′E at 352 km from Addis Ababa, the capital of Ethiopia. Jimma zone have 20 districts and has a population of 2.1 million (Figure 1). Jimma town is the capital of the Zone, has a population of over 100 000. The town has an average temperature of 20°C and a bimodal irregular raining system with an average annual rain fall of 200 mm. This irregular raining and temperature fluctuation has a great role for the outbreak of disease in animals and humans (12).

Study Design and Period

A cross-sectional study design was used for the collection of samples from November 2023 to April 2024 in order to address the objectives of the study.

Study Population

The study populations were randomly selected dairy cow in Jimma town. The sampling units were individual cattle under study area. The estimation of age was done by the examination of teeth eruption using the approach forwarded (13). Two age groups were considered; less or equal to 5 years and above five years. The body condition scoring was classified into three categories as poor, medium and good (14). The study included both sex groups (male and female).

Sample Size Determination

To determine the sample size, an expected prevalence of 50% will be taken into consideration since there is no research work on prevalence of bovine lung worm in the area. The desired sample size for the study will be calculated using the formula given by Thrusfield with 95% confidence interval (CI) and 5% absolute precision.

$$n = \frac{1.96^2 \text{Pexp}\ (1\text{-Pexp})}{d^2}$$

Where n = required sample size, Pexp = Expected prevalence, d = Desired absolute precision 5% with 95% confidence of level and $Z\alpha/2$ = statistic for a level of confidence, which is 1.96. In Jimma town dairy farm, there is no previous study. So, the expected prevalence should be 50% with a sample size of 384.

Laboratory Analysis of Fecal Sample

Fecal 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, sex, breed, management system, and body condition was properly recorded. Each bottle or glove containing the sample was properly labeled corresponding to the animal identity and date of sample collected. The samples were shipped to Jimma University College of Agriculture and Veterinary Medicine was processed in the parasitological laboratory. In the laboratory, following conventional method of modified Bearmann technique for detection of lung worm larvae, a minimum of 10 g of fresh faces was weighed from each sample for the extraction of L1 larvae for bovine.

Each sample was enclosed with double layered gauze fixed on to a string rod and submersed in a clean glass beaker filled with warm 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 a larva was present under stereomicroscope, small amount of specimen transferred to low power magnification of the compound microscope for morphological identification of lungworm larvae (15).

Data Management and Statistical Analysis

All collected data were coded and entered to Microsoft office excel 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. Confidence level was held at 95% and statistical analysis for the difference in prevalence of lung worm among risk factors were considered significant when was less than 0.05 ($P < 0.05$).

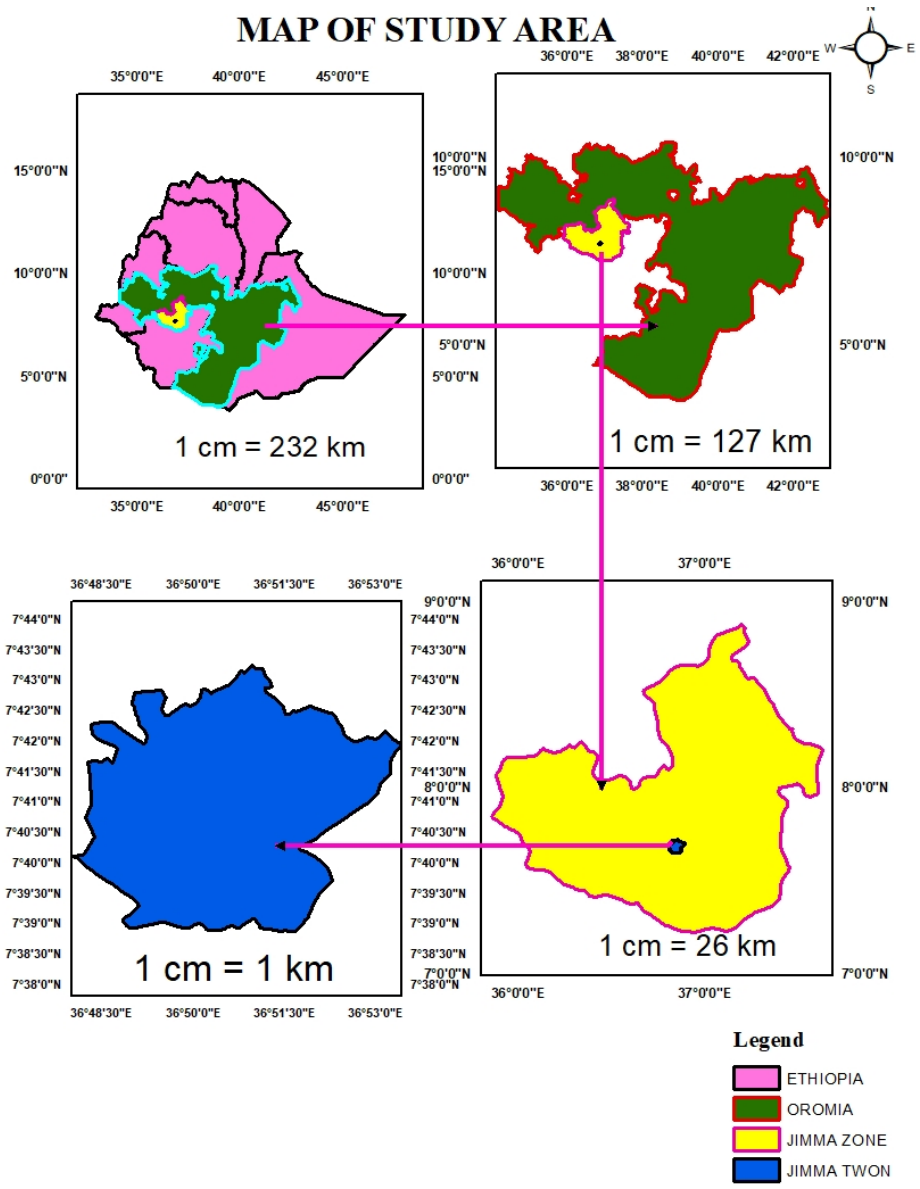

Figure 1. Map of study area. Source: GIS (ArcMap)

Results

Overall Prevalence of Bovine Lungworm

A total of 384 bovine (241 males and 143 females) fecal samples were examined and 39 (10.16 % 95% CI = 7.52-13.58) fecal samples were found to harbor bovine lungworm larvae *D. viviparous* (Table 1)

Table 1. Prevalence of *Dictyocaulus viviparous* in Cattles of Jimma Town, Ethiopia

Species of Animal	No. of Animal Examined	No. of Positive	Prevalence (%)
Cattle	384	39	10.156

Prevalence of Dictyocaulus viviparous and its Associated Risk Factors

Five potential risk factors were examined for their statistical association with the prevalence of lungworm. These factors included age, management system, sex, breed, and body condition. In the present study, multiple logistic regression analysis revealed that age, breed, and body condition have statistically significant associations with the bovine lungworm and satisfy the criteria of ($P < 0.25$) (Table 2). According to the age group of the animals, the parasite prevalence was 12.55% (27/215) and 7.1% (12/169) in the younger and older animal age groups, respectively. The odds were 2.479 (95% CI: 1.172-5.244, $P = 0.018$) higher in the young than adult age group.

In the present investigation, bovine lungworm among crossbreeds was higher 24.657% (OR = 4.519, 95%CI: 2.261-9.032) than local breeds 9.95%. Crossbreeds were more than five times more likely to be bovine lungworms than local breeds. Beside, bovine lungworm infection in different body conditions is scored higher in cattle with poor body condition (22.77% (OR = 3.168, CI: 1.903-

Table 2. Prevalence of Bovine Lungworm and its Associated Risk Factors

Risk Factors	Total	Positive	Prevalence	OR	χ^2	*P* Value	95%CI	
							Lower	Upper
Age								
Young	215	27	12.558	2.479	6.25	0.018	1.172	5.244
Adult	169	12	7.1					
Sex								
Female	143	19	12.286	1.693	2.38	0.121	0.870	3.293
Male	241	20	8.298					
Breed								
Local	211	21	9.95	4.519	16.99	0.001	2.261	9.032
Exotic	73	18	24.657					
Body condition								
Poor	101	23	22.77					
Medium	159	10	6.289	3.168	23.26	0.001	1.903	5.281
Good	124	6	4.838					
Management system								
Extensive	138	17	12.32					
Semi-intensive	135	14	10.37	1.106	0.227	0.635	0.73	1.675
Intensive	111	8	7.21					

OR, odd ratio, CI = confidence interval.

5.281) than 6.289% medium and 4.838% good body condition scores. Cattle with poor body condition were three times more likely to be affected by lungworm than cattle with a medium and good body condition score. While sex (OR = 1.693, 95% CI: 0.870–3.293, $P = 0.121$) and management system (OR = 1.106, 95% CI: 0.73–1.675, $P = 0.635$) were not statistically significant ($P > 0.05$).

Discussion

The present study revealed an overall prevalence of lung worm in cattle 10.16% (95% CI = 7.52- 13.58) which is higher than the finding of (11,16,17), who reported prevalence of 3.98% in Durame District, Southern Ethiopia, (0%) in Central Ethiopia, (4.7%) in Mendi town and 7.5% in Iran Tabriz city respectively. However, the current finding is lower than the findings of (18-20) who reported prevalence of (30.1%), (17.1%), (70%) in Woreta town, Northern part of Ethiopia, in Germany, and in Turkey respectively. This variation in prevalence of lung worm in cattle in different area may be due to the differences in variety of factors such as environmental factors, and other agro-ecological factors.

The present study indicated that the prevalence of lungworm infection in young animals was found to be higher (12.56%) than adults (7.1%). The difference in prevalence by age group was statistically significant ($P < 0.05$). Similar finding was reported in different countries (21-26). This might be associated with the apparent ability of the host to develop acquired immunity so that adult animals have the lower infection and the lower prevalence.

The current study also showed as there was no significant variation ($P > 0.05$) between sexes. This finding is corroborating with (27,28). This signifies that sex seems to have no impact on infections rate and both sex equally susceptible to bovine lungworm infection. This might be due to grazing of both female and male on the field and both sex animals do have similar environmental exposure.

The prevalence of lungworm infection in extensive management system was found to be 12.32% which is higher in comparison with the prevalence observed in semi-intensive (10.37%) and intensive (7.21%) management systems with no significant difference ($P < 0.05$). This might be because of the reason that cattle are infected by ingesting grass contaminated with larvae through fecal transmission (29).The another probable reason could be 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 succumb to the disease provided.

In the current study higher level of prevalence was observed in exotic breeds (24.5%) as compared to local breeds (9.95%) of cattle but with statistically significant difference ($P < 0.05$). This difference in prevalence between exotic and local breeds of cattle might be due to the reason that local breeds have innate resistance to infection or infestation. They can be affected in similar manner as exotic breeds if exposed to the parasite when they are young or after a long period of their first exposure.

Body condition scores were found to be a major risk factor ($P < 0.05$) in the prevalence of bovine lungworm infection which is in agreement with finding of (30-33).

The prevalence based on body condition scale was found to be 22.77%, 6.28% and 4.83% in poor, medium and good body condition, respectively. The possible reason for this result might be associated with the nutritional management of the animals. Poor body condition occurs as a result of lack of feed or nutritional management: this may lead to lack of resistance to infection and contribute for increased prevalence rate in poorly conditioned animals.

Conclusion and Recommendations

The current study has determined the prevalence of bovine lungworm in the study area. In the present study, five risk factors were considered to assess the impact of the factors on lungworm occurrence no matter how age, breed and body score conditions of animals were found to have a statistically significant association with the disease while sex and management system had no association with the disease. The study has also confirmed that lungworm infection is more prevalent in young, poor body condition, extensive management, and female and exotic breed animal groups. Based on the above conclusive findings, the following recommendations were forwarded:

- Regular deforming programs must be implemented.
- Young animals should be managed during possible pasture contamination.
- Further and detailed epidemiological studies must be conducted to design effective control measures.

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Authors' Contribution

Conceptualization: Walde Abdisa, Motuma Regassa.
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Competing Interests

The authors declare that they have no conflict of interest.

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