

Prevalence and Associated Risk Factors of Equine Lungworm in Lode Hetosa District, South Eastern Ethiopia

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Abstract: A cross-sectional study was conducted from November 2013 up to February 2014 in Lode Hetosa district, south eastern Ethiopia to determine the prevalence of equine lungworm and to assess the associated risk factors. Faecal samples were collected from 384 randomly selected equines (128 donkeys, 128 horses and 128 mules) and examined using modified Baermann technique. The overall prevalence of *Dictyocaulus arnifieldi* (*D. arnifieldi*) was 37.50%. Prevalence of lung worm infection in donkeys, mules and horses were 57.81%, 45.30% and 9.37 % respectively, with statistical significant variation ($\chi^2 = 69.1$, Degree of freedom (DF) = 2, $P = 0.000$). Age of equines was found to have a significant association with the prevalence of *D. arnifieldi* infection ($P < 0.05$), the prevalence to being high in age of greater than 10 years. Assessment of the three body condition scores (BCS) with their prevalence revealed a significant variation, the prevalence was very high in poor body condition groups ($\chi^2 = 37.5$, DF = 2, $P = 0.000$). Sex of the animals and months of the years found to have no significant association with prevalence of equine lung worm ($P > 0.05$). All the potential risk factors were assessed with the prevalence of lung worm infection in donkeys: body conditions and age of the donkeys were found to be statistical variation ($P > 0.05$). However, sex and months had no significant. In case of horses and mules the result showing that there were no significant values of risk factors except body condition. No statistical variation was also observed among different peasant association. However; the highest prevalence was recorded in Kiltu Bela (88%) where as the lowest record was seen in Gurra Haricho. Equine lungworm was significant important in the area hence; regular deworming and pasture management are recommended to reduce the worm burden in equine in the study area.

Key words: *Dictyocaulus arnifieldi* • Equines, Faeces • Lode hetosa district • Prevalence • Risk • Factors • Baermann technique

INTRODUCTION

Ethiopia is one of the developing countries in Africa, which is predominantly an agricultural country with over 85% of its population engaged in agricultural activity [1, 2]. The country has the highest equine population probably with the highest density per square kilometer in the world [3] and it has a total of 6.9% and 42.4% in the world and Africa equine population respectively [4].

Ethiopia has 21.7 million horses, 5.57 million donkeys (Second largest in the world next to China) and 380 thousand mules [5]. Equines (Donkeys, mules and horses) play an important role as working animals in many parts of the world, for packing, riding and carting. Equine power is

very crucial in both rural and urban transport system. This is because of its cheapness and availability and so provides the best alternative transport means in places where the road network is insufficiently developed and the landscape is rugged and mountainous and in the cities where narrow streets prevent easy delivery of merchandise [6]. In some areas of North West Kenya and Southern Ethiopia, donkey meat is a delicacy and the milk believed to treat whooping cough [7].

Ethiopia is home to the oldest feral horse population in Africa and the only wild horses left in East Africa, the Kundudo. One of the oldest recorded breeds, the Oromo bloodlines come from Ethiopia and later spread along the coast of the Red Sea. They were first imported into

England in 1861, where they quickly became prized for several of their unique characteristics. Arsi and Bale provinces of Oromia region are known with their densely populated equine population, mainly with Oromo breed horses [8]. Equine population is the highest in Oromia region mainly of the Arsi-Bale highlands [9].

Equines are one of the most important and mostly intimately associated with man. They have enormous contribution through their involvement in different social and economic sectors. In Ethiopia they have been as animals of burden for long period of time and still render valuable services mostly as pack animals throughout the country particularly in areas where modern means of transportation are absent, unaffordable or inaccessible [10].

Even though mules and donkeys have often been described as sturdy animals; they succumb to a variety of diseases and a number of other unhealthy circumstances. Among these, parasitic infection is a major cause of illness [11]. Lungworms are widely distributed throughout the world providing nearly perfect conditions for their survival and development but are particularly common in countries with temperate climates and in the highlands of tropical and subtropical countries. *Dictyocaulidae* are known to exist in East Africa (Ethiopia, Kenya and Tanzania) and South Africa [12].

Dictyocaulus arnfieldi is the true lungworm affecting donkeys, horses, ponies and zebras and is found throughout the world [13]. Donkeys and their crosses (Mules) are the natural hosts for lungworm and the condition in horses is usually found in those that have been in the company of donkeys and mules [14]. Unfortunately, they are rarely given any veterinary attention, they receive no feed supplements and their owners are often unaware of improved saddling techniques that would reduce the back sores their animals suffer from Tesfaye and Curran [15]. Despite the huge numbers of equine population and the increasing importance of equines (Donkeys, horses and mules) in the Ethiopian economy, very little research relating to equine lungworm has been carried out. Apart from few studies in other parts of Ethiopia, there has not been any previous information on equine lungworm in Lode Hetosa district where equines are back bone of the economy. The present study therefore conducted to determine the prevalence of equine lungworm in naturally infected horses, donkeys and mules in Lode Hetosa district and assess the associated risk factors of lungworm infection in the study area.

MATERIALS AND METHODS

Study Area: The present study was conducted from November 2013 to February 2014 in Lode Hetosa district located in Oromia regional state which is located about 164 km distance to the south east of Addis Ababa. From this district ten peasant association were selected namely Lode Jimata, Gurra Haricho, Kiltu Bela, Tulu Yembo, Gonde Korchasa, Shaya, Ticho, Tulu Bego, Aleko and Ifa Lode. Lode Hetosa district geographically located at an elevation of 1700-3036 meters above sea level. About 44% of the total area is highland, 51% mid-land and 5% is lowland within 6°59' and 8°49' latitude and 40°44' East longitude while the climatic condition of the area is "Weynadega". Lode Hetosa district and the surrounding farming community, has a total area of 334.92 sq. km. The area receives an annual range of rain fall from 800-1400 millimeter and annual average humidity ranging from 40-56%. The annual temperature range is 10-22.6 degree Celsius. It has a daily maximum temperature that can reach up to 25 degree Celsius and minimum temperature of 10 degree Celsius. The district has 121351 bovines, 161980 ovines, 3857 caprines and 121023 poultry [16].

Study Population: The study animals were equines found in Lode Hetosa district of south east Ethiopia. Livestock estimate of the year 2013 given by the agricultural Office of Lode Hetosa district indicates that the district has 46352 equines (8198 horses, 36284 donkeys and 1870 mules). Fecal samples were directly collected from the rectum of 384 equines (Horses (*Equus caballus*), donkeys (*Equus asinus*) and mules (*Equus hemionus*)) of all age groups, body conditions and both sex groups. They were all local breeds, kept under extensive management system used for packing and transportation.

Study Design and Methodology

Sampling Method and Sample Size Determination: The sampling method applied in the present study was cross sectional simple random sampling including all body condition, age and sex of individual study animals. The desired sample size was calculated according to the formula given by Thrusfield [17] at 50% of expected prevalence and 5% absolute precision at 95% of confidence interval. As the result, a total of 384 equines were sampled. A P- value of less than 0.05 was taken as statistical significant.

$$n = \frac{(1.96)^2 p_{xep} (1 - p_{xep})}{d^2} = \frac{(1.96)^2 0.5(1-0.5)}{(0.05)^2}$$

Where

n = required sample size,

P_{xep} = expected prevalence

d² = desired absolute precision at 95% Confidence interval.

Faecal Samples Collection and Examination: Faecal samples were collected directly from the rectum using arm length rubber gloves and placed screw-corked universal bottles which was labeled accordingly and soon brought from study area to Asella Regional Veterinary Laboratory. Information about the age, sex, body conditions, owner name and date of collection was recorded. Faecal samples were processed on the day of collection and stored in a refrigerator at 4 degree Celsius until processing. Coprological examination was performed using a modified Baermann technique for the detection of *D. arnfieldi* first stage larvae [18, 19].

Data Managements and Statistical Analysis: The collected data during sampling and laboratory results were entered and stored in Microsoft Excel spread sheet

2007. The data were thoroughly screened for errors and properly coded before subjecting to statistical analysis and analyzed using the Pearson chi-square test according to the species, age and body condition of animals. In all cases, the SPSS soft ware version 16.0 was used and the confidence level was held at 95% and the results were considered significant when P<0.05.

RESULTS

The Overall Prevalence of Equine Lungworm with Associated Risk Factors: The overall prevalence of equine lungworm in the study area was found to be 37.5% with the prevalence of 57.81%, 45.31 and 9.37% in donkey, mules and horse, respectively with a highly statically significance difference (P<0.05). There was statically significance variation in age groups and body condition score where as no variation in sexes and months.

The Prevalence of *D. arnfieldi* in Donkeys and Associated Risk Factors: The prevalence of lungworm in donkeys was 57.81% in Lode Hotosa district. In the study area there was statistical significance difference (P<0.05) in body condition score and age groups. In contrast there was no statistical variation (P>0.05) among sexes and months. The highest and lowest prevalence of lungworm 77.42% and 17.86% were recorded in poor and good body

Table 1: The prevalence of equine lungworm with different risk factors

Risk factors	No examined	No positive	Prevalence (%)	95% CI	χ^2 (P-value)
Species					
<i>E. asinus</i>	128	74	57.81	49.15-66.02	69.1(0.000)
<i>E. cabalus</i>	128	12	9.37	5.45-15.68	
<i>E. hemionius</i>	128	58	45.31	36.95-53.94	
Age					
<2 years	59	29	49.15	35.84-61.56	10.659(0.005)
2-10 years	250	79	31.60	26.15-37.60	
>10 years	75	36	48.00	37.07-59.13	
BCS					
Poor	57	33	57.89	44.98-69.81	37.475(0.000)
Medium	215	94	43.72	37.26-50.4	
Good	112	17	15.18	9.70-22.97	
Sex					
Male	167	65	38.92	31.85-46.48	0.255(0.345)
Female	217	79	36.40	30.30-43.00	
seasons					
November	96	40	41.67	32.31-51.67	1.333(0.721)
December	96	37	38.54	29.42-48.54	
January	96	34	35.42	26.58-45.38	
February	96	33	34.38	25.64-44.32	
Total	384	144	37.50	32.80-42.44	

Table 2: The prevalence of *D.arnifieldi* in donkeys based on different risk factors

Risk factors	No examined	No positive	Prevalence (%)	95% CI	χ^2 (p-value)
Sex					
Female	72	39	54.17	42.3-65.17	0.817(0.340)
Male	56	35	62.50	49.4-73.99	
BCS					
Poor	31	24	77.42	60.19-88.6	24.765(0.000)
Medium	69	45	65.22	53.45-75.4	
Good	28	5	17.86	7.88-35.59	
Age					
<2 year	37	25	67.57	51.47-80.4	8.011(0.018)
2-10 year	67	31	46.27	34.86-58.1	
>10 year	24	18	75.00	55.1-88.0	
Seasons					
November	25	16	64.00	44.52-79.7	1.713(0.634)
December	31	20	64.52	46.95-78.9	
January	34	18	52.94	36.74-68.5	
February	38	20	52.63	37.26-67.5	
Total	128	74	57.81	49.15-66.0	

Table 3: The prevalence of *Dictyocaulus arnifieldi* in horses based on different risk factors

Risk factors	No examined	No positive	Prevalence (%)	95% CI	χ^2 (P-value)
Sex					
Female	66	8	12.12	6.27-22.14	1.210(0.271)
Male	62	4	6.45	2.54-15.45	
BCS					
Poor	22	5	22.72	10.12-43.44	6.061(0.048)
Medium	60	5	8.33	3.61-18.06	
Good	46	2	4.35	1.2-14.54	
Age					
<2 years	9	2	22.22	6.32-54.74	2.919(0.232)
2-10 years	98	7	7.14	3.50-14.01	
>10 years	21	3	14.29	4.98-34.64	
Seasons					
November	35	6	17.14	8.1-32.68	4.45(0.2148)
December	41	4	9.76	3.86-22.55	
January	34	1	2.94	0.52-14.91	
February	18	1	5.55	0.99-25.76	
Total	128	12	9.37	5.45-15.68	

Table 4: The prevalence of *Dictyocaulus arnifieldi* in mules based on different risk factors

Risk factors	No examined	No positive	Prevalence (%)	95% CI	χ^2 (P-value)
Age					
<2 years	26	15	57.69	38.95-74.45	4.282(0.118)
2-10 years	70	26	37.14	26.77-48.85	
>10 years	32	17	53.12	36.45-69.13	
BCS					
Poor	5	5	100	56.55-100	15.223(0.000)
Medium	87	45	51.72	41.37-61.92	
Good	36	8	22.22	11.71-38.08	
Sex					
Female	79	32	40.50	30.37-51.53	1.924(0.114)
Male	49	26	53.06	39.38-66.3	
Seasons					
November	36	18	50.00	34.47-65.53	5.634(0.131)
December	24	13	54.17	35.08-72.11	
January	28	15	53.57	35.81-70.47	
February	40	12	30.00	18.07-45.43	
Total	128	58	45.31	36.95-53.94	

Table 5: Prevalence of equine lungworm in the based on of different peasant association

peasant association	No examined	No positive	Prevalence (%)	95%CI	χ^2 (P-value)
Lode Jimata	13	7	53.85	29.15-76.80	6.224(0.717)
Gurra Haricho	18	4	22.22	9.00-45.21	
Kiltu Bela	25	12	88.00	30.03-66.5	
Tulu Yembo	37	16	43.24	28.67-59.08	
Gonde Korchasa	53	22	41.51	29.26-54.91	
Shaya	58	21	36.21	25.06-49.08	
Ticho	55	18	32.72	21.82-45.9	
Tulu Bego	45	16	35.55	23.22-50.17	
Aleko	62	22	35.48	24.74-47.91	
Ifa lode	18	6	33.33	16.28-56.25	
Total	384	144	37.50	32.8-42.44	

condition score respectively in the study area. A 75%, 67.57 % and 46.27% prevalence were observed in old, young and adult age groups respectively.

The Prevalence *D. arnifieldi* in Horses and Associated Risk Factors: The prevalence of *D. arnifieldi* in horses in study area was 9.37% (12/128). Body condition score specific prevalence showed that the prevalence was 22.72%, 8.33% and 4.35% in poor, medium and good respectively. The prevalence of lungworm among the different BCS groups were statistically significant where ($P=0.048$, $\chi^2=6.061$). Other risk factors (Age, sex and months) were statically insignificant.

The Prevalence of *D. arnifieldi* in Mules and Associated Risk Factors: The observed prevalence of *D. arnifieldi* in mules in the study area was 45.31%. Like donkeys and horses the prevalence of lungworm in mules body condition scores were statically significant ($P=0.00$, $\chi^2=15.223$) with 100% and 22.22% in poor and good body condition score respectively were recorded. Other risk factors were statically insignificant ($P>0.05$).

Prevalence of equine lungworm in the bases of different peasant association: The present study result revealed that the prevalence of equine lungworm was statically insignificant variation was observed in the peasant association of the study area ($P=0.717$, $\chi^2=6.224$). Although the prevalence of lungworm in Kiltu Bela peasant association in this study was highest (88%) as compared to other peasant association, there was no statistically significant difference ($p>0.05$). The prevalence of the disease was lowest (22.22%) in Gurra Haricho peasant association as compared to other peasant association of the study area.

DISCUSSION

The overall prevalence of lungworm infection in the study population was 37.50% with the highest prevalence in (57.81%) in donkeys and the lowest prevalence (9.37%)

in horses. The prevalence of *D. arnifieldi* is also reported by different researchers from Ethiopia such as reported a prevalence of 13.8% [20], Getahun [21] reported a prevalence of 20% and reported a prevalence of 23.2% [22] in Jimma, Bale and Wonchi respectively. This difference might be due to the difference in environmental conditions, sample size, sampling time and management practice favoring the survival of the larvae of the parasite.

In this study, relatively higher overall prevalence of *D. arnifieldi* was recorded in donkey (57.81%) than in mule (45.31%) and horses (9.37%) [20]. Similar report also found that there was higher occurrence rate of *D. arnifieldi* in donkeys (35.29%) than in mules (29.26%) and in horses (4.26%). The observed higher prevalence in donkeys might be reservoir host [14] and attributed to the fact that less attention is given to these animals that is by far lower than their workload [15].

The prevalence of *D. arnifieldi* in donkeys in the present study (37.50%) was lower than reported by Feseha *et al.* [6], Hassan *et al.* [23] and Andersen and Fogh [24] who reports 83 %, 70.5% and 87.5% in Ethiopia, Sudan and Denmark respectively. On contrary, lower prevalence of lungworm was reported by Lyons *et al.* [25] and Pandey [26] in donkeys 54% and 48% in Kentucky (USA) and Morocco respectively. In several studies, 50-80% of donkeys have been found infected with *D. arnifieldi* [27, 28].

The present prevalence of lungworm infection in mules (45.31%) was higher than previous findings of Mersha *et al.* [20], Esheta [29] and Ram [30] who reported 29.26%, 20% and 14.10% prevalence of *D. arnifiledi* in Jimma town, in and around Bahir Dar and in Nepal respectively. On contrary, higher prevalence of lungworm in mules (54%) reported by Lyons *et al.* [25] in central Kentucky, USA. These differences in prevalence might be due to differences in agro-ecology, management systems, season and sample size.

In this study area the prevalence of *D. arnifieldi* in horses (9.37%) which was higher than the past findings of Mersha *et al.* [20], Saeed *et al.* [31] and Yacob and Hagos [32] who reported 2.5%, 4.26% and 0.5% in Lahore (Pakistan), Jimma and Arsi-Bale respectively. Before the advent of the anthelmintic, ivermectin, the prevalence of *D. arnifieldi* infection in horses in Kentucky at necropsy was approximately 11%, while it was 2% in live horses at the same time and at the same region, based on fecal examination [33, 34]. This difference may suggest that the difficulty in ante mortem diagnosis of *D. arnifieldi* in horses. However, patent infections have been found in horses, resulting in disease occurrence in closed herds with no exposure to donkeys or mules [27, 34].

In this study the age of animals was found as a major risk factor for statistical variation ($\chi^2=10.659$, $DF=2$, $P=0.005$) in the prevalence of lungworm infection. A prevalence of 41.15%, 31.60% and 48% were recorded in young, adult and old age groups, respectively. The present result was agree with Mersha *et al.* [20] reported 22.95%, 18% and 10.98% in old, young and adult age groups, respectively. This might be related to the condition that older and younger animals are taught to have decreased immunity.

The body condition of animals was also classified as poor, medium and good body condition scores. The prevalence according to body condition grade was 57.89%, 43.72% and 15.18% in poor, medium and good body condition scores of the equines respectively. In addition, in different species of equids (Donkeys, horses and mules), body condition score were considered as a risk factor and was statically significant ($p<0.05$). This might be due to Poorly nourished animals appear to be less competent in getting rid of infection although it is not unusual for well fed animals to succumb to the disease provided the right environmental conditions are made available [35].

Sex and seasons were not found to be a major risk factors ($P>0.05$) in the prevalence of equine lungworm infection. A prevalence of 38.92% and 36.40% were recorded in male and female respectively. This result was match with the prevalence reported by Mersha *et al.* [20] 12.66% and 18.42% respectively that is insignificant. Although the prevalence of male in this study was high (38.92%) as compared to female (36.40%), there was no statistically significant difference ($p>0.05$) in prevalence. In this study, the highest (41.67%) and lowest (34.38%) prevalence were observed in November and February, although months were insignificant ($P>0.05$) risk factors.

The current study clearly demonstrated that lungworm infection was highly prevalent in donkeys (57.81) of Lode Hetosa district. In the present study, age and body condition score were statically significant variation ($P<0.05$) in the prevalence of lungworm in donkeys. Other risk factors (Sex and seasons) were insignificant ($P>0.05$). A prevalence of 77.42%, 65% and 17.86% were recorded in poor, medium and good body condition score of donkeys respectively in the study area. A 67.57%, 46.27% and 75% prevalence were recorded in young, adult and old age groups of donkeys respectively with a significance variation ($\chi^2=8.011$, $p=0.018$). Even if sex of donkeys was insignificant, higher prevalence was recorded in male (62.50%) as compared to female (54.17%).

In the horses, body condition score was statically significant ($\chi^2=6.061$, $DF=2$, $P=0.048$) in the study areas in the prevalence of lungworm infection. In contrary, the sex, age and months were insignificant risk factors. The prevalence of 22.72%, 8.33% and 4.35% were recorded in poor, medium and good body condition score. The highest prevalence of (17.14%) *D. arnifieldi* were observed in horses in November in the study areas even though seasons were statically insignificant ($P>0.005$). This might be related to the condition that Most outbreak of verminous pneumonia occur during cool season specially autumn and early winter because the larvae stages of the causative worms tolerate and prefer low temperatures [12].

The prevalence of mule lungworm in the present study revealed 45.31% which was lower than donkeys (57.81%) and higher than horses (9.37%). This prevalence difference might be due the fact that Donkeys and their crosses (Mules) are the natural hosts for lungworm and the condition in horses is usually found in those that have been in the company of donkeys and mules [14]. Body condition score was strongly significant ($\chi^2=15.223$, $p=0.000$) with 100%, 51.72% and 22.22% in poor, medium and good BCS. But, sex, age groups and months did not show any significant difference in the prevalence of mule lungworm infection in the study area. Significantly higher infection rate of 100% was observed in poor body condition group than minimum infection rates of 22.22% in good body condition groups.

Out of the selected ten peasant association, the prevalence of *D. arnifieldi* in Kiltu Bela (88%) was highest and lowest in Gurra Haricho as compared to other selected peasant association of the study area although it was insignificant variation ($\chi^2=6.224$, $P=0.717$, $DF=9$). The highest and lowest prevalence in Kiltu Bela and Gurra Haricho respectively might be due to agro-ecological difference.

CONCLUSION

The present study indicated that equine lungworm to be the major problem in the area being highest in donkeys followed by mules and horses. Mostly the disease affect young and old animals having poor and medium body condition due to inadequate development of the immune system in young and old animals as well as their grazing habit and feeding condition of the medium body animals and use of the animals for longer period of time during working hours. The climatic condition of Lode Hetosa of Oromia region where rainfall is frequent and temperature is mild also favors the development and survival of infective larvae for most part of the years. Owing to the huge equines population in the study area considerable contamination to the communal pasture grazing system could be the other factor which favors the survival of the parasite. Animals of deferent age and sex group usually graze on communal pasture facilitated easy transmission of this parasitism. However, the problem due to lungworm of equines in the study area was given less attention because of its sub clinical nature. Hence strategic treatment of equines should be undertaken on the basis of sound and complete understanding on the epidemiology of lungworm of equines in the study district.

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