Global Veterinaria 22 (1): 49-55, 2020
ISSN 1992-6197

DOI: 10.5829/idosi.gv.2020.49.55

Prevalence and Associated Risk Factors of Bovine Fasciolosis in Jersey and Holstein Friesian X Boran Breed in Adaberga and Holeta, Ethiopia

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Abstract: A cross-sectional study was carried out from November 2016 to November 2017 on bovine fasciolosis in Holeta and Adaberga dairy farms by using coprological examination of feaces from sampled animals. The objective of the study was to determine prevalence and associated risk factors of bovine fasciolosis in Jersey breed and Holstein Friesian x Boran breed found in Adaberga and Holeta dairy farm respectively. Out of 580 cattle examined coprologically 249 (42.9%) were found positive for fasciolosis. The prevalence of bovine fasciolosis was higher in Holstein Friesian x Boran breed than Jersey breed. Higher prevalence of fasciolosis was recorded in Holeta dairy farm than Adaberga dairy farm. Breed and management systems were identified as potential risk factors for the occurrence of bovine fasciolosis in the study areas (P<0.05). However, the prevalence was not significantly affected (P>0.05) by sex and age of animals. Since the prevalence of fasciolosis was high in these farms emphasis should be given to the predisposing risk factors related to occurrence of fasciolosis and appropriate control and prevention option should be practiced. So that improving of management system, drainage of water bodies and restriction of grazing area with other points was recommended to reduce the disease problem in the farms.

Key words: Jersey · Holstein Friesian X Boran · Fasciolosis · Prevalence · Risk Factors

INTRODUCTION

Cattle constitute the major proportion of Ethiopian livestock resources with a total cattle population of 57.83 million [1]. They provide more than 30% of local meat consumption and generate a cash income from export of meat and live animals. They also contribute to the self-sufficiency of resources for poor farmers by providing milk, meat, manure and direct cash income [2]. Ethiopia has huge cattle population however, is constrained by a number of factors including malnutrition, disease, improper health care and other management problems [3].

Among many parasitic problems of farm animals, fasciolosis is a major disease, which imposes direct and indirect economic impact on livestock production, particularly of sheep and cattle [4, 5]. In general, infection of domestic ruminants with *Fasciola hepatica* and *Fasciola gigantica* causes significant economic loss estimated at over USD 200 million per annum to the agricultural sector worldwide, with over 600 million animals infected [6]. Tolosa and Tigre and Fufa *et al.* [7, 8] have reported financial losses of 6300 USD and 4000 USD per annum, respectively due to liver condemnation at slaughter houses.

The distribution of fasciolosis is worldwide; however, the distribution of *F. hepatica* is limited to temperate areas and highlands of tropical and subtropical regions [7]. The definite hosts for *F. hepatica* are mammals, among which cattle and sheep are the most important one. The geographical distribution of trematode species is depending on the distribution of suitable species of snails. The Genus Lymnea in general and *Lymnea truncatula* in particular is the most common intermediate host for *Fasciola hepatica* [9]. In Ethiopia, bovine fasciolosis exists in almost all

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regions. However, the epidemiology and *Fasciola species* involved vary significantly with locality. This is attributed mainly due to the variation in the climatic and ecological conditions such as altitude, rainfall, temperature and livestock management system [10].

The epidemiology of fasciolosis was influenced by the grazing habits of the animals. When nutritional conditions are compromised also provides an important dynamics for infection transmission. Animals grazing in wet marshy areas, favored by the intermediate host, are more likely to be infected by fasciolosis. Typically long and wet seasons are associated with a higher rate of infection. However, cattle are more likely to ingest large numbers of metacercaria during dry periods following a wet season. This is due to a reduction in available pasture, forcing the animals to graze in swampy areas or in areas where the water has receded, thus exposing them to vegetation heavily infected with metacercariae [11].

Because of the dependence on climatic and environmental conditions of both the intermediate hosts and the free-living stages of *Fasciola* spp, there was an important spatial component in the epidemiology of the disease and spatial distribution models have been developed for several regions across the world [12, 13]. The validation of these models with field observations has shown that they are capable of identifying regions at high risk for *Fasciola* presence and hence may act as a means to increase awareness of the disease among animal health workers and farmers. However, in most studies, the risk areas comprise large regions and it is known that, both within low or high risk areas, *Fasciola* infected and uninfected farms can co-exist next to each other, depending on the presence/absence of suitable habitats for the principal intermediate host snail and local farm management practices [14].

The life cycle of *Fasciola* spp is a typical of Digenetic trematodes. Eggs laid by the adult parasite in the bile ducts of their hosts pass into the duodenum with the bile. The eggs then leave the host through the faeces. At this stage, eggs are still not embryonated, further development to maturation taking approximately two weeks. The eggs then hatch to release the motile miracidium, which will then locates and penetrates the intermediate snail host. After penetrating the snail, the miracidium loses its cilia and becomes a sporocyst. The sporocyst is dividing and forming redia and a fully mature redia showing cercaria stages. The mobile cercaria snail generally leaves the snail 4-7 weeks after infection by migrating through the tissues of snails. On emerging from the snail the cercaria attaches to submerged blades of grass or other vegetation like watercress [15, 16, 17].

One miracidium hatching from a fluke egg can produce up to 4,000 infective cysts (metacercariae) due to the vegetative multiplication at the sporocyst and redia stages. The metacercarial cysts, when ingested along with the contaminated vegetation by the definitive host enter into the small intestine, releasing the young parasite which penetrates the gut wall, entering the peritoneal cavity. From there, it migrates directly to the liver over a period of approximately seven days, directly to the liver. The juvenile fluke then penetrates the liver tissues, through which it migrates, feeding mainly on blood, for about six weeks. After this period, the fluke enters the bile ducts, maturing in to a fully adult parasite after about 3 months from initial infection [15, 16, 17].

Several control and prevention methods against ruminant fasciolosis are available and can either be used independently and as two or more of them. These methods involve reduction in number of intermediate host (snail) by chemical or biological means, strategic application of anthelmintic and reduction in the number of snails by drainage, fencing and other management practices and reduction in the risk of infection by planned grazing management [18]. Reduction of pasture contamination may be accomplished through the use of anthelmintic, management regimes, molluscicides and biological competition as components of an integrated control program [18]. In addition, the use of resistant animals to reduce the impact of infection may have potential, especially where treatment costs are relatively high [19].

In Ethiopia the prevalence of bovine fasciolosis has shown to range from 11.5% to 87% [20]. The economic losses due to fasciolosis are caused by mortality, morbidity, reduced growth rate, condemnation of liver and increased susceptibility to secondary infections and the expenses of control measures [20]. Different investigators so far conducted and reported variable prevalence of bovine fasciolosis in different localities of the country [21, 22].

Adaberga and Holeta farms are one of the large dairy farms in Ethiopia, located in the west of Addis Ababa where huge dairy breed populations are found. Environmental conditions and altitude of the area was conducive for the occurrence of fasciolosis. However, little information was available about its prevalence and associated risk factors in the farms especially in Jersey and Holstein Friesian × Boran breeds. Therefore, the objectives of this study were to determine the prevalence and associated risk factors of bovine fasciolosis of Jersey and Holstein Friesian × Boran breeds in Adaberga and Holeta dairy farms.

MATERIALS AND METHODS

Description of the Study Area: The study was conducted in Holeta and Adaberga dairy farms from November 2016 to November 2017. Holeta is located 30 kilometer west of Addis Ababa. The area is situated at 9°04'-9°13'N latitude and 38°29'-38°39'E longitude. The average altitude for the area ranges from 2200-2500 meter above sea level. It receives an average annual rainfall of 1060 millimeter and has a bimodal rainfall pattern, the short rains occurring from March to April and the long rains from July to October. The monthly mean minimum and maximum temperatures are 4.6°C and 23.3°C, respectively. The farming system of the area was mixed type were crop production and livestock rearing are done side by side. The livestock population was estimated at 139,020 cattle, 75,850 sheep, 13,237 goats, 19,251 equines and 96,804 poultry. Livestock are raised in traditional extensive system and are herded by village children during the cropping season and during the dry season are allowed to browse and graze over cropping fields, along the stream and irrigation canals freely. The most important crops grown in the study area include: Teff, sorghum, wheat, maize, chick pea and barley. The predominant soil was vertisol type.

Study Population: The study animals were Holstein Friesian × Boran breed found in Holeta dairy farm and Jersey breed in Adaberga dairy farm. The study was conducted on randomly selected 380 Holstein Friesian × Boran breed in Holeta and 200 Jersey breed in Adaberga dairy farm. Both dairy farms are semi intensive farming system in which animals had access to free grazing in the morning. The areas where animals freely graze were marshy. Housing system of Adaberga dairy farm was closed type, while closed and open shaded housing system in Holeta dairy farm. Unlike Adaberga dairy farm, Holeta dairy farm the liquid waste product was drained to the pasture where animals graze.

Study Design: A cross-sectional study was conducted to determine the prevalence of bovine fasciolosis and associated risk factors in Jersey breed and Holstein Friesian × Boran through faecal examination in Holeta Agricultural Research Center laboratory from November 2016 to November 2017.

Sampling Method and Sample Size: Simple sampling method was used to selected Jersey breed in Adaberga dairy farm and the whole cross breed in Holeta dairy farm were the study populations. Since there was no previous study in dairy farms to establish the prevalence and associated risk factors of bovine fasciolosis, the sample size was determined by consider 95% confidence interval, the prevalence of 50% and 5% absolute precision fasciolosis using formula given by Thrusfield [23]. Hence the numbers of animals needed for this study was 384 cattle, but a total of 580 animals involving in this study to increase the accuracy of the study. A total of 200 cattle were selected from Adaberga dairy farm and 380 of them were from Holeta dairy farm. A semi structured questionnaire format was designed to generate information related to type of farm, breed, sex and management practices. It was also considered both sexes and age. Age was classified as < 2 years, 2- 4 years and >4 years age.

Parasitological Examination: Fecal samples were collected directly from the rectum of each animal and placed in universals bottles and transported to Holeta Agricultural Research Center parasitological laboratory by preserving with 10% formalin. Sedimentation technique was used to detect the presence or absence of fluke eggs in the fecal sample collected according to Urquhart *et al.* [24]. Two grams of faeces was added to 42 ml of water in a graduated cylinder. The contents were then mixed thoroughly using a glass rod and were poured through a tea strainer to remove large debris. The solution was then further passed through a sieve (mesh aperture 210 mm) into a conical flask and water was run through the sieve to ensure no eggs remained attached to the sieve. The filtrate was then allowed to sediment for 3 min after which the supernatant was siphoned off taking care not to disturb the precipitated matters. The latter was stained with two drops of methylene blue and the entire sediment placed on slide covered with a cover slip and viewed under a compound microscope (Labomed). Eggs of *Fasciola* species were identified by their characteristic morphology and color. To differentiate between eggs of *Paramphistomum* species and *Fasciola* species, a drop of methylene blue solution was added to the sediment where eggs of *Fasciola* species show yellowish color while eggs of *Paramphistomum* species stain by methylene blue [25]. Samples that were not processed within 24 hours were stored in a refrigerator at 4°C.

Data Management and Statistical Analysis: The data was generated through coprological examination in laboratory and it was entered to Microsoft excel program and analysis was made through statistical software SPSS version 20.0 to determine the prevalence and association of risk factors with the disease occurrence. The risk factors associated with fasciolosis was assessed based on the information obtained from interview. The association of fasciolosis on the bases of breed, age, sex and farm was compared using X^{-2} square test and P-value < 0.05 were considered to be statistically significant.

RESULTS

From the total animals examined (580), 249 (42.9%) of them were found to be positive for fasciolosis up on faecal examination. The highest prevalence of fasciolosis was observed in Holeta dairy farm (53.2%), while the lowest prevalence (23.5%) was recorded in Adaberga dairy farm (Table 1).

The statistically significant difference (P<0.05) was observed in prevalence of bovine fasciolosis between Adaberga and Holeta dairy farms. The relative abundance of Fasciola eggs was obtained in Holstein Friesian x Boran breed which was 53.2% and relatively small prevalence found in Jersey breed which was 23.5%. The present study showed that the prevalence of fasciolosis 43.0%, 35.3% and 46.0% was recorded in <2 years old, 2-4 years old and >4 years old groups, respectively. However, no statistically significance difference (P>0.05) was detected on the prevalence of bovine fasciolosis in different age groups. The result revealed that the prevalence of bovine fasciolosis of 44.0% and 30.4% were recorded in females and males respectively. There was also no statistically significant difference (P>0.05) on the prevalence of bovine fasciolosis between female and male animals (Table 2).

DISCUSSION

The overall prevalence of bovine fasciolosis was 42.9% in the present study. This result was in line with Mihrete *et al.* and Daksa *et al.* [26, 27], who reported that 32% and 32.6% prevalence of bovine fasciolosis in Adwa and Guduru and Abay Chomaan districts, respectively. This result was also similar with report of Asmare and Samuel [28] with 30.02% prevalence around in Dangila; Yilma and Mesfin [10] 33.42% in North Gonder, Fikirtemariam *et al.* [29] 36.72% in Bahir Dar, Shiferaw, Feyisa and Ephrem [30] 42.25% in Assela and Biniam, Hanna and Sissay [31] 41.41% in Woreta, Northwestern Ethiopia. On the other hand, the prevalence bovine fasciolosis reported in the current study was higher than the values 14.4% reported in Dire Dawa [32]; 12.4% in Kombolcha [9]; 4.9% in Soddo. The present result was lower than the report of Dagne [33] (80.5%) in Debre Berhan, Yadeta [34] (82.5%) in western Shoa and Terefa, Wondimu and Fekadu [35] (53.48%) in Jimma. This variation in prevalence of bovine fasciolosis might be due to differences in environmental factors, management system and breed of animals.

In the present study, statistically significant variation has been observed in prevalence of bovine fasciolosis between farms (P<0.05).This may be due to a wide range of altitude (2200 - 2500 meter above sea level), drainage of the liquid waste into the grazing area in Holeta dairy farm, variation in management system of the two farms, high cattle density per grazing area in Holeta dairy farms. This result agrees with the report of Bennema *et al.*

Table 1: The prevalence of fasciolosis in Adaberga and Holeta dairy farms

Farms	Total animals examined	Total animals positive	Prevalence (%) (95% CI)
Adaberga	200	47	23.5 (0.18-0.29)
Holeta	380	202	53.2 (0.48-0.58)
Overall	580	249	42.9 (0.39-0.47)

Table 2: Chi-square analysis of association of the potential risk factors with bovine fasciolosis in Adaberga and Holeta dairy farms

Variables	Categories	Total animals examined	Total animals positive	Prevalence (%)	χ^2	P-value
Farm	Adaberga	200	47	23.5	47.043	0.001
	Holeta	380	202	53.2		
Breed	Jersey	200	47	23.5	47.043	0.001
	HF× Boran	380	202	53.2		
Age	<2 years	293	126	43.0	2.113	0.25
	2-4 years	85	30	35.3		
	>4 years	202	93	46.0		
Sex	Female	534	235	44.0	1.31	0.16
	Male	46	14	30.4		

and El-Tahawy *et al.* [36, 37] who reported that management system was associated with bovine fasciolosis. In addition, management variables explained the variation on the spatial distribution of *fasciola spp* in dairy farms better than metrological or environmental variables. Similarly, breed was statistically significant associated with occurrence of bovine fasciolosis (P<0.05). This study finding is in line with that of El-Tahawy *et al.* [37], Sanchez-Andrade *et al.* [38], Kanyari, Kagira and Mhoma [39], Jaja *et al.* [40] in which they reported significant association between bovine fasciolosis and breed of cattle.

The prevalence of fasciolosis based on the sex of the cattle was statistically insignificant (P>0.05), this could be due to the exposure of male and female cattle to similar ecological condition and practices of similar management system without considering their sex [41]. Moreover, sex has significant effect on prevalence of bovine fasciolosis which results from long exposure of male outdoor when females are kept in door at the beginning of lactation [42]. The prevalence of bovine fasciolosis was 30.4% and 44.0% in male and female cattle, respectively. This study finding is in line with reports of Feleke and Girma [41], Bayou and Geda [43] and Yosef, Yosef and Nuraddis [44] who reported that sex of cattle was not significant association bovine fasciolosis. The result of this study indicated that there was no statistically significance difference (P>0.05) age groups on the prevalence of fasciolosis. This is not in agreement with the work done by Ephrem, Feyisa and Shiferaw [42] at Assela and showed that age has significant effect on the prevalence of bovine fasciolosis in which there was decrease infection rate as age increase due to acquired immunity manifested by humoral response and tissue reaction in bovine liver due to previous challenges. Author [45] also reported that the animal becomes resistant as age increases due to liver fibrosis which impedes the passage of immature flukes.

There was deworming schemes as control method in both farms but the prevalence of bovine fasciolosis was moderately found to be high, this may be resulted from exposure of cattle to contaminated pasture with eggs of *fasciola*, grazing of animals in marshy area and the presence of drug resistance in the farm. This study was conducted in a period known to be dry in Ethiopia; however, the prevalence observed was considerable and reflects the existence of suitable ecological conditions such as altitude, rainfall and temperature in the area. Climatic factors in the highland areas are more favorable for the propagation and activity of the snail intermediate hosts and progression of the parasite life cycle for most part of the year. In general the highland areas, where there were a number of water pockets, marshy and water lodged areas were found associated with more feacal egg output during the dry and wet periods which was similar with finding of Wamae *et al.* [46], Mahammed *et al*. [47], Ashebir and Shichibi [48] and Wakuma *et al.* [49].

CONCLUSION

The prevalence of bovine fasciolosis is high in the study area due to the presence of biotopes suitable to the development of snail intermediate host and parasites. Farms and breeds were statistically significantly associated with prevalence of Fasciolosis in study areas. Even though, high prevalence of fasciolosis and presence of risk factors for disease occurrence in the farms, there was scarcity of information on control and prevention options of the disease. Hence, emphasis should be given to the identification of the predisposing factors in the study area and control and prevention of the disease should be implemented.

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