World Journal of Veterinary Science

ISSN: 2689-5951

Review Article

Prevalence, Associated Risk Factors and Economic Importance of Bovine Fasciolosis in Boloso Bombe District, Wolaita Zone, Southern Ethiopia

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Abstract

Bovine fasciolosis is a significant parasitic disease that causes direct financial damage because it mostly affects the liver. The condition not only results in the condemnation of the liver but also in financial losses because of low-quality carcasses, slowed growth, or decreased output. From January to August 2023, a cross-sectional study was conducted in Boloso bombe woreda to determine the prevalence, risk factors, and economic significance of fasciolosis. An examination revealed out of the 384 cattle (356 male and 28 female) slaughtered at the Bombe Municipal Abattoir, 19.53 percent carried fasciola. According to the study, there was a more significant association ($p<0.05$) between the age of the animals and the prevalence of fasciolosis infestation, with young animals showing a higher prevalence than adults. Breed, sex, body condition score, and animal origin were all seen in significantly correlated with fasciola infection ($P>0.05$). During the study period, the estimated yearly economic loss from fasciolosis resulting from liver condemnation was 263,655 ETB (4793.7 USD). The study's findings showed that bovine fasciolosis is a parasite disease of cattle in the study area that has a significant economic impact. Therefore, it is important to raise knowledge about the effects of the disease on cattle and to develop and execute effective prevention and control measures for fasciolosis. In addition, further epidemiological research on the biology and ecology of the intermediate host should be carried out.

Keywords: Prevalence; Risk factors; *Fasciola hepatica; Fasciola gigantica*; Boloso bombe

Introduction

Over a billion people around the world depend on the livestock industry for their livelihoods and food security. The livestock industry contributes roughly 40% of the agricultural GDP, with individual country figures ranging from 30% to 80% [1]. With 65 million cattle, 40 million sheep, 51 million goats, 8 million camels, and 49 million chickens, Ethiopia is the country in Africa with the greatest number of livestock [2]. The nation exports live animals, meat, edible parts, and skin to earn cash. It also has a large number of ruminants that contribute significantly to meat consumption [3]. Several factors prevent the cattle industry's enormous potential from being fully used including malnutrition, traditional management and disease [4].

Parasitism is amongst the major concerns for the development of livestock sector in tropics [5]. Fascioliasis is known to be one of the most important parasitic diseases in Ethiopia that lowers production in ruminants, which are the natural hosts for Fasciola. Bovine fasciolosis is one of the most important parasitic diseases of cattle causing mortality and production losses in various parts of Ethiopia [6]. Bovine faciolosis is caused by digenean of the genus Fasciola commonly referred to as liver flukes. The two species most commonly implicated as the etiological agents of fasciolosis are *Fasciola hepatica* (*F. hepatica*) and *Fasciola gigantica* (*F. gigantica*) [7]. F. hepatica has a worldwide distribution but predominates in temperate zones while F. gigantica is found on most continents, primarily in tropical region [8].

The ecology of snails, which function as intermediate hosts and transfer the disease to other species, is crucial to the disease's ability to spread. While Lymnaea natalensis truncatula, an amphibian with a global range and the most prevalent IH for F. hepatica, is a significant aquatic snail for *F. gigantica* in Africa, [9]. Trunculata prefers wet muck to free water, therefore the availability of suitable habitats for snails-permanent habitats include the banks of ditches or streams and the edges of small ponds-is one of the many reasons causing fasciolosis outbreaks. Temporary habitats like as vehicle ruts, rain pools, and hoof tracks may appear after intense rainfall or flooding. Fields with clumps of rushes are often suspect sites. In addition, a slightly acid pH environment is optimal for *L. truncatula*, excessively acid pH levels are detrimental, such as occur in peat bogs, and areas of sphagnum moss [10]. The complex nature of the lifecycle and epidemiology of this snail-borne disease presents challenges for predictive mapping at the herd level, as well as disease management and animal husbandry at the individual level [11,12].

Cattle that are infected with fasciolosis usually get it from eating contaminated pastures or water in wetland areas. Phases of the disease in ruminants might be acute, subacute, or chronic. Chronic fasciolosis causes calcification of the hepatic tissues, fibrosis, and thickening of the bile duct, among other changes in the liver [13]. It can cause the liver to grow and undergo various pathological alterations in herbivorous animals, leading to the liver's condemnation. According to Nyirenda et al. (2019) [14], liver damage brought on by immature *F. gigantica* may also put the animals at risk for Black disease, which

Citation: Mamo TT, Kalacho ND. Prevalence, Associated Risk Factors and Economic Importance of Bovine Fasciolosis in Boloso Bombe District, Wolaita Zone, Southern Ethiopia. World J Vet Sci. 2024; 4(2): 1025.

Publisher Name: Medtext Publications LLC

Manuscript compiled: Jul 05th, 2024

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is brought on by Clostridium novyi, which would raise the death rate. Adult flukes found in the bile duct of final host and shed eggs into the bile then enter into the intestine to pass outside with feces [2].

The financial losses are divided into two categories: direct losses, which include medication expenses, labor costs, drenches, and liver condemnation at slaughterhouses; and indirect losses, which are linked to lower productivity and include things like lower feed conversion rates in cattle, poor growth rates, lower production, and higher costs for replacement stock. Due to a lack of planned and efficient disease control strategies, tropical nations like Ethiopia are predicted to experience a high loss rate from parasite diseases like fasciolosis [15].

Although bovine fasciolosis is more common and associated with several problems, there hasn't been any prior, well-documented research on the disease in the study district. For this reason, the goals of this study are to ascertain the prevalence of bovine fasciolosis and determine the financial loss resulting from liver condemnation at the Boloso bombe Municipal Abattoir.

Materials and Methods

Study area

Boloso bombe woreda is located 219 miles from Hawassa, 57 km from the town of Wolaita Sodo, and 435 km south of Addis Ababa. The woreda is 27220 hectares in total size. 51.47% of the estimated 126,640 people on Earth in 2005 E.C. were female. The woreda's elevation varies from 1150 meters in the west to 2277 meters above sea level in the southern region. Road networking between woredas and between kebeles and other woredas is weak to moderate. The range of the mean annual rainfall is 1500 mm to 1700 mm [16]. The soil of woreda is primarily clay and sandy, while the geography is primarily plateu, or flat. Rainfall in the highlands and on the plateau is nearly constant. There are two main agricultural systems that are based on this natural variance. Highland areas with consistent and high rainfall are ideal for growing wheat, barely, enset, beans, and fruits including avocado, bananas, and mango. Due to the crops' perennial nature and the modest holding size (between 0.25 and 05 hectares), hand hoeing is the most common cultivation technique. Large grazing lands, comprising approximately 5.14% of the total area, are utilized for the purpose of herding sheep, goats, cattle, and donkeys. There are 73139 cattle, 7885 sheep, 11330 goats, 6407 donkeys, 153 mules, 34 horses, and 66111 poultry in the vast livestock production system [17].

Study design

A cross-sectional investigation of the prevalence, associated risk factors and economic importance of fasciolosis in Boloso bombe woreda was carried out from January 2023 to August 2023.

Study animals

The research subjects were cattle with varying age, breed, sex, and bodily condition that were brought in for slaughter at the Bombe Municipal Abattoir. Based on tooth eruption patterns and information from the owners, the ages of the animals were ascertained. During the sampling process, each cattle sample was recorded and classified as either mature or old.

Sample size determination

The sample size for this study was determined by the formula described by Thrusfield (2005). Accordingly, at 95% confidence level and precision of 5% the total sample size was determined to be 384 since there was no research carried out on the title previously in the study area. So, for this particular study the sample size was as following:

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

$$n = (1.96)^2 \frac{0.5(1-0.5)}{(0.05)^2} = 384$$

Where n= sample size required

1.96=the value of Z at 95% confidence interval

Pexp= expected prevalence

d= desired absolute precision

Hence, 384 cattle were sampled using simple random sampling method from the study area.

Study methodology

Ante mortem and postmortem examination

Ante mortem examination: An examination conducted in a well-lit area where the animals may be seen both individually and collectively at rest and in motion. The age, sex, origin, and physical condition were noted prior to slaughter.

Postmortem examination: The animals that were inspected for their livers and bile ducts during the antemortem examination were further monitored during the postmortem inspection. After a thorough examination that included palpating and seeing the entire organ, an incision was made along the lobes' bile ducts. We looked for immature and adult Fasciola parasites in the liver parenchyma and main bile channels, respectively.

Species identification: Fasciola species were easily recognized using morphological parameters including shape and size after the flukes were collected in the universal container containing 5% formalin as a preservative. According to Urquhart et al. (1996) and Soulsby (1982) [18,19], they were divided into four categories: mixed forms (*Fasciola hepatica* and Fasciola gigantica), relatively small-sized Fasciola hepatica, relatively large-sized and more leaf-like *Fasciola gigantica*, and undifferentiated or juvenile forms of Fasciola species.

Estimation of direct economic loss due to liver condemnation: The direct financial loss was analyzed on the basis of liver condemnation due to bovine fasciolosis at Boloso Bombe woreda municipal abattoir. It was analyzed by considering the average number of annually slaughtered cattle in the abattoir from retrospective recorded data, the current mean selling price of one healthy liver from at Bombe town and overall prevalence of bovine fasciolosis in Bombe municipal abattoir from the present study. The information on the current price of one normal liver was obtained from the different butcher houses in the town. Hence, direct economic loss was calculated on annual basis according to the formula adopted from Ogunrinade & Ogunrinade (1980) [20].

ALC = MCS × MLC × P

Where **ALC**=Annual loss from Liver Condemnation

MCS= Mean annual Cattle Slaughtered at woreda municipal abattoir

MLC= Mean cost of one Liver at town

P= current abattoir prevalence of the bovine fasciolosis at Boloso bombe municipal abbatoir

Data management and statistical analysis

The recorded raw data were entered in to Microsoft excel data base system to be analyzed using STATA version 14 statistical software. Descriptive statistics was computed. Pearson's chi-square (x2) was used to evaluate the association between the prevalence of fasciolosis and different factors. A 95% confidence interval and P-value less than 0.05 (at 5% level of significance) were considered significant in all analysis.

Results

Overall prevalence

From the total 384 cattle slaughtered during the period from February 2023 to August, 2023 at Boloso bombe Municipal Abattoir, 75(19.53%) were found to harbor fasciola from the analysis that was made.

Association of different risk factors with the occurrence of fasciolosis

As indicated in below table (Table 1) the occurrence of bovine fasciolosis was found relatively the same in all areas where the animals originated. Postmortem prevalence of bovine fasciolosis within different origin indicated that the highest prevalence (22.9%) was found in those animals originated from Gadalla kebele and the lowest prevalence (17.1%) was recorded from Morocha kebele. However, there was no statistically significant variation (p>0.05) observed between the areas where the animals originated.

This study indicated that the higher prevalence was recorded in male (20.2%) than female (10.7%), and revealed non-significant association P>0.05 with the prevalence of bovine fasciolosis. The study revealed a significant association (P=0.002) between age and the occurrence of fasciolosis in animals with high prevalence (27.2%) was seen in male animals than (14.1%) females; and indicated; males have more chance to be affected by diseases than females. A non-significant association was seen between body condition score and fasciolosis. Even though there was no significant difference seen; high proportion (30.7%) of poor animals were affected by fasciolosis followed by medium body scored animals (26.4%) and animals with good body condition score (15.9%). This study also indicated a non-significant association P>0.05 between breed of cattle and fasciolosis infestation (Table 1).

Fasciola species identified in the study area

Based on morphological characteristics of fasciola species such as shape, size the identified species of fasciola in the study area were 81.3%, 10.6% and 8% *Faciola hepatica*, *Fasciola gigantica* and mixed infections respectively which is indicated in table 2 (Table 2).

Table 2: Species of fasciola identified in the study area.

No.	Species identified	Frequency	Percentage (%)
1	*Faciola hepatica*	61	81.3
2	*Fasciola gigantica*	8	10.6
3	Mixed infections	6	8

Economic analysis

The analysis of fasciolosis's economic relevance was conducted using data gathered from postmortem examinations and interviews. The mean retail price of bovine liver in Bombe town was 450 ETB (8.2 USD) whereas the average yearly rate of animals slaughtered in the study abattoir was estimated to be 3000. Fasciolosis was currently prevalent at 19.53% in the research area.

Therefore, a total annual loss from organ condemnation due to fasciolosis is ALC = MCS × MLC × P

ALC=3000×450×19.53%=263,655 ETB (4793.7USD) annually.

Discussion

Bovine fasciolosis is economically important and widely distributed disease in almost all region of Ethiopia (Kassie and Ali, 2019) [11]. The prevalence rate, epidemiology and the species involved vary in locality. One of the most important factors that influence the occurrence of Fasciolosis in an area is availability of a suitable snail habitat (Zekarias and Bassa, 2019) [21]. The overall prevalence of bovine fasciolosis in cattle slaughtered at Boloso bombe municipal abattoir during the study period was 19.53%. This finding was comparable with some reports from different parts of Ethiopia. The current study is in close agreement with the findings of Regassa and Chalchisa, (2023) [2]; Yusuf et al. (2016; Adane Zewde et al. (2019) [22,9]; Gebrecherkos (2012) [10]; Kassie and Ali (2019) [11] who reported 22.1% at Bishoftu Municipal Abattior, Ethiopia; 24.4% in Municipal Abattoir of Haramaya, Ethiopia, 20.4% at Wolaita Sodo Municipal Abattair, Ethiopia, 21.50 % in municipal Abbatoir of Adigrat, Tigray, Ethiopia and 23.4% at Gondar Elfora Abattoir, Gondar, Ethiopia respectively. However, it is much lower than that of many other studies from different abattoirs in the country which disagree with Nota and Dima (2022) [23], Ashenafi et al. (2016) [24]; Niguse (2020), and Gebeyehu and Tulu (2018) [15] who reported 48%, 39.9%, 46.87%, and 39% in Dello mena woreda, Bale zone, south eastern Ethiopia; Mekelle municipal abattoir; at municipal abattoir of Mudulla, Tembaro woreda, SNNPR, Ethiopia, and in and Around Ambo District Abattoir, Ethiopia respectively. This relatively higher

Table 1: Association of different risk factors with the occurrence of fasciolosis

No	Variables		No. Examined	No. affected	%Prevalence	X^2	P-Value
1	**Origin**	Badaye	121	21	17.3	1.53	0.884
		Gadala	122	28	22.9		
		Morocha	70	12	17.1		
		Zaba	71	14	19.7		
2	**Breed**	Local	367	73	19.8	0.68	0.416
		Cross	17	2	11.7		
3	**Sex**	Male	356	72	20.2	1.49	0.231
		Female	28	3	10.7		
4	**Age**	Young	158	43	27.2	10.08	0.002
		Adult	226	32	14.1		
5	**Body condition score**	Good	318	57	15.9	3.16	0.082
		Medium	53	14	26.4		
		Poor	13	4	30.7		

prevalence in different parts of Ethiopia and other countries than the present study might be attributed to the differences in climatic, ecological conditions, alterations of the climatic condition and the type of management and production systems (Girma, 2019) [7]. In fact, a majority of areas in study area was dry land which is not suitable for the growth and life cycle of *fasciola* and its intermediate hosts.

This study revealed that there was a significant association $p<0.05$ between age and fasciolosis infestation in animals with high prevalence was seen in young animals than adults. There was a decrease in infection rate (prevalence) as age increased. This finding is in agreement with Debela et al. (2014); Yusuf et al. (2016) [22]; Birhan et al. (2019), Niguse (2020); Kassie and Ali, (2019) [11], Tesema (2017) [3]. This may be due to the result of acquired immunity with age which is manifested by humoral immune response and tissue reaction in bovine liver due to previous challenge (Yusuf et al., 2016) [22]. The young may have a higher rate of parasite infestation than adults since they do not have the same level of immunity. According to Bhusal et al. (2020) [25], young animals are more vulnerable to parasite infestation than adult animals. Mature animals' resistance is caused by significant liver fibrosis, which impairs the migration of juvenile flukes. Bile duct calcification and stenosis also contribute to the resistance by creating an unpleasant environment for adult parasites, which ultimately leads to their expulsion (Khan et al., 2019) [26].

During this study period there was no statistically significant difference ($P > 0.05$) in infection rates between the sexes and fasciolosis infection in animals. This finding which the same with reported by Fikirtemariam et al. (2013) [27]; Solomon and Abebe (2007) [28]; Legesse et al. (2017) [5]; Rather it indicated a relatively higher prevalence in male than female in proportion. This signifies that sex has no impact on the infection rate and both male and female animals were equally susceptible and exposed to the disease.

In the current study, there was statistically insignificant association ($p>0.05$) between the different categories of body conditions of the animals and the prevalence of fasciola. This finding is in agreement with Nota and Dima (2022) [24], Getnet & Bayih (2018) [12], Fikirtemariam et al. (2013) [27]; Adane Zewde et al. (2019) [9]. A higher percentage of animals with poor body condition than animals with medium body condition and animals with good body condition scored for fasciolosis, despite the fact that no discernible difference was seen. This could be linked to decreased resistance brought on by starvation; although it is common for well-fed animals to pass away from the illness, undernourished animals seem to be less capable of removing infections. Similar to this, animals in poor physical condition may be more vulnerable to fasciolosis due to various infections, whether parasitic or not (Bilal and Musa, 2021 [1]; Addy et al., 2020 [28]; Khan et al., 2020) [26].

This study also revealed a non-significant correlation between the breed of cattle and the presence of fasciolosis. This suggests that all cattle breed that graze on both wild and developed pastures have a same chance of contracting illnesses within the same research region since they are linked to the same management practices. The current conclusion is consistent with reports from many regions of the nation (Feleke and Girma (2018) [29], Gebrie et al. (2015) [30], Legesse et al. (2017) [5] Bayou and Geda (2018) [6].

The research findings also revealed a negligible correlation ($p>0.05$) between the study locations and the occurrence of fasciola infections. Despite the fact that the infection rates at the various study locations varied. The varying levels of veterinary services across regions, agroecological variations, and climatic factors like altitude, temperature, moisture, humidity, and soil that may promote the growth of the intermediate host, snail, and parasite itself could all contribute to the variations in the prevalence of bovine fasciolosis between study sites (Foustine, 2021) [31]. This result is consistent with observations made by Shafi (2021) [32], Bayou and Geda (2018) [6], and Legesse et al. (2017) [5].

Throughout the research area, *F. hepatica* was the most common species involved in bovine fasciolosis. The species involved and prevalence differ greatly depending on the location. The current findings concur with observations made by Nota and Dima (2022) [24], Regasa and Chalchisa (2023) [2], Ashenafi K, et al. (2016) [25], and Kassie and Ali (2019) [11]. Variations in the climate and ecosystem, including altitude, rainfall, temperature, and livestock management practices, may be the primary cause of this (Shafi, 2021) [32]. The existence of intermediary host L. truncatula may be the reason for the higher frequency of *F. hepatica* than *F. gigantica*. Actually, the majority of livestock that were killed came from highland regions, *F. hepatica* is found between 1200 and 2560 meters above sea level [11].

Economic losses are caused by fasciolosis for a variety of reasons, including mortality, miscarriages, stunted growth, decreased production of milk and meat, and disapproval of both underweight carcasses and contaminated livers [9,14,33-36]. This study simply looked at the overall yearly economic loss of 263,655 ETB (4793.7 USD) from the condemnation of organs owing to fasciolosis. This demonstrated that there are notable losses due to fasciolosis in the studied area.

Conclusion and Recommendations

Bovine fasciolosis is a significant parasite illness that causes direct financial damage because it mostly affects the liver. Apart from liver condemnation, the condition also results in economic losses because of low-quality carcasses, slowed growth rates, or decreased productivity factors that were not taken into account in this study. The current investigation verified that bovine fasciolosis was widespread and had an impact on animals' well-being and output. Therefore, in order to reduce these losses, it is desirable to increase disease control procedures. Public education regarding the importance of this snail-borne disease in the nation is equally crucial. Additionally, since the disease is zoonotic in nature, medical and paramedical staff should be made aware of it so that they can likely consider it as a differential diagnosis in all functional liver deficiencies. Epidemiological studies on the biology and ecology of the intermediate host can also help develop sustainable planning and implementation strategies for disease control.

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