Prevalence and associated risk factors assessment of bovine fasciolosis in and around Bahir Dar, Ethiopia

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Abstract

Bovine fasciolosis is a parasitic disease of cattle caused by ingesting metacercariae of liver flukes from the genus Fasciola. A cross-sectional study was conducted from November 2021 to April 2022, encompassing a total of 384 cattle randomly selected from diverse locations. The study included cattle of various ages and genders, aiming to to determine the prevalence of bovine fasciolosis and its associated risk factors in and around Bahir Dar, Ethiopia. Fecal examinations were performed to detect fluke eggs, and data were analyzed using descriptive statistics in STATA Version 20.0 to summarize bovine fasciolosis prevalence. Chi-square tests assessed relationships with infection rates and risk factors, with significance set at $P < 0.05$. Out of 384 fecal samples analyzed, 49.21% tested positive for Fasciola eggs. Origin areas included Tikurit (50%), Sebatamit (61.84%), Latammba (27.65%), and Kebele 11 (59.37%). Cattle in poor condition showed higher prevalence (64%) compared to those in medium (50%) and fat condition (26.96%). Age showed differences with young cattle at 50.38%, adults at 47.33%, and old cattle at 50.47%. Sex distribution indicated 49.73% prevalence in males and 48.73% in females. Regarding breed, local cattle had a prevalence of 51.62%, while crossbreeds showed 46.15%. Significant variations were observed based on locality and body condition, whereas age, sex, and breed showed no statistically significant differences ($p < 0.05$). Despite these differences, bovine fasciolosis remains prevalent in the area. Enhancing farmer awareness, regular deworming, and effective management are crucial to control the disease and reduce economic losses.

Keywords : *Bahir Dar; Bovine fasciolosis; Ethiopia; Fecal examination; Prevalence; Risk factors*

1. Introduction

Ethiopia boasts one of Africa's largest livestock populations, including approximately 55.03 million cattle, 27.32 million sheep, and 28.16 million goats as of 2019. Cattle are particularly crucial, accounting for about 81.2% of the country's total annual milk production. Despite their importance, livestock productivity in Ethiopia is hindered by various challenges such as diseases, malnutrition, and management deficiencies, with parasitic infections being a notable concern (Legesse et al., 2017).

Parasitic infections present substantial health challenges to the global livestock sector due to their ability to cause diseases that can severely impact animal health, productivity, and economic outcomes for farmers and agricultural industries. Among these, Fasciolosis stands out as a prominent concern affecting various animals such as cattle, buffaloes, sheep, goats, and even humans of all ages. It is caused by ingesting metacercariae of liver flukes from the genus Fasciola, typically found on contaminated forage, in water, or on raw vegetables (Ardo et al., 2013; Figtree et al., 2015; Najib et al., 2020). Livestock contract the infection directly from contaminated environments (Irsik et al., 2008), while humans usually acquire it through consumption of contaminated food or water (Aleixo et al., 2015).

Fasciolosis can lead to severe liver pathology, including damage caused by the migration of flukes through the liver and other organs, in both humans and animals (Najib et al., 2020). Clinically, the infection is known to induce inflammation of the bile ducts and obstruction of the biliary system in both animals and humans (Sah et al., 2017). The disease is endemic globally, with reported cases in the Americas (Kleiman et al., 2007), Asia (Nguyen et al., 2011), and Africa (Abunna et al., 2010). The distribution of fasciolosis depends on the presence of suitable aquatic snail species such as Lymnaea truncatula and Lymnaea natalensis, which serve as intermediate hosts (Boray & Love, 2007). Fasciolosis is prevalent worldwide and causes serious problems in sheep, goats, and cattle (Soliman, 2008). Economic losses due to fasciolosis infection in animals include mortality, morbidity, reduced growth rates, liver condemnation, increased susceptibility to secondary infections, costs associated with implementing control or treatment protocols, decreased productivity, and reduced fertility and milk production (Bernardo et al., 2011).

Several studies on the epidemiology of fasciolosis among animals have demonstrated that factors such as age, sex, breed, and livestock management exert a significant influence on the prevalence of this disease (Phiri et al., 2005; Keyyu et al., 2006; Abunna et al., 2010). Previous studies have explored the prevalence of fasciolosis and identified regional risk factors. They have underscored the importance of further investigation due to its pivotal role in assessing the local epidemiology of the disease.

(Aregay et al., 2013; Gebrie et al., 2015; Yitayal & Taddie, 2020). Therefore, the objective of the current study was to determine the prevalence of bovine fasciolosis and its associated risk factors in and around Bahir Dar, Ethiopia.

2. Materials and Methods

2.1. Study Area

A cross-sectional study was conducted from November 2021 to April 2022 in and around Bahir Dar, Ethiopia (Figure 1). Bahir Dar is situated approximately 575 km northwest of Addis Ababa, with an altitude ranging from 1500 to 2600 meters above sea level. The city's coordinates are 12° 29' N latitude and 37° 29' E longitude. It experiences an average annual rainfall of 1200 to 1600 mm and temperatures ranging from 8 to 31°C annually. The region is characterized by plain plateaus covering about 70% of the land, featuring various bush formations, low woods, evergreen lands, and semi-humid highland vegetation. The area is predominantly used for agriculture, cultivating crops such as teff, wheat, maize, and pulse crops (Legesse et al., 2017).

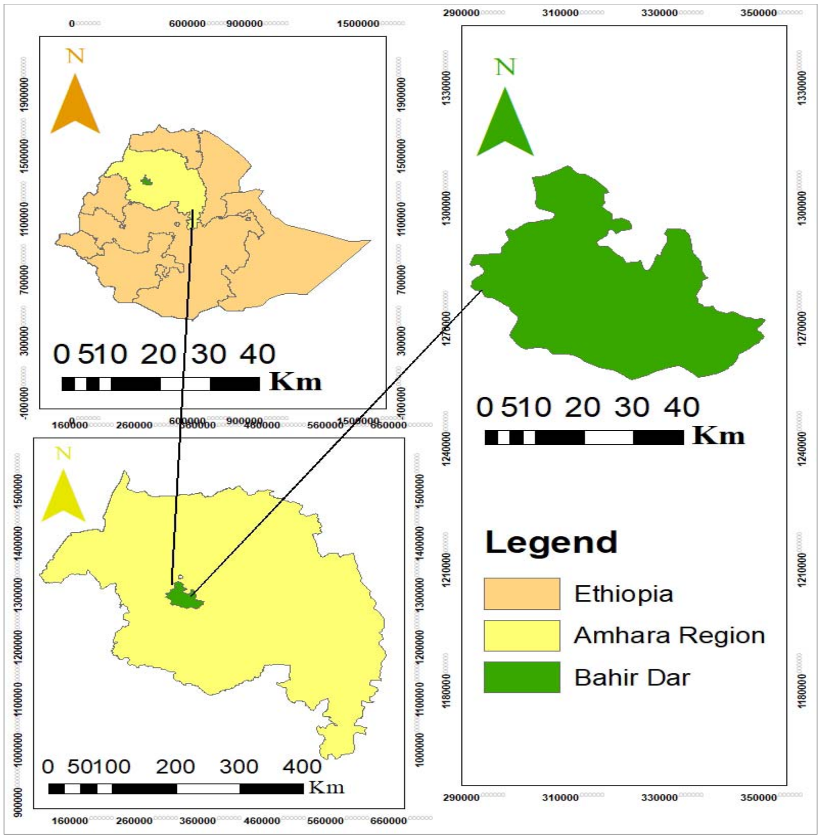
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Figure 1 : Map of the the study area

2.2. Study Animal and Sampling Method

The study animals comprised cattle from selected sites in and around Bahir Dar, specifically Kebele 11, Sebatamit, Tikurit, and Latammba Kebeles. These cattle included both local breeds and crossbred Holstein Friesian cattle. A total of 384 cattle, spanning all age groups and both sexes, were randomly selected from various origins. The average age of the cattle was determined using dentition (categorized as young and adult) as described by Cringoli et al. (2002), and their body condition scores were recorded following the guidelines outlined by Nicholson and Butterworth (1986).

2.3. Study Design and Sample Size

A cross-sectional study design was employed to assess the prevalence of bovine fasciolosis and its associated risk factors in and around Bahir Dar town from November 2021 to April 2022. Factors including origin (place), breed, age, sex, and body condition were considered as potential risk factors for the occurrence of fasciolosis. The sample size for collecting fecal samples from the bovine population was determined following the guidelines outlined by Thrusfield (2005), using a 95% confidence interval and 5% absolute precision, assuming an expected prevalence of 50%.

$$\frac{1.96^2 \times Pexp \times (1 - Pexp)}{d^2}$$

Where n represents the required sample size, Pexp denotes the expected prevalence, and d stands for the desired absolute precision.The estimated sample size will be 384 animals.

2.4. Fecal Examination and Identification of Fasciola Eggs

Fecal samples collected directly from animals' rectums were preserved in universal bottles with 10% formalin for transport to the Bahir Dar Regional Veterinary Laboratory for analysis. At the laboratory, the sedimentation technique, following protocols detailed by Faria et al. (2008) and Elelu et al. (2016), was employed to detect fluke eggs present in the samples. To differentiate between Fasciola species eggs and other types, such as Paramphistomum species eggs, a methylene blue solution was utilized on the sediment. Fasciola eggs displayed a distinct yellowish hue, characterized by their larger size and thin, operculated shells, as outlined by Hussein et al. (2010). In contrast, Paramphistomum eggs stained blue, as outlined by Mifsut and Ballarin (2015).

2.5. Data Analysis

The raw data collected from the study were first organized and entered into a Microsoft Excel database using spreadsheet software. Following this, the data underwent analysis using descriptive statistics in STATA Version 20.0 to summarize the prevalence of bovine fasciolosis. To assess the statistical relationships between infection rates and various risk factors (age, sex, breed, and locality), a chi-square (χ^2) test was employed. This test compared infection rates across these factors, with statistical significance set at $P < 0.05$.

3. Results

3.1. Prevalence

The prevalence of bovine fasciolosis across various risk factors is presented in Table 1 and Figure 3. The overall prevalence rate of fasciolosis in the study area was 49.21%. Detailed analysis by origin revealed varying rates: Sebatamit exhibited the highest prevalence at 61.84%, followed by Kebele 11 at 59.37%, Tikurit at 50%, and Latammba at 27.65%. Regarding body condition scores, cattle in poor condition showed the highest prevalence at 64%, followed by those in medium condition at 50%, and fat cattle at 26.96%. Among different age groups, prevalence rates were 50.38% in young cattle, 47.33% in adults, and 50.47% in older cattle. Similarly, prevalence rates across sex groups were 49.73% in males and 48.73% in females. Among different breed groups, local breeds exhibited a prevalence rate of 51.62%, while crossbreeds showed a rate of 46.15%.

Statistical analysis revealed significant differences in prevalence among origin locations and body condition categories. However, no significant differences were observed among age groups, sex groups, and breed groups ($p < 0.05$).

3.2. Identification of Fasciola Eggs

The egg of the Fasciola species detected in the cattle fecal sample in the study is presented in Figure 2. The criteria for identification were established using morphological features guided by Hussein et al. (2010) and Mifsut and Ballarin (2015). These eggs are notably ovoid in shape with a distinctive thick, yellowish-brown shell, often displaying an operculum at one end.

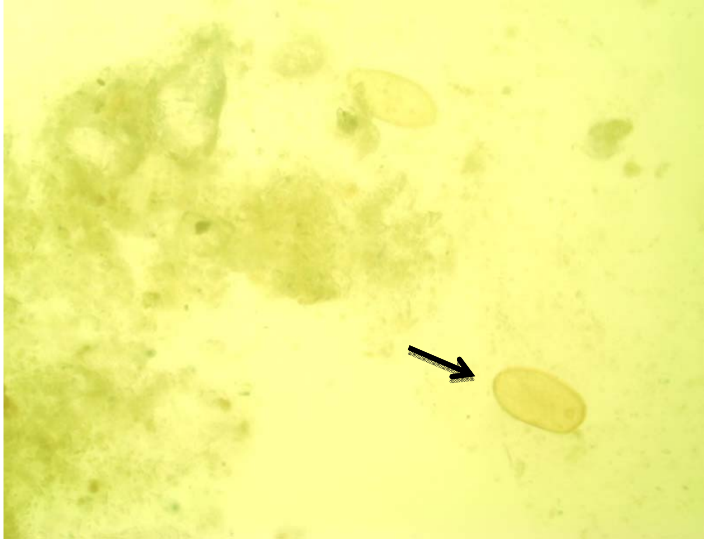

Figure 2 : Egg of *Fasciola* species: yellowish egg (arrow)

Table 1: Prevalence of Bovine Fasciolosis Based on Risk Factors

Factors	Category	Examined	Positive	χ2	P-value
Origin	Tikurit	118	59 (50 %)	26.31	0.000
	Sebatamit	76	47 (61.84%)		
	Latammba	94	26 (27.65%)		
	Kebele 11	96	57 (59.37%)		
Body condition	Poor	125	80 (64 %)	28.6	0.000
	Medium	170	85 (50 %)		
	Fat	89	24 (26.96 %)		
Age	Young	129	65 (50.38%)	0.839	0.3503
	Adult	150	71 (47.33%)		
	Old	105	53 (50.47%)		
Sex	Male	187	93 (49.73%)	0.844	0.3503
	Female	197	96 (48.73%)		
Breed	Local	215	111 (51.62%)	0.287	1.134
	Cross	169	78 (46.15%)		
Total		**384**	189 **(49.21%)**		

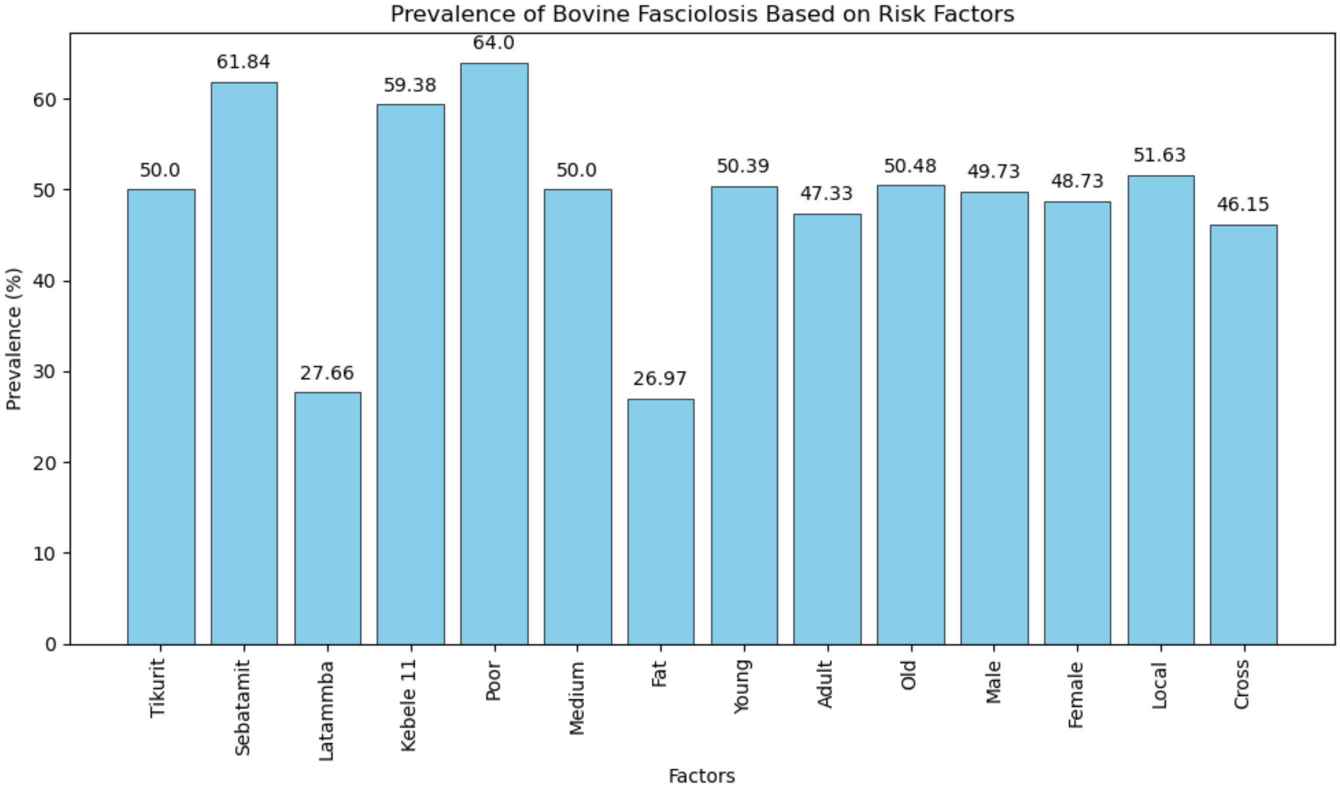

Figure 3: Prevalence of Bovine Fasciolosis Based on Risk Factors

4. Discussion

The study revealed an overall prevalence of bovine fasciolosis of 49.21% in the study area, which closely aligns with previous research findings. Tsegaye et al. (2012) reported a prevalence of 41.41% in Woreta, while Demssie et al. (2012) found 54.5% in Jimma. Additionally, studies conducted in Angacha Woreda (Eshetu et al., 2017), the North-East Amhara Region (Ayelign & Alemneh, 2017), and Eastern Shoa, Kuyu District (Mohammed et al., 2018) documented prevalence rates of 40.62%, 47.10%, and 54.2%, respectively.These similarities are attributed to shared agro-ecological conditions across Ethiopia, which provide favorable habitats for the intermediate hosts of Fasciola spp., such as snails of the genus Lymnaea. Agrarian practices like communal water sources and irrigation facilitate transmission, with contaminated pastures and water serving as major infection routes for cattle (Gebrie & Alemneh, 2015).

Conversely, lower prevalence rates were noted in some regions such as Soddo in Southern Ethiopia (4.9%) (Abunna et al., 2010), Nekemte in the East Wollega Zone (15.9%) (Asrese & Ali, 2014), and Wolaita Soddo in Southern Ethiopia (15.9%) (Tilahun et al., 2014). Similarly, slightly higher but still relatively low prevalence rates were recorded in areas like Mecha District in the West Gojam Zone

(31.5%) (Ewnetu et al., 2015), Zenzelma in Bahir Dar (26%) (Legesse et al., 2017), Bahir Dar itself (32.3%) (Gebrie et al., 2015), Shambu in Western Ethiopia (30.8%) (Desa & Mitiku, 2019), and Gondar in Northwestern Ethiopia (23.44%) (Gebrie & Alemneh, 2015). This variation could be attributed to differences in altitude, topography, weather conditions, and disparities in livestock owners' awareness of disease management practices. These include protecting cattle from infected areas, maintaining dry pastures, and eliminating contaminated vegetation that could harbor Fasciola larvae. Additionally, variations in the use of anthelmintics to treat infected animals by veterinary health personnel may also contribute (Asressa et al., 2012).

Significant differences in the prevalence of bovine fasciolosis were observed among different origins: Sebatamit (61.84%), Kebele 11 (59.37%), Tikurit (50%), and Latammba (27.65%). These findings are consistent with earlier studies (Mebrahtu & Beka, 2013; Gebrie et al., 2015; Yusuf et al., 2016; Eshetu et al., 2017; Desa & Mitiku, 2019; Yitayal & Taddie, 2020) reporting significant variability in prevalence among different origins. However, other studies (Belay et al., 2012; Tsegaye et al., 2012; Petros et al., 2013; Aregay et al., 2013; Tilahun et al., 2014; Asrese & Ali, 2014; Ewnetu et al., 2015; Legesse et al., 2017; Ayelign & Alemneh, 2017; Bayou & Geda, 2018; Zewde et al., 2019) found no significant differences among origins.

Body condition scores showed significant variability in the prevalence of bovine fasciolosis: cattle in poor condition exhibited the highest prevalence at 64%, followed by those in medium condition at 50%, and fat cattle at 26.96%. This variability among body condition categories is consistent with findings from several earlier studies (Demssie et al., 2012; Belay et al., 2012; Petros et al., 2013; Asrese & Ali, 2014; Tilahun et al., 2014; Ewnetu et al., 2015; Gebrie & Alemneh, 2015; Yusuf et al., 2016; Eshetu et al., 2017; Legesse et al., 2017; Mohammed et al., 2018; Kassie & Ali, 2019; Desa & Mitiku, 2019; Yitayal & Taddie, 2020). Conversely, some studies reported non-significant variability in prevalence rates among different body condition categories (Mebrahtu & Beka, 2013; Aregay et al., 2013; Gebrie et al., 2015; Bayou & Geda, 2018; Zewde et al., 2019).

Age did not significantly influence the prevalence of bovine fasciolosis in the study area: young cattle (50.38%), adults (47.33%), and older cattle (50.47%). This lack of variability among age groups corresponds with findings from several earlier studies (Tsegaye et al., 2012; Belay et al., 2012; Mebrahtu & Beka, 2013; Tilahun et al., 2014; Gebrie & Alemneh, 2015; Gebrie et al., 2015; Legesse et al., 2017; Bayou & Geda, 2018; Mohammed et al., 2018; Desa & Mitiku, 2019). However, some studies have reported significant variability in prevalence rates among different age groups (Petros et al., 2013; Aregay et al., 2013; Ewnetu et al., 2015; Yusuf et al., 2016; Ayelign & Alemneh, 2017; Eshetu et al., 2017; Kassie & Ali, 2019; Zewde et al., 2019).

Similarly, sex did not significantly influence the prevalence of bovine fasciolosis in the study area: males (49.73%) and females (48.73%). This lack of variability aligns with findings from several earlier studies (Tsegaye et al., 2012; Petros et al., 2013; Aregay et al., 2013; Mebrahtu & Beka, 2013; Tilahun et al., 2014; Gebrie et al., 2015; Ewnetu et al., 2015; Ayelign & Alemneh, 2017; Legesse et al., 2017; Bayou & Geda, 2018; Desa & Mitiku, 2019). Conversely, significant variability in prevalence rates among sex groups has been reported in other studies (Eshetu et al., 2017; Mohammed et al., 2018; Zewde et al., 2019).

Breed also did not significantly influence the prevalence of bovine fasciolosis in the study area: local breeds (51.62%) and crossbreeds (46.15%). This finding corresponds with several earlier studies that also reported non-significant differences in prevalence rates among breed categories (Tilahun et al., 2014; Gebrie & Alemneh, 2015; Legesse et al., 2017). Conversely, significant variability among breed groups has been documented in other studies (Tsegaye et al., 2012; Aregay et al., 2013; Asrese & Ali, 2014).

5. Conclusion

The study reveals a concerning prevalence of Fasciola eggs in cattle fecal samples, with nearly half testing positive (49.21%). Localities and body conditions significantly influence these rates, whereas age, sex, and breed did not show notable variations ($p < 0.05$). Despite these differences, bovine fasciolosis remains prevalent in the area. It is crucial to enhance farmer awareness, implement regular deworming practices, and adopt effective management strategies to control the disease and minimize economic losses.

Data sharing statement

All data generated or analysed during this study are available upon the request of the corresponding author.

CRediT authorship contribution statement

Abraham Belete Temesgen: Writing – review & editing, Writing – original draft, Resources, Investigation, Conceptualization. Tesfaye Mesfin: Writing – review & editing, Writing – original draft, Resources, Investigation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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