Prevalence and associated risk factors of bovine schistosomiasis in *Dembecha* district, North West Ethiopia

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Received: 12 December, 2023 **Accepted:** 21 June, 2024 **Published:** **17** September, 2024

ABSTRACT

A cross-sectional study design using a cluster sampling method was employed to estimate the prevalence of bovine schistosomiasis, identify potential risk factors, and reveal the distribution of snails in moist environments in the Dembecha district of Ethiopia. Fecal examinations for parasitic eggs and visual observations of snail distributions were conducted in four kebeles (the lowest administrative unit in Ethiopia) within the study district. The study investigated potential risk factors such as age, sex, body condition, management system, and grazing area of cattle. The results indicated that the prevalence of schistosomiasis was 16.4% (63 out of 384), with significantly higher rates in cattle with poor body condition ($p = 0.003$). Wad and Yetsed kebeles exhibited relatively high snail infestations compared to Godber and Yemehal. In conclusion, schistosomiasis is prevalent in the Dembecha district, necessitating further research to identify the species of the parasite and its snail intermediate host.

Keywords: Prevalence; Schistosomiasis; Snail; Bovine; Dembecha; Ethiopia
DOI: https://dx.doi.org/10.4314/ejst.v17i2.2

INTRODUCTION

Schistosomiasis, caused by blood flukes (schistosomes), is a widespread disease endemic in many developing countries (Gryseels, 2012). Schistosomes are dioecious parasitic flatworms that live in the vasculature of their mammalian definitive hosts (Utzinger, 2014). This disease is a snail-borne trematode infection of humans and animals, and bovine schistosomiasis has been reported from parts of various parts of tropical and subtropical countries (Stothard *et al.*, 2004). Parasitological techniques used to demonstrate the eggs of the parasite from fecal samples represent the classical method for the detecting Schistosoma infection in bovines (Aradaib *et al.*, 1995). Infections with all major Schistosoma species can be treated to reduce worm burden, which, in turn, decreases parasitic egg production thereby reducing the morbidity and mortality of the infected host (Inobaya *et al.*, 2014). The spatial and temporal distribution of intermediate host snails plays an important role in the epidemiology and control of schistosomiasis.

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Snail distribution is influenced by numerous environmental and anthropogenic factors (Krauth *et al.*, 2017). In Ethiopia, bovine schistosomiasis is endemic, particularly in areas where large permanent water bodies and marsh pasture areas are infested with snails (Yihunie *et al.*, 2019; Kifle *et al.*, 2022). However, data are scarce regarding the magnitude of cattle schistosomiasis and the distribution of snails in and around the Dembecha district. Therefore, this study aimed to estimate the prevalence of bovine schistosomiasis, identify associated potential risk factors, and indicate the distribution of snails in various moist environments of the study area.

MATERIALS AND METHODS

Description of the study area

This study was conducted in and around Dembecha district, West Gojam Zone of the Amhara Region, Northwestern Ethiopia. The district covers an area of 971,291 km^2. The main rainy season extends from June to October, while the dry season lasts from November to May. The area experiences summer rainfall with a mean annual rainfall of 1,006 mm. The mean temperature ranges from 15 to 25 $^{\circ}$C and the altitude varies from 1500 to 2995 m.a.s.l. The landscape of the Dembecha district is characterized by the presence of large permanent water bodies, small streams, and swampy and marshy pasture lands (Dembecha District Office of Agriculture, 2018). Figure 1 shows the map of the study area.

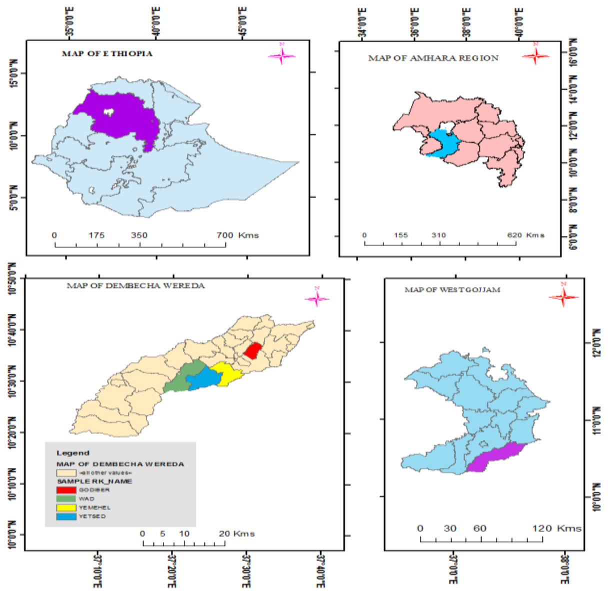

Figure 1. Map of the study area

Study population

The cattle were divided into two age groups: young (≤ 2 years) and adult (>2 years), including both local and exotic breeds under extensive and semi-intensive management systems. The age of cattle was estimated using the dentition pattern of the animals as previously described (Matharu, 1968). Cattle were also categorized into three body condition scores: poor, medium, and good based on the visibility of the skeleton (Nicholson *et al.*, 1986).

Study design

A cross-sectional study was conducted in four kebeles of Dembecha district from September to October 2022 to estimate the prevalence of bovine schistosomiasis and identify potential risk factors associated with the disease.

Sampling method and sample size determination

A cluster sampling method was applied for selecting study kebeles and peasant associations. From the total of thirty-one kebeles in the Dembecha district, Yemehal, Godber, Yetsed, and Wad were selected. Cattle with a history of recent deworming were excluded from sampling.

The sample size for this study was calculated using cluster sampling formula (Bennett *et al.*, 1991), $n_c = p(1-p)d/s^2b$ with assumption of intracluster correlation coefficient (ρ) as 0.2, 95% confidence interval and 5% precision. Here p is expected prevalence of shcistosomiasis, which was 16.5% (Aragaw *et al.*, 2018), d is design effect, s is desired level of precision and b is the estimated average number of cattle, which is 5, in a household. The design effect $(d) = 1+(b-1)\rho$ (Donner *et al.*, 1981), and $d= 1+(5-1)0.2=1.8$.

Therefore, the number of clusters (samples) necessary for this study was calculated as follows: Number of clusters = $p\ (1-p)\ d/s^2b$ = 0.16 (1-0.16) 1.8 / $0.05^2$5 =19. From nineteen clusters, a total of 384 cattle were selected for examination of schistosoma eggs in feces.

Fecal sample collection and transportation

After proper restraint and recording basic information, fresh fecal samples were collected directly from the rectum of individual cattle using gloves. Each sample was labeled and preserved in 10% formalin in clean screw cap universal bottles to prevent the hatching of miracidia before reaching the laboratory to diagnose within 24 h of collection. Samples were brought to the parasitology lab for conventional sedimentation. In a nutshell, 40 ml of water was added to around 3 g of excrement in a centrifuge tube, and everything was well mixed. After pouring the suspension through a tea strainer into a different centrifuge tube, it was allowed to sit for fifteen minutes. The sediment was then re-suspended after the supernatant was poured off. Until the supernatant was removed, this process was done three times. Lastly, the silt was examined under a low power (10x) microscope after being pipetted onto a clean slide. When the slides had an oval to spindle form, a central bulge, and a terminal spine on one side, they were considered positive.

Snail distribution

During the snail survey, all potential habitats in the aforementioned kebeles were visited, including the stream sides of watering points, muddy areas, irrigation canals, swampy regions, dam areas, and some moist, bushy places covered with plants. Snail surveys were conducted in the morning when the environmental temperature was relatively low and the humidity was suitable for snail survival. During each sampling session, snails were collected from each site by handpicking and placed between two layers of moistened cotton in a labeled petri dish, then preserved with ethanol for further examination.

Data management and analysis

The data were coded, entered, and properly stored in a Microsoft Excel spreadsheet before statistical analysis using SPSS software version 20. Descriptive statistics, as well as univariate and multivariate logistic regression analyses, were conducted to identify potential risk factors associated with bovine schistosomiasis. A statistical significance level of $p < 0.05$ was considered significant.

RESULTS

The prevalence of bovine schistosomiasis

The examination of 384 cattle revealed that 16.4% tested positive for the Schistosoma parasite. Notably, higher prevalence rates were observed among specific groups: adults: 18.4%, females: 18.7%, poor body condition: 25.0%, and extensively managed: 16.9%. In terms of associations, body condition score correlated with Schistosoma positivity, while factors such as age, sex, breed, origin of cattle, and management practices did not show significant associations with schistosomiasis based on univariate analysis (see Table 1). All variables with a p-value of 0.25 or less from the invariable analysis were included in the multivariate logistic regression analysis. The results reaffirmed that poorly conditioned cattle exhibited a significantly higher infection rate of schistosomiasis (see Table 2).

Table 1. Prevalence and risk factors of bovine schistosomiasis using invariable logistic regression

Risk factors		**Sampled**	**Positive**	**Prevalence (%)**	**OR**	**OR of 95% CI**	***p*-value**
Age	Young	118	14	11.9	-	-	
	Adult	266	49	18.4	1.68	0.89-3.2	0.11
Sex	Male	181	25	13.8	-	-	
	Female	203	38	18.7	1.56	0.90-2.71	0.12
Breed	Local	338	56	16.6	-	-	-
	Cross	46	7	15.2	0.90	0.38-2.12	0.82
Body condition	Poor	152	38	25.0			
	Medium	162	19	11.7	0.40	0.22-0.72	0.00
	Good	70	6	8.6	0.29	0.12-0.71	0.01
Manage-ment	Extensive	326	55	16.9	-	-	
	Semi-extensive	58	8	13.8	0.79	0.35-1.76	0.56
Origin	Yemehal	96	10	10.4		-	-
	Godber	96	16	16.7	1.72	0.74-4.01	0.21
	Yetsed	96	18	18.8	1.98	0.86-4.56	0.11
	Wad	96	19	19.8	2.12	0.93-4.84	0.07

*CI= confidence interval; OR= odds ratio

Table 2. Prevalence and risk factors of bovine schistosomiasis using multivariable logistic regression.

Risk factors		**Number sampled**	**Positive**	**Prevalence (%)**	**OR**	**OR of 95% CI**	***p*-value**
Age	Young	118	14	11.9	-	-	-
	Adult	266	49	18.4	2.282	1.2-4.5	0.019
Sex	Male	181	25	13.8	-	-	
	Female	203	38	18.7	1.474	0.8-2.6	0.191
Body condition	Poor	152	38	25.0	-	-	
	Medium	162	19	11.7	0.343	0.2-0.7	0.001
	Good	70	6	08.6	0.252	0.1-0.7	0.005
Origin	Yemehal	96	10	10.4	-	-	-
	Godber	96	16	16.7	1.559	0.7-3.7	0.319
	Yetsed	96	18	18.8	2.474	1.0-5.9	0.041
	Wad	96	19	19.8	2.784	1.2-6.6	0.021

*CI= confidence interval; OR= odds ratio

Risk factors

The findings indicate that cattle in good and medium body condition, as well as adult cattle, were three times less likely to acquire Schistosoma infection compared to those in poor body condition. Additionally, the Yetsed and Wad kebeles were identified as being three times more likely to serve as sources of Schistosoma parasites. These results highlight the significance of body condition and specific geographic locations in the risk of schistosomiasis infection among cattle.

Snail distribution in and around Dembecha district

In *Dembecha* district, snails were distributed along the stream side (26.3%), muddy area (22.8%), swampy area (14.9%), and on the surface of green leaves (9.6%). We found that the highest snail infestation was along the steam side. Wad kebele had the highest (42.1%) snail infestation among others (Table 3).

Table 3. Snail distribution in the different moist sites of Dembecha area, West Gojam Zone, Amhara Region, Ethiopia.

Kebele	**Along stream side**	**Muddy area**	**Swampy area**	**On green leaves**	**Total**
Yemehal	4	3	2	0	13 (11.4%)
Godber	5	6	3	2	21 (18.4%)
Yetsed	8	5	4	4	32 (28.0%)
Wad	13	12	8	5	48 (42.1%)
	30 (26.3%)	26 (22.8%)	17 (14.9%)	11 (9.6%)	114

DISCUSSION

The overall prevalence of bovine schistosomiasis in the current study area was found to be 16.4%, which is relatively lower than rates reported in various other regions of Ethiopia. For instance: 21.28% in and around Haramaya (Dagm *et al*., 2024), 16.7% in South Wollo and Oromia Zones, 24.6% in South Achefer district (Yirsaw *et al*., 2016), 22.92% in and around Bakko Town (Feyissa *et al*., 2017), 22.2% in South Achefer district (Yihunie *et al*., 2019), 26.3% in and around Gozamen District (Yezina *et al*., 2019).

Conversely, the prevalence in this study was higher than that found in South Gondar (13.7%, Mersha *et al*., 2012), around Debre Tabor town (7.6%, Mihret *et al*., 2015), in and around Nekemte (5.7%, Abriham *et al*., 2018), and in Dangila district (11.5%, Adane *et al*., 2015).

The discrepancies in prevalence rates may be attributed to several factors, including differences in irrigation practices, cattle husbandry methods, animal healthcare, climatic conditions, the availability of suitable intermediate hosts, and environmental factors like humidity and temperature. In the Dembecha district, cattle are primarily kept for milk production, fattening, or ploughing, often subjected to zero grazing or managed in individual grazing lands far from moist environments. Additionally, the local production of alcohol (known as areki in Amharic) generates a byproduct called brinte, which serves as the main supplemental feed for cattle. These factors collectively likely contributed to the limited exposure of cattle to conditions favorable for schistosomiasis in the study area.

In the study area, the highest prevalence of cattle schistosomiasis was recorded in Wad kebele at 19.8%, followed by Yetsed at 18.8% and Godber at 16.7%. The elevated prevalence in Wad Kebele may be attributed to the presence of numerous marshy areas and the Gantina River, which traverses the communal grazing lands of Barza Mesk, Shembekuma, and Chikulit. This river serves as a major water source for livestock, creating a favorable environment for the intermediate host of the parasite. Similarly, the prevalence in Yetsed and Godber can be linked to marshy and stagnant water bodies, such as Beter Mesk and Worke Mesk, as well as the presence of rivers like Getem and Gula. In contrast, the lowest prevalence of 10.4% was observed in Yemehal, where the conditions were less favorable for the intermediate host due to seasonal marshy areas and small rivers that may dry up during the dry season. As noted in veterinary parasitology literature, marshy areas and stagnant water bodies—such as small streams, ponds, and irrigation sites—are significant sources of schistosomiasis infection (Urguhart *et al*., 2003). Additionally, cattle in poor body condition were more susceptible to schistosomiasis, a finding supported by previous research (Yihunie *et al*., 2019) indicating that poorly conditioned cattle are particularly vulnerable. Body condition is closely linked to nutrition and immunity; inadequate nutrition can compromise an animal's ability to maintain immunity against diseases (Alwarawrah *et al*., 2018). This highlights the relationship between nutritional status and the susceptibility of cattle to schistosomiasis. Although the moist environments in the study kebeles were infested with snails, the life cycle of schistosomes could be interrupted if these snails were unable to acquire miracidium, the first larval stage of Schistosoma.

CONCLUSION

Taken together, schistosomiasis in cattle was prevalent in Dembecha district with a wider distribution of snails in moist environments. However, Schistosoma species identification and distinguishing snail hosts responsible for this disease warrants further investigation.

ACKNOWLEDGEMENTS

The authors would like to thank staff members of the Dembecha District Livestock Development Office for their kind support during field sample collection and laboratory work.

DECLARATION

The authors declare that there is no conflict of interest regarding the publication of this article

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