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A Study on Prevalence of Bovine Schistosomiasis in Fogera Woreda, North Western of Ethiopia

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Abstract: A cross sectional study was conducted in Fogera Woreda, Amhara Regional State, North Western of Ethiopia, involving a field survey to determine the prevalence of bovine Schistosomiasis and to assess the determinant factors associated with the occurrence of the disease. Out of a total of 442 cattle examined, 72 (16.28%; 95% CI; 12.97-20.07%) were found positive for *Schistosoma bovis (S. bovis)* using coproscopic examination. Although there was no significant difference ($p > 0.05$) between in different breeds of cattle, higher prevalence was observed in the local breed (17.49%) when compared to cross breed animals (8.4%). In investigating the influence of sex on the infection rate, a significant difference ($p < 0.05$) was found between male and female sexes. Female animals were highly infected (20.9%) than that of their male counterparts (11.71%). Moreover, statistically significant ($p < 0.05$) difference was obtained among different age groups of cattle, the highest being in animals between 2-5 years age group (25%) followed by animals > 5 years of age (15%) and < 2 years of age (10%). Thus, an urgent implementation of control methods should be applicable to the area and creation of awareness to cattle owners on the impact of the disease is necessary.

Key words: Bovine · Schistosomiasis · Prevalence · Coprology · Fogera

INTRODUCTION

Ethiopia lies within the tropical altitudes of Africa and has an extremely diverse topography and a wide range of climatic features and altitudes of agro-ecological zones, which makes the country suitable for different agricultural production systems. This in turn has contributed to the existence of large diversity of farm animal genetic resource in the country [1].

Animal production is an important part of agricultural sector of the Ethiopian economy. The livestock population of the country is the largest in Africa. However, production is well below potential due to the poor health status of national herds among other reasons [2]. The current cattle, sheep, goat, camel and poultry population of Ethiopia is approximately 38, 28, 18, 1, 56.5 million, respectively. These livestock are almost entirely managed by the resource poor small holder farmers and pastoralists [1].

Development of large animals is constrained among other important factors by a wide spectrum of diseases like schistosomosis. Schistosomosis (Blood fluke disease or bilharziasis) is an infection due to the genus *Schistsoma* [3]. Although this parasite occurs to many tropical and subtropical areas, the disease is important to livestock mainly in Eastern Asia, Africa and India [4, 5]. Schistosomes are thin, elongated flukes up to 2 cm long primarily parasitizing blood vessels of the alimentary and bladder responsible to cause schistosomosis [3].

A total of nineteen (19) different species are described worldwide [6] and they can be differentiated between from their morphological features, lifecycle, host specificity, enzyme and DNA and behavioral characteristics [7]. Out of ten species reported to naturally infect cattle, six have received particular attention mainly because of their veterinary significance; *S. matthiee*, *S. bovis, S. cunasoni, S. indicum, S. nasale* [8, 9].

Adult schistosomes are obligate parasites of the blood vascular system of vertebrates. Schistosomes are dioceious (Unisexual) worms which are an exception with of to the trematodes and have an indirect life cycle, while water snails act as an intermediate host belonging to the genera *Bullinus* and *Planorbis* [10]. The geographical distribution of *Schistosoma* has been determined primarily

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by the distribution of the snail intermediate host particularly *Bullinus* and *Planorbid* species which are important for bovine and ovine schistosomosis [3].

In Ethiopia, different *Bullinus* species (*B. truncatula, B. africancus* and *B. abyssinicus*) serves as the intermediate host as reported on to different regions of the country like Tigray, Gondar, Gojjam, Wolega, Sidamo, Shewa, Arsi, Harrarge and Wollo. The prevalence of *S. bovis* was found to be 12.3% in cattle in Bahir Dar [11] 5.5 % in Awassa and 1.5% in Gewani [12]. However, *S. Mattheei* has not been reported in Ethiopia [11, 13].

After copulation of male and female schistosomes within the lumen of vein, adult female moves against the venous blood flow in to small venules, when she deposited 200-2000 eggs per day. The ova pass through the wall of blood vessels and then to adjacent tissues. The ova may be discharged in feces or urine and large amount may be trapped in tissues of the final host [3, 14]. In the water, eggs are hatched and release miracidia. The miracidia then invade suitable water snails and develop in to cercariae. When cercariae are fully matured, they leave the snail and invade the final host through the skin or mucus membranes after penetration; cercaria develops into schistosomula, which are transported through the lymph and blood to their predilection sites [14-16].

The pathology and clinical signs of the disease are largely attributed to the spined egg causing tissue irritation in cattle. The clinical signs exhibited are emaciation, marked diarrhea mixed with blood or mucus, dehydration and marked weight loss [6, 17, 18]. At necropsy, the disposition and enzyme secretion by the pores of egg can cause a rupture of the basement membrane, obstruction of the small venules and their migration results in small hemorrhagic ulcer that leads to overt hemorrhage and anemia [19].

Schistosomosis, which is known for its chronic course [6, 11, 20], will not show rapid changes in the animal or herd. This lead to undermining the important of the disease, but we have no adequate way to measure it and can easily be over looked [11].

In addition to high prevalence and outbreak of the disease, it has an economic impact like production losses due to *S. bovis* resulting from mortality, delayed growth, partial liver condemnation, poor future reproduction performance and subclinical infections. These cause significant losses due to long term effects on an animal growth and productivity capacity or milk yield, draft power and increases susceptibility to other parasitic and bacterial diseases [17, 18, 21].

Apart from the above, there have been few publications which indicate the economic effect indirectly by estimating the delay growth, uncompensated weight loss at 10 kg in one year and later these animals command a lower export price ($ 390 and $ 400) [18] and also delayed conception and large calving interval which have also a big economic impact on livestock production system [22].

Even though the disease has got negative impacts, it is only within recent years and wide spread deaths of cattle and sheep that recognition has been given to the veterinary importance of these parasites [23-25].

In humans, economic losses in terms of working hours have been shown [11, 26] and it can also cause cutaneous larva migrans, often called "Swimmers itch" (Cercarial dermatitis) in agricultural workers and swimmers [3].

Diagnosis of the disease is based mainly on the clinico-pathological picture of diarrhea, wasting and anemia, coupled with a history of access to natural water sources. The relatively persistent diarrhea, often blood stained and containing mucus may help to differentiate this syndrome from Fasciolosis [3]. The demonstration of the characteristics of the eggs in the feces or in squash preparations of blood and mucus from the feces is useful in the period following patency, but less useful as egg production drops in the later stages of infection [3]. The eggs are characteristic in shape and size for each species. The schistosome eggs are oval (as in *S. mansoni, S. haematobium, S. japonicum)* to spindle shaped (as in *S. bovis, S. mattheei)* containing a single spine protruding from the shell. The position of the spine on the egg shell is a distinguishing feature; a lateral spine in the ova of *S. mansoni*, a rudimentary lateral spine in *S. japonicum* and a terminal spine in others [27].

Over the years, different drugs with known schistosomocidal effect and also others agents with toxic effects such as antimonials, trichlorphone or neguvon have been tested against visceral schistosome infection in cattle [24, 25]. Praziquantel is now recognized as a drug of choice against all forms of human schistosomosis [28]. In cattle, it has been successfully used against *S. bovis* and *S. spindale* [29, 30].

Obviously the most effective way to control cattle schistosomosis in endemic area is fencing of dangerous waters and supply of clean water to prevent contact between the animal and the parasite. Unfortunately, this is not always possible in most parts of the world where nomadic type of management of animal prevails [6]. Other methods of control are targeted against the snail intermediate host population like chemical measures include the use of molluscicdes of current available chemicals Bayluscide (Niclosamide) and copper sulfate are the choice of molluscicide. In addition to these, native Ethiopian plant, *Phytoplacca dodecandara* locally known as 'Endod' is also an effective molluscicide [13].

Epidemiological studies conducted on bovine schistosomosis are suggestive of the endemicity of the disease particularly in areas with permanent water bodies and marshy pasture areas like Gewane and Awassa the infection rate was found to be 1.5% and 5.5%, respectively [12]. Apart from this, 17.4% prevalence was reported on to the current study area by Bahir Dar Regional Laboratory Disease investigators in the year 2006. In spite of those information's available in the study area; this work was done to have current information on the prevalence of the disease.

Therefore, the objectives of this study were to determine the prevalence of bovine Schistosomiasis in Fogera Woreda and to investigate the factors associated with the occurrence of the disease in the study area.

MATERIAL AND METHODS

Study Area: The study was conducted in Fogera Woreda which is located in South Gondar Zone of the Amhara National Regional State (ANRS), North Western of Ethiopia. Fogera Woreda is located in the North West of Bahir Dar Town at a distance of 60 kms, on the main high way leading to Gondar. The Woreda is bordered on Farta Woreda in the east, Dera in the South, Lake Tana in the West and Libokemkem Woreda in the North. The total area of Fogera are 117,414 hectares (ha) out of which 54,471.76 ha is crop land, 9,602.36 ha grazing land, 2,190 ha forest land, 251 ha is covered with perennials, 23,354 ha is water body (Lake Tana), 7,075 ha is used for constructions, 4,375 ha waste land and the rest 1,698.24 ha are swampy areas. Topographically, the flat (Plane) area accounts for 76%, mountain and hills 11% and the valley bottom is 13%. Fogera has 40,958 households in which 40,630 are in rural areas and 328 households are found in the urban area. The Woreda is agro-ecologically characterized as moist "Weina Dega" and the annual rainfall is monomodal ranging from 1,103 mm to 1,336 mm and the temperature ranges from 19-20°C [31].

The population size of Fogera Woreda is 236,553. Out of these, 121,424 are males and 115,129 are females. Among this, 208,898 (88.3%) people live in the rural areas and the rest 27,654 (11.74%) are in towns [32]. Fogera has 40,958 households in which 40,630 found in rural areas and 328 households are found in the urban area [31].

In Fogera Woreda, there are 157,128 cattle (109,989.6 TLU), 7,607 sheep (760.1 TLU), 27,867 goats (2,786.7 TLU), 339 Mules (237.3 TLU) and 246,496 (2464.96 TLU) chicken and 21,883 beehives. Only 2831 (1.8%) cattle are found in urban whereas 154,297 (98.2%) are located in the rural areas [33]. Both traditional and modern (Semi-intensive) stock farming are practiced in the study area. In the traditional system, animals are often kept out doors and grazed all day near the vicinity of around swampy area.

Study Populations: The sampling units of the study were local and cross breed cattle in which 'Fogera breed' is dominant local of cattle [34]. A total of 442 cattle were examined. Of these animals, 222 were males whereas the remaining 220 were females. Breed, sex and age, of the animals were the explanatory variables used to investigate variation in the susceptibility of animals with the disease in the study area. The age of animals was determined according to De-lahunta and Habel [35]. The variation in prevalence among different age groups was noted by classifying animals into three groups as: < 2 years old (Group I), between 2-5 years of age (Group II) and > 5 years (Group III).

Study Design: A cross sectional study design was adopted to determine the prevalence of bovine schistosomosis. Faecal samples were collected from selected animals only during a single visit made on field trips.

Sample Size Determination: The desired sample size was determined using the formula given by Thrusfield [36] for simple random sampling.

$$N = \frac{1.96^2 \times P_{exp}\ (1-P_{exp})}{d^2}$$

where,

N = Required sample size

P_{exp} = Expected prevalence

d^2 = Desired absolute precision

The sample size required for the present study at 95% confidence level, with 5% desired absolute precision and an average prevalence of 17.4% is 221 cattle. But in this study a total of 442 cattle were selected using simple random sampling method to increase the precision of the estimated prevalence of the disease.

Study Methodology: The purpose of coprological examination was to determine the presence or absence of *Schistosoma* eggs in the feces. Fresh fecal samples were directly collected from the rectum of 442 selected animals and preserved with 10% formalin in a universal bottle to prevent hatching of miracidia then after sedimentation procedure was done till the sediment of the fecal sample become clear. Following these all procedures, the prepared samples were observed under low power magnification of the microscope in the laboratory.

Statistical Analysis: The data collected were entered in to Microsoft Excel Data base system. Data were analyzed using STAT 7 intercoded statistical software. The prevalence was calculated by dividing the proportion of cattle infected with *Schistosoma* (the finding of at least one *Schistosoma* egg in the faeces) by the total number of animals examined multiplied by 100%. The determinants of schistosomosis were investigated using percent values and Pearson's Chi-square (x^2) test. A statistically significant association between variables was said to exist if the calculated $p < 0.05$ at 95% confidence interval (CI).

RESULTS

Prevalence Study: From the total of 442 cattle examined in the field survey, 72 (16.28%; 95% CI: 12.97-20.07%) animals were found harboring *S. bovis* at coproscopic examination. Out of 222 male animals examined, 26 (11.71%) were found infected whereas among 220 female study animals, 46 (20.9%) were found excreting the egg of *S. bovis* (Table 1).

The prevalence of the disease in Kuher Abo, Shena and Rebe Kebeles from where animals were examined was determined to be 15.64%, 17.0% and 16.2%, respectively. The number of animals examined and found excreting the egg of *Schistosoma* is presented in Figure 1.

Risk Factors Investigation

Variation between Breeds: From 385 local and 59 cross breeds examined, 17.49% and 8.4%, respectively, were found positive. Local breeds showed higher infection rate as compared to crosses, however, the difference was not statistically significant ($p > 0.05$). The variation in the susceptibility of the two breeds to schistosomosis is presented in Table 1.

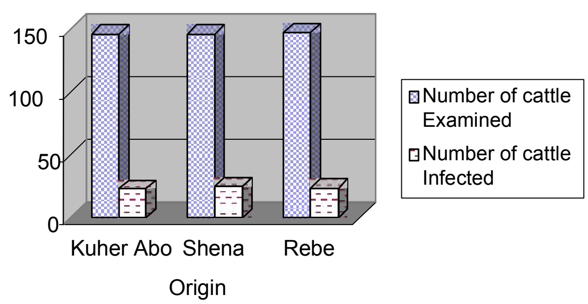

Fig. 1: The number of animals examined and found infected in three selected kebeles of Fogera Woreda.

Table 1: Association of bovine Schistosomiasis with breed, age and sex of cattle examined at the study area

Risk Factor	Number of Animals Examined	Negative	Positive	Prevalence	x^2-Value	P-Value
Breed						
Local	385	318	67	17.49%	3.0496	0.081
Cross	59	54	5	8.40%		
Age						
< 2 years	180	161	19	10.50%		
2-5 years	136	102	34	25%	12.0425	0.002
> 5 years	126	107	19	15%		
Sex						
Male	222	194	26	11.71%	6.8598	0.009
Female	220	174	46	20.90%		
Total	442	370	72	16.28%		

Variation among Age: A statistically significant difference ($p < 0.05$) in the rate of infection was found among the different age groups considered. Animals between 2-5 years of age were found highly infected than the rest age groups. Table 1 summarizes the variation in susceptibility of cattle among different age groups.

Variation Between Sexes: The prevalence of infection between male and female sexes was compared in this study and variation in sex specific prevalence was found statistically significant ($p < 0.05$). The level of infection was recorded higher in females (20.9%) than males (11.71%). Table 1 shows comparison in susceptibility between the two sexes.

DISCUSSION

A cross sectional study was conducted on cattle in three selected kebeles of Fogera Woreda. Out of 442 cattle examined, 72 had *Schistosoma* eggs giving an overall prevalence of 16.28% indicating that *Schistosoma* is widespread in the study area. The presence of the characteristic eggs in fecal examination indicates exposure of the animals to the parasite.

The overall prevalence of *Schistosoma* in the present study (16.28%) was in agreement with the finding of Solomon *et al*. [37] who reported a prevalence of 17.4% in the same study area (Fogera Woreda). In fact, there is a decrement by 1.12%. This might be due to the emphasis that the concerned bodies were paying efforts in prevention and control of disease in the area, though the decrement needs further quantification to determine the level of improvement made.

Different studies conducted in Bahir Dar revealed 33.8% [38] 29.0% [39] 17.4% [40] and 22.06% [41] prevalence of bovine schistosomiasis. Other studies made in showed a prevalence of 1.5% in Gewane [12] 5.5% in Awassa [12] and 28.0% in Kemissie [42]. The difference in the prevalence of schistomosis seen among the present study and those above-mentioned studies might be explained in different ways. The lower prevalence of schistomosis recorded in fecal examination, 1.5% in Gewane [12] and 5.5% in Awassa [12] might be due to the fact that trematodes are intermittent egg layers so that the chance of detecting eggs by fecal examination might be minimal. In addition, not all *Schistosoma* eggs are excreted in the feces, many of them could be trapped in the tissues [43]. Furthermore, having pivotal role for parasitic infestation, almost all parasites need adequate humidity and relatively low ambient temperature [44]. Higher prevalence of the diseases was documented in Bahir Dar, a place where lakes and rivers are abundant that is very ideal for parasite like *Schistosoma* having intermediate host inhabiting such environment, hence, animals might get a continuous exposure. So the difference in the rate of infection between the present study and those of the aforementioned studies might also be associated with the difference in their agro-ecology.

Even though the prevalence of schistosomiasis was higher in local breed of cattle (17.49%) than those in cross breeds (8.4%), the difference was not statistically significant ($p > 0.05$). The lower prevalence in cross breed cattle attributed to the modified management systems that exist in urban areas. Many people kept cross breed cattle in-doors and they moved them on the afternoon to grazing fields where animals get access of being infected, but relatively with minimal risk of being exposed, since the period of contact was short. While local breed animals were kept all the day in the field where they get a continuous access of infection. Though it seems a paradox, since local breed animals get higher risk of contracting infection, immunity may take the role of compensation, it is already established that innate or acquired immunity to *Schistosoma* and *Fasciol*a species occurs in animals. Immunity is manifested by decreased number of egg laid, by a decrease in the number of viable eggs or decrease in the ability of the animal to withstood super infection [45].

In this study, a significantly ($p < 0.05$) higher prevalence of *S. bovis* was observed in animal age grouped II (2-5 years) than in animals categorized in age group I (< 2 years) and group III (> 5 years). The prevalence was found to be 10.5%, 25% and 15.0% for age group I, II and III, respectively. This variation could be related with the length of exposure, young animals have lower chance of exposure to infection. From physiological point of view, animals begin their life with liquid meal and then they will be provided with collected feed until they experience grazing. In addition, young cattle were mostly indoor so that they might not get access to the infective stage as compared to the adult once [46] mostly this is practiced in our country to prevent calves from suckling milk and also to reduce labor associated with managing calves at the filed since calves will wander here and there when they get access to the field. With regard to a high prevalence of infection on the age group II, this may be due to longer exposure to the infective stage of the parasite without having major difference in susceptibility or resistance to this worm as compared to age group I animals and lower prevalence in age group III might be due to the intervention made by the immune system. Many animals become resistant to some parasites as they get matured, this is associated with innate or acquired immunity. If host are infected at an older age, the parasites either fail to develop, or are arrested as larval stage in the tissues [44].

From the total of 442 animals examined, 222 were females out of which 46 were found positive yielding a prevalence of 20.9%; and among 220 male animals examined, 26 were found positive giving an overall prevalence of 11.71%. There was statistically significant difference between sex groups ($p < 0.05$). This might be associated with the use of ox for ploughing, which provides them to spend most of their time on work with lower risk of being exposed. Apart from this, males are the selected animals to be sold for subsistence in their early life. Even though the chance of exposure is low as compared to females of equivalent age, there is another phenomenon that occurs as age increases for both sexes. Animals will resist subsequent infection and expression of the disease or eggs in the feces [46, 47]. While female animals are primarily kept for milk production so they would be allowed to graze almost all of their time in the area so getting higher risk of being exposed. And on contrary to males old females will be sold since the milk yield decreases as the animal gets aged. On top of this, there is a breakdown in immunity around the pre-parturient period and during lactation. Recent studies support the hypothesis that there is a competition between the immune system and the udder for nutrients, particularly metabolisable nutrients [44] this might further favor the difference in the prevalence between the two groups.

Generally, schistosomiasis was wide spread in the study area with higher prevalence that affects the health of animals directly and either directly or indirectly the health of humans too. More importantly, the productivity of animals will be seriously affected and this will hamper the journey toward maintaining feed self-sufficiency and it also affects the countries return from foreign currency, since *Schistosoma* infested animals will experience poor body condition, retarded growth and reduced draught power. So reducing the infestation rate will directly or indirectly improve specifically the livelihood of animal producers and the country's currency return in general.

CONCLUSION

Although there has been little recognition of its veterinary significance, cattle schistosomiasis can cause significant loss throughout the world. This is due to the nature of the disease which occurs at subclinical level with long term effect on the animal growth and productivity and increased susceptible to other parasitic and bacterial disease. Hence, it is important to obtain more information on natural *Schistosoma* infection. The present observation indicates that bovine schistosomosis is one of the endemic disease to the animals in the study area, as the result it involves a serious attention in the future. A high infection rate in female animals and in animals aged from two up to five years was recorded. Thus, appropriate prevention and control strategies should be implemented to lower the prevalence of the disease in the study area.

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