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Prevalence and Associated Risk Factors of Bovine Schistosomiasis in and Around Bakko Town, west Shoa Zone, Oromia, Ethiopia

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Abstract- Schistosome are a treamatode, snail-born parasitic of circulatory system in domestic animals and man. Ruminants are usually infected with cercariae by active penetration of the unbroken skin. *Schistosoma bovis* is the main cause of cattle schistosomiasis and is common in marshy area. A cross sectional study was conducted from November 2015 to March 2016 in and around Bakko town of Oromia, Ethiopia to investigate the prevalence and associated risk factors of bovine schistosomiasis. Simple random sampling technique was used to select 384 study animals and householders, whereas peasant associations (PA) were selected purposively focusing on those residing around Gibe River. Coprological examination with faecal sedimentation technique was used to recover the eggs of schistosoma. This revealed an overall prevalence of 22.92% (88/384) (95%CI: 18.71, 27.12). Multivariate logistic regression was used to examine the strength of association between predictor variables and the occurrence of schistosoma infection.

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Abstract- Schistosome are a treamatode, snail-born parasitic of circulatory system in domestic animals and man. Ruminants are usually infected with cercariae by active penetration of the unbroken skin. *Schistosoma bovis* is the main cause of cattle schistosomiasis and is common in marshy area. A cross sectional study was conducted from November 2015 to March 2016 in and around Bakko town of Oromia, Ethiopia to investigate the prevalence and associated risk factors of bovine schistosomiasis. Simple random sampling technique was used to select 384 study animals and householders, whereas peasant associations (PA) were selected purposively focusing on those residing around Gibe River. Coprological examination with faecal sedimentation technique was used to recover the eggs of schistosoma. This revealed an overall prevalence of 22.92% (88/384) (95%CI: 18.71, 27.12). Multivariate logistic regression was used to examine the strength of association between predictor variables and the occurrence of schistosoma infection. Even though risk factors like sex, age, body condition score, months and origins were considered, only origin (p=0.000) and animals' body condition score (p=0.001) were significantly associated with the occurrence of bovine schistosomiasis. Animals with medium and good body condition score were less likely to harbor *Schistosoma bovis* eggs than those with poor body conditions. This finding indicated that bovine schistosomiasis is one of the major livestock health problems which might be big limiter to livestock productivity in the study area. Therefore, further research should be conducted to obtain detailed information on its epidemiology for further control and prevention strategic development.

Keywords: cattle, bakko tibe, risk factors, prevalence, bovine schistosomiasis.

I. Introduction

Ethiopia has the largest livestock population in Africa. An estimate indicates that the country is a home for about 57.83 million cattle, 28.04 million sheep and 28.61 million goats (CSA, 2016). These farm animals are the major backbone of agricultural sector's income for Ethiopia and its livestock owners. Parasitism is one of the major bottle necks to livestock development in the tropics including Ethiopia (Sissay *et al.,* 2007). From these parasites cattle schistosomiasis is one of the major economically important animal diseases as it causes mortality, retarded growth, poor productivity, low milk yield and increased susceptibility to other parasitic or bacterial disease '(Marquardt and Greive, 2000; Lefevre *et al*., 2010)'. It is caused by parasitic schistosome which is a treamatode, snail-born parasitic of circulatory system in domestic animals and man. Although this parasite occur in many tropical and subtropical areas, the disease is important in livestock mainly in eastern Asia, Africa and India (Sewell and Brocklebsy, 1990). Other names given to schistosomiasis are blood fluke disease and bilharzosis (Parija, 2004). The term shistosome or schistosoma means split body and refers to the fact that the males have a ventral groove called a gynaecophoric canal (Marquardt and Greive, 2000). They are thin, elongated fluke, up to 2cm long primarily parasitize in blood vessels of alimentary, nasal vein and bladder.

The geographical distribution has been determined primarily by the distribution of snail intermediate host, particularly *Bulinus conturtus, Bulinus truncates, Physopsis africana and physopsis globosa* are important for bovine and ovine schistosomosis (Urquhart *et al*., 1996). Domestic animals in various tropical areas may be infected with *Schistosoma bovis* (cattle and sheep), *Schistosoma indium* (horses, cattle, goats in Indian), *Schistosoma matheei* (sheep, South Africa), *Schistosoma suis* (Swine and goats in India), *Schistosoma japonicum* (humans, carnivores, artiodactylids, perissodactylids, rodents and primates) and *Schistosoma margrebowei* (horses, ruminants and elephants in Africa), *Schistosoma spindale* (ungulates); *Schistosoma nasale* (cattle, causing 'snoring disease') '(He *et al*., 2001)'. *Schistosoma mekongi*, conversely, is limited to humans and dogs, with pigs also possibly a natural host (Crosby & Garnham, 2009). *Schistosoma haematobium* affects (human and non-human primates (not apes), artiodactylids (pigs, buffalo) in Africa, and Middle East); *Schistosoma mansoni* has vast host (Human and non-human primates (including apes), rodents, insectivores, artiodactylids, procyonids (raccoon) in Africa, Middle East, South America, and Caribbean) (Standley *et al*., 2011).

Transmission of Schistosomiasis is mainly based on contamination of water with cercaria, use of such water for drinking or irrigation and the presence of snails in area. All adult species of genus schistosoma are found in the mesenteries, portal, sub-serosal,

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pancreatic, and sometimes splenic veins and the branches of the pulmonary arteries and also in the nasal mucosal veins. They copulate there, and the female lay eggs which reach the outside either through feces or urine (Nithiuthai *et al.*, 2004). Eggs passed in the feces must be deposited in water if they are to hatch and release miracidia, which invade suitable water snails (*Bulinus* and *Physopsis*) and develop through primary and secondary sporocysts to become cercariae. When fully mature the cercariae leave the snail and swim freely in the water to find new hosts. Ruminants are usually infected with cercariae by active penetration of the unbroken skin, although infection may be acquired orally while animals are drinking water (Marquardt, 2000; Jozef, 2015).

Schistosoma bovis is the main cause of cattle schistosomiasis. It has localized distribution, which is found commonly in northern, eastern, southwestern and central parts of Ethiopia (Yalelet, 2004). Reports on animal schistosomes are very scanty and epidemiological studies conducted on Bovine schistosomiasis are suggestive of the endemicity of the disease particularly in the area with large permanent water bodies and marsh pasture area (Mersha *et al.*, 2012). The prevalence of *Schistosoma bovis* has been reported from different regions of the country by a number of authors; in Kemissie it was 28% by Ameni *et al.* (2001), in Bahir Dar it was 33.8% by Solomon (2008), in Fogera it was 10.17% by Mengistu *et al.* (2012), and 13.70% by Mersha *et al.* (2012), in Debre Tabor it was 7.6% by Mihret and Samuel (2015), in Dangila it was 11.5% by Alemayehu *et al.* (2015) and in and around Bahir Dar it was 26.3% by Samuel *et al.*, (2016) were evident by coproscopic examination. The report from Bahir Dar Abattoir by Hailu (1999) revealed that prevalence 48%; 30.3% by Yalelet (2004) and 28.14 by Almaz (2007) 28.14% and in Jimma 13.46% prevalence by Abebe *et al.* (2011).

When these are an evident on its endemicity in the country, there is no any assessment and report regarding the prevalence, and associated risk factors of bovine schistosomiasis in and around Bakko town, Oromia, Ethiopia. This area is endowed with large water body and marshy areas. Moreover, estimation of prevalence and associated risk factors of the disease is important for decision making, planning, development and implementation of control and prevention strategies. Therefore, the present study was carried out to investigate the prevalence and associated risk factors of bovine schistosomiasis in and around Bakko town.

II. Materials and Methods

a) Study Area and Period

The study was conducted in and around Bako town from Nevomber 2015 to March 2016. Bako town is the center of Bakko-Tibe district in Oromia National Regional State of Ethiopia. The town is located 250 km in the west of Addis Ababa, the capital of Ethiopia, at an altitude of 1650 meter above sea level on 37° 09' E and 9° 06' N. The town has hot and humid climate with average relative humidity of 60%. It gets a bimodal pattern of rainfall with the main rainy season extending from June to September and a short rainy season that extends from March to May with an average annual rainfall of 1300 mm. Mean monthly maximum and minimum temperatures are about 28 and 14°C, respectively, with an average monthly temperature of 21°C. It has larger boundary border with Gibe River. Farm animals are the major source of agricultural income for the livestock owners. The livestock estimate of the year 2014\15 given by Bakko Tibe District office of Animal Healthy and Marketing indicates that the district has 180046 indigenous livestock population which constitutes ox 40334, cow 47681, heifers 22982, bulls 25891, calves 1720; sheep 12627; goats 14354; donkey 8499; horse 3721; mule 1033, poultry 1204 and 219 exotic breed. Livestock is reared in the area with mixed farming and extensive free grazing animal husbandry practice. In addition the farmers in study area are carrying out the agricultural irrigation channel and dam activities around the river that favor the survival and multiplication of intermediate host. These grazing areas are potential source of schistosoma infection due to the frequent contact of animals to the water bodies (BTWOAHM, 2016).

b) Study Design

A cross-sectional study was used to determine the prevalence and associated risk factors of bovine schistosomiasis. It involved categorization of the study population according to their origin namely Peasant Association (PA), body condition score (BCS), sex and age. From the total of eleven kebeles in and around Bakko town, six peasant association namely Dambi gobbu, Dambi dima, Gajo, Bakko 01, Bakko 02 and Abbo metti were selected purposively as they are the near border of Gibe river and have stagnant water bodies that is a favorable environmental condition for the intermediate host; while simple random sampling technique was employed to select house holders and the study animals from all the six PAs.

c) Sample Size Determination

The desired sample size was calculated by using the formula given by Thrusfield (2005); with 95% confidence interval, 5% desired absolute precision and 50% expected prevalence because it gives maximum minimal sample size. Accordingly, the determined number of animals was 384.

d) Study Population

The study animals were privately owned by small holder farmers and managed under traditional loose extensive husbandry system. The dominant cattle

breed in the region was local indigenous zebu cattle most were Horo breed. These animals are often kept out, grazed and crossed all day near the vicinity of the Gibe river as it is communal grazing lands and watering points for the farmers. All age groups and both sexes are included in the study. Body condition scores of the study animals was categorized as poor body condition score (1-2), medium body condition score (3-4) and good body condition score (5) according to Morgan *et al*. (2006).

e) Data collection and laboratory analysis

After proper restraining and recording all the relevant information like date of sample collection, identification number of the animals and the hypothesized risk factors into the pre-prepared data recording sheet, fresh fecal samples were directly collected from the rectum of the animals in the field using gloved hand. The collected sample was preserved in 10% formalin in clean and labeled screw cap universal bottle to prevent hatching of miracidia before reaching laboratory to diagnose within 24 hours of collection. It was placed in ice box and transported to Bakko Agricultural Research Center laboratory. Then, the samples were concentrated using sedimentation technique and, smears were made on microscopic slide and observed under low power (10x) microscope. The slides were judged positive when oval to spindle-shaped with centrally bulged and terminal spine on one side of egg was identified according to the keys and description recommended by Urquhart *et al.* (1996) in the laboratory.

f) Statistical Analysis

The data were first entered in to Microsoft Excel work sheet version 2010 and analyzed using Statistical Package for Social Sciences (SPSS) software version 20. Descriptive and inferential statistics were utilized to summarize the data. The overall prevalence of schistosomiasis was calculated by dividing the total number of animals positive to the total number of animals examined. For inferential analysis multivariate logistic regression was used to infer on the level of strength of association of explanatory variables hypothesized with the outcome variable after calculating the odds ratio. A 95% confidence interval of the OR and p-values were used to describe statistical significance associations. The association is judged as significant when p- value is less than 0.05.

III. Results

Among a total of 384 cattle examined using coprological examination 22.92% (88/384; 95% CI (18.7, 27.1)) were positive for *schistosoma bovis* eggs. The multivariate logistic regression analyses of the risk factors indicated the presence of strong statistical association of schistosoma infections with the body conditions (p=0.001) and animal origins (p=0.000) while variables like sex, age and months are not significantly associated with the risk of acquiring schistosoma infection.

a) Prevalence of Bovine Schistosomiasis Based on Risk Factors

The prevalence of bovine schistosomiasis was higher in Bakko 02 (43.75%) than the other five PAs. As indicated in table 1, statistically significant difference (p=0.000) was observed among origins with occurrence of bovine schistosomiasis. Cattle from Bakko 02 PAs were 1.626 times more likelihood to be infected by bovine schistosomiasis than animal from Dambi dima PAs, while animal from Dambi gobbu, Gajo, Bakko 01 and Abbo metti PAs had 0.447, 0.061, 0.256 and 0.794 times less likely to be infected by bovine schistosomiasis than animals from Dambi dima respectively.

Based on the body condition score of the study animals the prevalence of bovine schistosomiasis was highest in poor body condition (32.46%) followed by medium body conditioned animals (21.42%) and good body conditioned (11.86%). Strong statistical association (p= 0.001) was observed between body condition scores and occurrence of schistosomiasis (Table 1). Cattle with good and medium body condition scores had 0.254 and 0.708 times less likelihood to harbor bovine schistosomiasis than animal with poor body condition score respectively.

The highest prevalence of bovine schistosomiasis according to the study months (period) was recorded in January (27%) followed by November (25%) and the lowest was during March (15.58%) as indicated in (Table 1). Eventhough the result was higher in January, the difference was not statistically significant.

The prevalence of bovine schistosomiasis based on sex was 18.45% and 28.09% in male and female respectively. Although the prevalence was relatively higher in female; the differences in infection probability is not statistically significant (p=0.126) as indicated in Table 1. The prevalence of bovine schistosomiasis regarding to the age groups of study animals was lower in adult (19.2%), versus (24.6%) in young indicating the odds of schistosomiasis to be 1.236 more likely in young but was not statistically significant (Table1).

IV. Discussion

The cross-sectional study was primarily conducted to assess the prevalence of bovine schistosomiasis and investigate potential risk factors related to its occurrence. Its overall prevalence was 22.92% (88/384; 95% CI (18.7, 27.1)). This is important because quantitative assessment this disease provided good evidence to look for its economic burden. Accordingly, the present study revealed that bovine

schistosomiasis is found to be an important livestock disease in and around Bakko town.

This result is higher when compared with previous findings of Lo and Lemma (1973) 1.5% prevalence in Gewanie; Amero (1993) 12.4% prevalence in Awassa; Yalelet (2004) 17.4% prevalence, and Almaze (2007) 10.93% prevalence in Bahir Dar; Zelalem (2010) 12.5% prevalence, Mengistu *et al*. (2012) 10.17% prevalence, and Mersha *et al*. (2012) 13.70% prevalence in Fogera; and Mihret and Samuel (2015) 7.6% prevalence in Debre Tabor. The difference could be due to the presence of stagnated water bodies and marshy pasture land, epidemiological factors like hosts' breed, agro-ecological factors like irrigation practices, husbandry (management) practice of animal like freely grazing or tied, health care of animals. For example, Hailu (1999) had reported that Fogera breed is known for its tolerance to parasitic diseases. As described by Mersha *et al*. (2012) cattle schistosomiasis is dependent on environmental factors such as moisture, rain fall, temperature, water bodies (stagnate, swampy, marshy), snail intermediate hosts and husbandry practice such as grazing system, keeping animals whether they are kept all together or separately, feeding (contaminated pasture with cercaria) and drinking areas.

This finding is almost comparable with the reports of Solomon (2008) 24.73% prevalence, and Samuel *et al.* (2016) 26.3% prevalence in and around Bahir Dar, Belayneh and Tadesse (2014) 24.3 % prevalence and Assefa *et al*. (2016) 26.6% prevalence in Bahir Dar.

However, it is lower than the previous studies conducted in Bahir Dar by Hailu, (1999) 34% prevalence; in Kemissie by Amen *et al*. (2001) 28% prevalence; in Bahir Dar by Almaz and Solomon (2011) 37.7% prevalence and in Dembia by Alemseged (2015) 27.13% prevalence. These variations may be due to the difference in humidity and water (moisture) contents, and irrigation practice of the study areas. It also might be due to variation in sample size, study season and duration of the studied area from current study site. As stated by Maqbool *et al. (*2003) and Cameron *et al. (*2004), the presence of schistosomiosis and difference in their prevalence will be influenced by the local climatic conditions, presence or absence of water reservoirs, lakes, rivers and availability of suitable intermediate hosts. Irrigation practice is favorable for development and multiplication of snail intermediate hosts as reported by Mersha *et al*. (2012).

The result showed relatively highest prevalence of cattle schistosomiasis in Bakko 02 (43.73%) and Dambi dima (32.81%) Kebeles while the lowest prevalence in Gajo (3.12%) and Bakko 01(10.94%) with statistically significant difference (p=0.000). The variation in the prevalence of the disease may be due to presence of stagnant water bodies, number of rivers and streams, high moisture nature of most of the grazing areas, and larger boundary border of Bakko 02 and Dambi dima to Gibe River than others. This make more favorable condition for the multiplication of intermediate host, hence the schistosoma infection and give more chance of infection to occur. Mersha *et al*. (2012) and Samuel *et al*. (2016) have reported that logged water, poorly drained areas with acidic soil are often endemic to schistosomiasis. As compared to other Kebeles Gajo has lowest number of tributary rivers, stagnated water bodies and far from Gibe River that may contribute to lowest prevalence of the disease.

When the data on the monthly prevalence of bovine schistosomiasis were analyzed, it was observed that highest prevalence of bovine schistosomiasis occurred in the January (27.28%). This is may be due to the agricultural practices of the study area that the farmers are carrying out the irrigation activities for potatoes, tomatoes, cabbages and chili pepper mostly during January; after collecting their usual summer agricultural products. Also lack of feed and water during the dry month of January may make the animal to graze around marshy area that might be contaminated by the infective cercaria. William (2001) also reported that the two important factors influencing the incidence of schistosomiasis are adequate temperature and moisture in the environment, which helps the hatching of fluke eggs, the availability of cercariae and population of the snails. Pfukeni *et al.* (2005) in Zimbabwe also reported similar finding.

The sex level result difference indicated that prevalence was relatively higher in female (table 1). This finding agrees with the previous findings of Solomon (2008) 29.61% prevalence in female and 19.54% prevalence in male in and around Bahir Dar, Belayneh and Tadesse (2014) 25.9% prevalence in female and 22.4% prevalence in male in Bahir Dar, Asressa *et al*. (2012) 11.22% prevalence in female and 4.94% prevalence in male in Andassa Livestock Research Center and Alemseged *et al*. (2015) 30.70% prevalence in female and 23.30% prevalence in male in Dembia district but not in line with previous findings of Mersha *et al*. (2012) 15.38% prevalence in males and 12.14% prevalence in female, Mengistu *et al*. (2012) 12.05% in male and 8.33% in female and Marawe *et al*. (2014) 4.2% in male and 3.2% in female in Fogera; Assefa *et al*. (2016) 28.7% in male and 25.1 % in female in and around Bahir Dar. The insignificance of the difference may show that both sexes were at about the same risk to acquire the infection for the reason they graze at the same time, in the same grazing area with the same grazing behavior because there is no interference on movement for grazing, drinking and contact with the parasite in terms of sex as it is extensive management system. Therefore, the disease appeared to be well distributed between the two sexes. Similar finding was reported by Almaz and Solomon (2011) in Bahir Dar.

The prevalence of schistosomiasis in this study in relation to was higher in young (24.6%) than the adult animals (19.2%) as indicated in (table 1). This result is in agreement with previous finding of Marawe *et al.* (2014), who reported 9.57% prevalence in young and 2.06% prevalence in adult in Fogera, but it is not in line with the report of Alemseged *et al.* (2015) 30.10% prevalence in young, 27.80% prevalence in adult and 17.60% prevalence in calves in Dembia district. The absence of significant difference between age categories might be because of equal exposure to the risk factors. Since the management was freely grazing extensive husbandry system; all age has equal chance of contacting infective cercaria and acquiring the infection on the field. All the animals were grazing in the marshy and stagnated area that is suitable for the snail intermediate vector. The lower result in adult as compared to young could be due to strong acquired immunity against the parasites, which could suppress the worm fecundity and decrease the release of parasitic eggs within the faeces. Samuel *et al.* (2016) also reported similar justification in and around Bahir Dar.

The statistical analysis of this study showed that body condition score of the animals had significant influence on the prevalence of bovine schistosomiasis in the study area. The highest prevalence was observed in animals with poor body conditioned (32.46%) followed by medium body conditioned (21.42%); while the lowest was observed in cattle with good body conditioned (11%), in which the difference was statistically significant (table 1). This could be due to the fact that acquired immune status of animals with poor body condition and that are weak become suppressed and prone to become more susceptible to harbor parasites as stated by Marquardt and Greive (2000) and Mihret and Samuel (2015).

This finding is in line with the result reported by Merawe *et al.* (2014) in Fogera, where higher prevalence (9.3%) was observed in animals with poor body condition than medium (0.4%) and good (3.9%) body condition, Belayneh and Tadesse (2014) who reported high prevalence in poor body condition (68.88%) than that of medium (17. 54) and good (11.36%) body conditions in Bahir Dar and Samuel *et al.* (2016) who reported 36.8% in good, 19.7% in medium and 10.6% in good body condition in and around Bahir Dar.

The overall prevalence of this study is 22.9%; which is big and can cause a significant economic loss to the local communities. It can be concluded that origin and body condition of animal were highly associated with the occurrence of bovine schistosomiasis. The disease might be present in endemic pattern in the study area that deserves serious attention. Therefore, it is important to obtain detail epidemiological investigation with regard to the host parasite relationship, available snail species which will aid for further control and prevention strategic development. Schistosomiasis should be taken into consideration as a one of the major limiting factor to livestock productivity in and around Bakko town; hence any attempt towards animal disease control strategy must include it in the priority list.

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Table 1: Final multivariable logistic regression model output of factors associated with fecal shedding of schistosomia eggs from cattle (n=384) from Bakko, Ethiopia.

Risk factors	Categories	No	(Prevalence %)	95%CI	OR	95%CI	P-value
Origin	Dambi Dima	64	21 (32.81%)	(21.3, 44.3)	ref.	ref.	
	Dambi Gobbu	64	13 (20.03%)	(10.5, 30.2)	0.447	(0.193, 1.035)	
	Gajo	64	2 (3.12%)	(-1.1, 7.4)	0.061	(0.013, 0.278)	0.000
	Bakko 01	64	7 (10.94%)	(3.3, 18.6)	0.256	(0.097, 0.675)	
	Bakko 02	64	28 (43.75%)	(31.6, 55.9)	1.626	(0.756, 3.497)	
	Abbo Metti	64	17 (25.56%)	(15.7, 37.4)	0.794	(0.357, 1.769)	
Months	November	76	19 (25%)	(15.3, 34.7)	ref.	ref.	
	December	77	19 (24.67%)	(15, 34.3)	0.855	(0.382,1.911)	0.410
	January	77	21 (27.28%)	(17.3, 37.2)	1.105	(0.494, 2.468)	
	February	77	17 (22.08%)	(12.8, 31.3)	0.738	(0.324, 1.681)	
	March	77	12 (15.58%)	(7.5, 23.7)	0.491	(0.205, 1.174)	
Sex	Female	178	50 (28.09%)	(21.5, 34.7)	ref.	ref.	0.126
	Male	206	38 (18.45%)	(13.8, 23.7)	0.662	(0.389, 1.125)	
Age	Young	264	65 (24.62%)	(19.4, 29.8)	1.236	(0.684, 2.236)	0.483
	Adult	120	23 (19.2%)	(12.1, 26.2)	ref.	ref.	
BCS	Poor	154	50 (32.46%)	(25.1, 39.9)	ref.	ref.	
	Medium	112	24 (21.42%)	(13.8, 29.0)	0.708	(.377, 1.329)	0.001
	Good	118	14 (11.86%)	(6.0, 17.7)	0.254	(0.126,0.510)	
Total		384	88(22.92%)	(18.7, 27.1)			

OR=Odds Ratio, No-=Number of animal examined, CI=Confidence Interval, ref=reference cell

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