

# Some Epidemiological Studies of *Schistosoma bovis* Infection in Cattle in East Darfur State, Sudan

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**Abstract:** Schistosomiasis is a snail-borne trematode infection in man and animals in tropical and subtropical countries. It is an economically important disease caused by several *Schistosoma* species and results in economic losses through mortality and morbidity from severe infection and meat condemnation. This study was conducted to determine the magnitude of *Schistosoma bovis* and the distribution of its intermediate host in East Darfur State during January, 2015 to December, 2015. Simple random sampling method was used to select the faecal samples from Eldaein, Bahr-el-Arab and Abu Gabra Localities, the carcasses in Eldaein abattoir and the snails' samples from Bahr-el-Arab River. *Schistosoma* eggs were identified using sedimentation method of faecal samples and light microscopy under X40. The snails and adult *Schistosoma* worms in liver and mesenteric veins of the carcasses were visually examined and identified during the survey period, giving overall prevalence of 1.46% and 1.83% in the faecal samples and slaughtered cattle respectively. The infection rate was 0%, 1.90% and 1.28%, in Eldaein, Bahr-el-Arab and Abu Gabra localities respectively. The sex-specific prevalence was 1.96% in male and 0.86% in female. The study revealed that the infection rate was higher (1.89%) in calves 2-4 years old compared with other age groups. The autumn season showed the highest rate of infection among other seasons and reached 16. (2.24%), while it was (1.46%) in summer and (0.45%) in winter. The result showed the presence of the intermediate host in and surrounding stagnant water ponds and swamps and other natural water bodies. The study concluded that *Schistosoma bovis* and its intermediate host prevalent in the study area and the co-existence of different intermediate hosts for other *Schistosoma* spp and dependence of humans and their livestock on the same water resources in the study area may lead to development of zoonotic hybrid schistosomes, which constitute health hazards to animals and humans, hence the necessity for coordinated preventive and control measures.

**Keywords:** Epidemiology, *Schistosoma bovis*, East Darfur State, Sudan

## Introduction:

Bovine Schistosomiasis caused by *Schistosoma bovis* is a snail-borne trematode infection in domestic and wild animals in tropical and subtropical countries (Islam *et al.*, 2011; Zangana and Aziz, 2012). *Schistosoma bovis*, a member of *Schistosoma haematobium* group is ruminant haematic parasite that lives in the portal mesenteric system of the host. Its life cycle pertains between cattle and buffaloes which act as final host and some fresh water snails, mainly *Bulinus* spp as intermediate hosts (Kane *et al.*, 2008). Zoonotic hybrid Schistosomes between *Schistosoma bovis* and *Schistosoma haematobium* may develop when humans and livestock are in contact with the same water bodies (Jérôme *et al.*, 2016). The disease is economically important as it causes considerable liver and carcass condemnations and mortality (Eisa, 1966).

The geographical distribution of *Schistosoma* spp infecting cattle is mainly determined by the distribution of their intermediate hosts (De Bont and Verduyck 1998; De Kock *et al.*, 2004). *Schistosoma bovis* is found mainly in tropical and subtropical Asia and Africa. Previous studies on epidemiological aspects of bovine schistosomiasis caused by *Schistosoma bovis* in the Sudan revealed prevalence rate of 49.5% in Upper Nile Province (Eisa, 1963), 62% in Bahr-el Ghazal Province (El Khawad *et al.*, 1976), 89.7% in western provinces of the Sudan (El Khawad *et al.*, 1978), 1.5% in Abyei Area (Gad Al Kareem *et al.*, 2012) and 6.6% in Duiem District (Abdalla, 2014). Despite of these studies, information on the epidemiology of bovine Schistosomiasis and distribution of *Bulinus* snails, the intermediate host of *Schistosoma bovis* in East Darfur State is not clarified. This study is aimed to determine the magnitude of *Schistosoma bovis* and the distribution of its intermediate host in East Darfur State, Sudan.

## Materials and Methods:

### The study Area:

East Darfur State is located between longitude 25<sup>0</sup> –27<sup>0</sup>E and latitude 10<sup>0</sup>- 13<sup>0</sup> N. It is about 1135 kilometers from Khartoum, the capital of Sudan. It shared borders with South Darfur State at West, North Darfur State at North, West Kordofan State at East and Republic of South Sudan at South. The area is characterized by Savannah grasslands and woodlands with sandy soil in its northern and eastern parts and muddy land in southern and south western parts, where Bahr-el-Arab River runs and makes large flooded

areas that reserve stagnant water which is a suitable habitat for snails. The rainfall usually starts in June and ends in October, with annual rain fall ranges from 200- 300 ml, at northern parts and increases gradually to reach the maximum fall (900ml) at southern Bahr-el-Arab and Abu Gabra Localities (Ministry of Agriculture & Forest, 2015). The cattle population in the study area was estimated to be about 3,730,000 (Ministry of Animal Resources and Rangeland, 2015). The nomadic type of animal husbandry system is practiced, where nomads move with their animals by the end of the rainy season southwards along fixed routes known as (*Maraheel*) in pursuit of water and green pasture for their herds. They spend most of the hot dry season at the banks of Bahr-el-Arab River. Some nomads move with their animals deep into Bahr-el-Ghazal State (South Sudan) where their animals intermix freely and share common water bodies and pasture with animals from the South Sudan and those which come from Kordofan States, the situation that predispose their animals to infectious and water- borne diseases. With the onset of the rainy season, the nomads start escaping from flooded areas by moving back toward to the north.

### Study design and samples collection

#### Faecal sample collection and examination:

A total of 2059 fresh faecal samples from local cattle breed (*Bos indicus*), which reared under traditional nomadic husbandry system were collected by simple random sampling through rectum, during Jan. 2015 to Dec. 2015. The samples were labeled and kept in clean dry screw capped containers involving about 5-20 ml of 10% formalin solution then transferred to the laboratory for diagnosis. A sedimentation technique was used where three grams of faeces were dissolved in 5- 20 ml of saturated sodium chloride solution then well mixed , filtered and the debris left on the screw was discarded. Fifteen ml of the strained fluid was centrifuged at 1500 rpm for 2 minutes and supernatant was discarded. A drop of methylene blue was added then one ml of the sediment was placed on glass slide, covered with cover slip and examined microscopically under X40 for *Schistosoma spp* ova. The number of eggs per gram of faeces was calculated by McMaster counting technique to estimate egg output as described by (Antónia *et al.*, 2002).

#### Adult worm samples collection and examination:

Livers and intestines were examined by simple random sampling methods during meat inspection in Eldaein abattoir (capital of the state) during Jan. 2015 to Dec. 2015. Each sample was clearly labeled and examined by visual inspection and knife incision, then transferred to the laboratory for diagnosis. Adult *Schistosoma* worms were recognized as white thread worms. Collected adult worms were washed three times by normal tap water and preserved in 10% formalin solution in universal bottles for counting and identification depending on their morphological characteristics.

#### Snail samples collection and identification:

The snail samples were collected from Bahr-el-Arab River by simple random sampling methods, using protected hands in the shallow water bodies and digging in riverbed during the hot dry season of 2015. The snails were identified depending on their morphology as described by Mandahl-Barth (1962).

#### Data analysis

The collected data were subjected to statistical analysis by (SPSS) version 22 using analysis of variance. Confidence level at 95% and  $p < 0.05$  was set for significance.

## Results

### Faecal samples result:

A total of 2059 bovine faecal samples (1124 male and 935 female) were examined for *Schistosoma* eggs, during the study period. Out of these, 30 were found infected with *Schistosoma bovis* eggs (Fig 1), giving an overall prevalence of 1.46%. The infection rate of *Schistosoma bovis* in male and female cattle examined were 22 (1.96%) and 8 (0.86%) respectively. It was significantly higher in male compared with female cattle ( $p < 0.05$ ). No other *Schistosoma spp* eggs were diagnosed during the survey period. The prevalence rate of *Schistosoma bovis* in three localities of the study area was shown in Table (1) and the age – specific prevalence rate of the parasite was shown in Table (2). The observed seasonal prevalence rate of *Schistosoma bovis* was 1.46%, 2.24% and 0.45% in Hot dry (summer), Hot wet (autumn ) and Cool dry (winter) respectively.

### Adult parasite results:

A total of 1800 bovine carcasses' were examined for *Schistosoma* adult worms in Eldaein slaughter house, during the study period. The overall prevalence rate was 1.83 % (  $n = 33/1800$ ). No other than *Schistosoma bovis* worms were encountered. The sex- specific prevalence rate of adult *Schistosoma bovis* was 1.13 % ( $n = 7/618$ ) in male and 2.20% ( $n = 26/1182$ ) in female cattle, while age-specific prevalence rate in cattle more than four years old was 2.02 % ( $n = 27/1334$ ) and 1.29% ( $n = 6/466$ ) in less than four years old.

The intensity of *Schistosoma bovis* adult worms in different predilection sites, in cattle slaughtered in Eldaein abattoir during the study period was excessive ( $> 200$ ) in 15.2% and moderate (101-200) in 36.4% of liver and portal vein, while mild infection (1-100) was observed in 48.4% and 100% of liver and portal vein together and mesenteric veins respectively (Figure 2).

### Snail samples results:

Snail samples were collected from Bahr- el- Arab River at Bahr- el- Arab locality in dry season during the study period. Depending on shell morphology which was described by Mandahl-Barth (1962), the collected snails were identified as *Bulinus spp.* (21.9%), *Biomphalaria spp.* (15.6%), *Lymnaea spp.* (50%) and (12.5%) were identified as *Oncomelania spp.* (Figure 3-A through 4-D) respectively.

### Discussion:

Schistosomiasis is a snail-borne trematode infection in man and animals that has medical, veterinary and social importance in Asia and Africa.

The present study showed that the overall prevalence of *Schistosoma bovis* in faecal samples was 1.46% which was almost similar to the prevalence of *Schistosoma bovis* in nomadic cattle herds, in Abyei area as reported by Gad Al Kareem (2008), where the traditional nomadic management is predominant in both Areas. The result was lower than those reported by Kamanja *et al.* (2011), Kerie and Seyoum (2016) who observed the prevalence of *S. bovis* eggs to be 16.9% and 24.6% in Kwale District, Kenya and South Achefer district, northwest Ethiopia respectively.

The variation in the prevalence rate related to locality may be due to the fact that prevalence depended on the existence of animal contact with the natural permanent or seasonal water bodies and distribution of the intermediate host of *Schistosoma bovis*.

The sex-specific prevalence rate indicated that it was significantly higher in male (1.96%) compared with female cattle (0.86%). This result was in line with that reported by EL Doush (1995) who reported the incidence rates of 10% in males and 0% in females at Atbara, Northern State of the Sudan.

The age - specific prevalence of *Schistosoma bovis* infection was found lower in calves less than one year, being 0.94% and increased gradually to reach the peak (1.89%) in age group 2-4 Years, then decreased to 1.23% in age group more than 4 Years. Majid *et al.* (1980) found the prevalence of the disease to be higher in younger cattle reaching its maximum level (90%) in calves 1-5 years old and subsequently declining markedly with the increasing age. This may be due to age susceptibility or host immunity as response to continuous exposure to infection.

The seasonal prevalence was 0.45% in winter, 1.46% in summer and 2.24% in autumn. Similarly, Abdalla (2014) reported the highest rate of incidence (16.1%) of *Schistosoma bovis* in El.Duiem Rural Area in summer, but the lowest rate (0%) was recorded in winter. This may be explained by the high existence of the intermediate host in autumn and gradually decrease through summer and winter and also the increasing in the frequency and duration of animals in contact with water bodies during the summer as compared to winter, as claimed by interviewed animal owners in the study area.

The prevalence of *Schistosoma bovis* adult worms in Eldaein slaughter house was 1.83%, which is lower than that reported by Kamanja *et al.*, (2011) who reported a prevalence of *S. bovis* adult worms to be 25.1% in Kwale District, Kenya. These variations in prevalence rate may be explained by the distribution of the intermediate host and efficiency of contact with cercariae-contaminated water.

The intensity of *Schistosoma bovis* worms in different predilection sites of cattle body revealed mild (48.4%), moderate (36.4%) and excessive (15.2%) infection rate in livers and portal veins, but only mild infection rate was observed, in small and large intestines which indicated that adult schistosomes mainly inhabit the mesenteric veins of cattle.

The survey on snails, locally known by pastoralist as (*Um karkour*) showed that (21.9%) of snails collected were identified as *Bulinus spp.*, the intermediate host of *Schistosoma bovis*, cause bovine Schistosomosis which locally known by the cattle owners as (*Abu sirrate*). The presence of this snail species together with species of other genera (*Lymnaea*, *Biomphalaria* and *Oncomelania*) constitute epidemiologic determinants of schistosomosis, fasciolosis, paramphistomosis and other trematodes infections as well as possibility of development of zoonotic hybrid schistosomes as Jérôme *et al.* (2016) reported in Senegal.

The study concluded that bovine schistosomosis caused by *Schistosoma bovis* and its intermediate host are prevalent in the study area and the existence of different intermediate hosts for other trematodes constitutes health hazards to animals and human in the area, hence the necessity of coordinated preventive and control measures.

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**Table (1).** The prevalence of *Schistosoma bovis* in three localities of East Darfur State during January to December, 2015 based on faecal examination.

Locality	No. of samples			NO. positive			Prevalence (%)		Total
	M	F	total	M	F	total	M	F	
EL daein	142	80	222	0	0	0%	0%	0%	0%
Bahr-el- arab	591	462	1053	16	4	20	2.71%	0.87%	1.90%
Abu Gabra	391	393	784	6	4	10	1.53%	1.02%	1.28%
total	1124	935	2059	22	8	30	1.96%	0.86%	1.46%

\* M = Male , F = Female.

**Table (2).** Age – specific prevalence rate of *Schistosoma bovis* in East Darfur State during January to December, 2015 based on faecal examination.

The Group	No. examined	No. positive	The prevalence (%)
< 1 years	106	1	0.94%
1-2 years	211	3	1.42%
2-4 years	689	13	1.89%
> 4	1053	13	1.23%
total	2059	30	1.46%



Figure(1). *Schistosoma bovis* egg encountered in bovine faecal sample in the study area(indicated by an arrow).

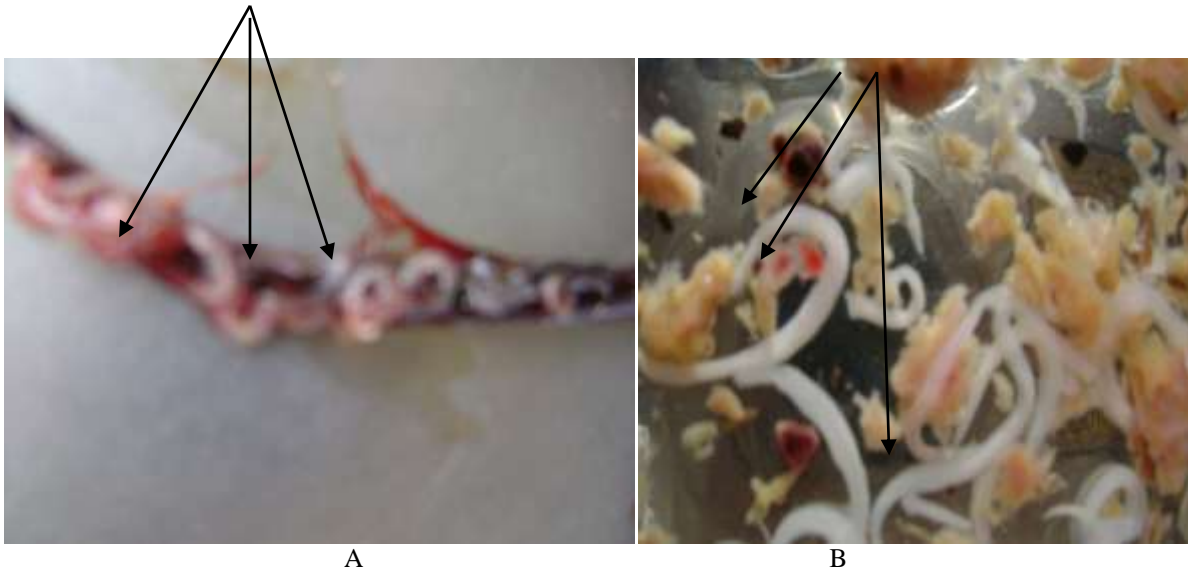


Figure (2). *Schistosoma bovis* adult worms in: A. mesenteric veins, B. crushed liver of the cattle: indicated by arrows).



Figure(3-A). *Bulinus* spp.



Figure (3-B). *Biomphalaria* spp.



Figure (3-C). *Lymnaea* spp.



Figure (3-D). *Oncomelania* spp.