ISSN: 2977-4047

Journal of Life Sciences Research and Reviews

SCIENTIFIC Research and Community

Review Article

Open Access

Review on an Epidemiology of Schistosomiasis in Ethiopia and its Public Health Importance

Banchigizie Fetene Akililu

Animal Health Department, Banja Woreda Livstock Development Office, Injibara, Ethiopia

ABSTRACT

Schistosomiasis or Bilharziasis is a disease caused by trematodes of the genus Schistosoma with different species. Schistosomes are dioecious (separate sex) trematodes or flukes with flat bodies which live in the vascular systems (mesenteric vein, portal vein), bladder and typically in other organs of their definitive hosts. The distribution of Schistosoma infection varies from place to place. Schistosomiasis is common in many tropical and sub tropical areas as well as in Africa, Asia and India. Schistosomabovis S.mattheei, S.intercalatum, S. spindale, S.nasalis and S.indicumhave significant veterinary important in livestock production in Africa, Asia, and south Europe. The distribution of Schistosoma infection varies from place to place. Schistosomabovis is the commonest species in Africa and Mediterranean region. The definitive hosts of Schistosoma species are mammals. Mainly, cattle and sheep, as well as human being serve as final host for Schistosomiasis. worms, Schistosoma parasites have an indirect life cycle, while water snail act as an intermediate host belong to the genera Bullinus and Physopsis. Embryonated eggs of Schistosoma are excreted through faeces, urine and nasal discharge from definitive host, depending on the localization of the species. Infection hosts occur through skin penetration typically when they are watering, grazing, swimming, or washing with in contaminated water in which certain types of snails that can carry the parasite are present. Schistosomiasis is one of the most prevalent parasitic diseases and an important public health problem in many developing countries. It is prevalent in tropical and sub-tropical areas, especially in poor communities that had low access to safe drinking water and adequate sanitation. The drug of choice for all species of Schistosomiasis is praziquantel. Control measures of Schistosomiasis are applying based on interrupting the epidemiological cycle of the parasite by removing the adult parasites with chemotherapy, by eliminating the intermediate host (snail) with molluscicides and habitat modification and preventing access of definitive hosts to natural water course contaminated with cercariae.

***Corresponding author**

Banchigizie Fetene Akililu, Animal Health department, Banja Woreda Livstock Development Office, Injibara, Ethiopia.

Received: May 07, 2025; **Accepted:** May 16, 2025; **Published:** May 23, 2025

Keywords: Bovine, Pathogenesis, Treatment, Schistosomiasis

Introduction

Schistosomiasis or Bilharziasis is a disease caused by trematodes of the genus Schistosoma with different species. The taxonomic classification of the organism is presented as kingdom Animalia, Phylum Platyhelminthes, class Trematoda, sub class digenea, Family Schistosomatidae, Genus Schistosoma and species *Schistosoma bovis, Schistosoma leiperi, Schistosoma mattheei, Schistosoma mansoni, Schistosoma hematobium, Schistosoma nasalis, Schistosoma japonicum, Schistosoma spindale, Schistosoma indicum and Schistosoma Intercalatum* [1].

Schistosomes are dioecious (separate sex) trematodes or flukes with flat bodies, which live in the vascular systems (mesenteric vein, portal vein), bladder and typically in other organs of their definitive hosts [2,3]. The term Schistosoma means split body and refers to the fact that the males have a ventral groove called gynaecophoric canal where, the adult female is permanently lying [3].

Schistosomiasis is common in many tropical and sub tropical areas as well as in Africa, Asia and India. Schistosoma bovis Schistosoma mattheei, *Schistosoma Intercalatum, Schistosoma spindale, S.nasalis and Schistosoma indicum* have significant veterinary important in livestock production in Africa, Asia, and south Europe [4]. The distribution of Schistosoma infection varies from place to place. *Schistosoma bovis* is the commonest species in Africa and Mediterranean region whereas; *Schistosoma spindale, Schistosoma indicum and Schistosoma nasalis* have been reported in Asia as the major cause of Schistosomiasis [4,5].

Some geographical areas like, small streams, ponds, swampy areas around rivers and lakes (in Ethiopia, Lake Tana, Ziway, Abay River) and in irrigation sites can act as source of infection for Schistosomiasis. However, the distribution of the disease has been primarily determined by the distribution of snail intermediate host, particularly *Bulinus* and *Physopsis* species which are important for bovine Schistosomiasis [3].

Ethiopia is highly endemic for Schistosomiasis, since temperature in Ethiopia appears to be the major factor that affects the distribution Schistosoma species [6]. Schistosomiasis is a chronic debilitating infection that affects both animals and humans by its' different species. It is one of the major concerns of animals in the world and the disease has public health importance [2,7,8]. It can cause high economic losses by resulting mortality, low fertility, retard growth, poor productivity, low milk yield and increased susceptibility to other disease in livestock [9].

Literature Review

Description of the Parasite

Schistosoma parasites are differing from other members of flukes in that the sexes are separate (dioecious) [10]. Schistosoma means

split body and refers to the fact that the males have a ventral groove called gynaecophoric canal where, the adult female is lying permanently in a groove [3]. The parasite primary parasitize in the blood vessels of the alimentary tract and bladder of animals and humans. In human, Schistosoma parasites are often responsible for sever and debilitating disease. And veterinary interest lies in the fact that they can cause a similar disease in animals, some of which may act as reservoirs of infection for man [8].

Host Range

Definitive Host

The definitive hosts of Schistosoma species are mammals. Mainly, cattle and sheep, as well as human beings. *Schistosoma bovis* commonly affects ruminants, *Schistosoma mattheei* (ruminants and man), *Schistosoma japonicum* (domestic animals and humans), *Schistosoma mansoni* (man and wild animals), Schistosoma nasalis (ruminants and horse), *Schistosoma incognitum* (pigs and dogs), *S.spindale* (ruminants, horse and pigs) which are common in tropical and sub-tropical countries [4]. *Schistosoma haematobium*, *Schisosoma japonicum*, and *Schisosoma mansoni* that can cause intestinal schistosomiasis use human beings as definite host.

Intermediate Host

The intermidate hosts of Schistosoma parasites are snails, particularly *Bulinus* and *Physopsis* species which are important for bovine Schistosomiasis, which can play a major economic role intropical and sub-tropical areas [3]. In Ethiopia, different Bulinus species (Bulinus truncates, *Bulinus africanus and Bulinus abyssinicus)* that serve as the intermediate hosts were reported from different regions like Gondar and Gojjam [11].

Generally, the intermediate hosts are widely distributed, then schistosomiasis that are pathogenic to domestic animals are also widely distributed throughout Africa, the middle East, Asia and some countries bordering Mediterranean [12]. The ideal suitable conditions for snails are the presence of stagnant water bodies, marshy area, and irrigation canals and then these are suitable condition for the distribution of Schistosomiasis [3].

Morphology

Schistosoma parasites are dioecious (separate sex) flukes with flat bodies [2]. The female is long and cylindrical shape; the anterior part is narrower than the middle and the posterior parts while the male is broad and flat with the side of the body curved inwards to form a groove called the gynaecophoric canal, where the female is permanently laid. The length of adult schistosoma varies greatly depending up on the species. The adult male of *Schistosoma bovis* is 9-12 mm long and 1-2 mm wide and the female is 12-28 mm long [2]. These parasites have also two suckers: the anterior sucker (prominent and characteristic) and ventral suckers (without hooks) [13].

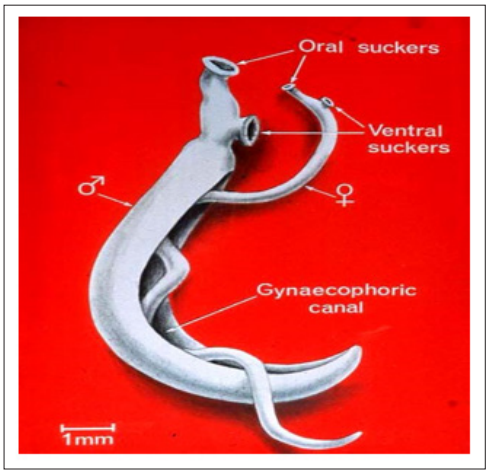
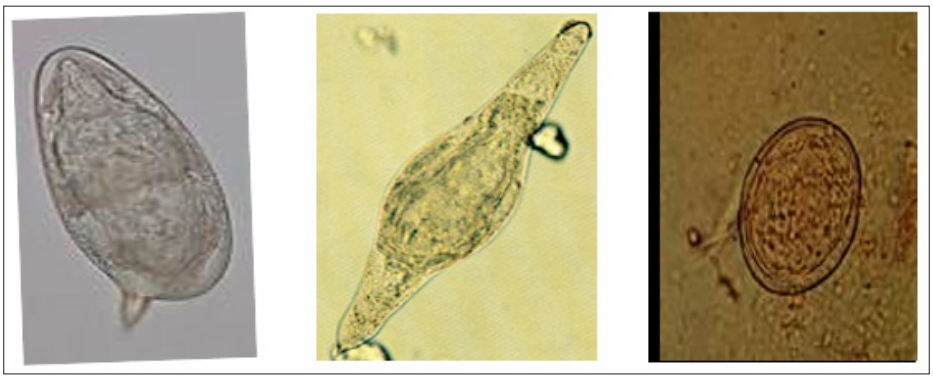


Figure 1: Schistosoma Species Male and Female in Copula [14]

Microscopically eggs are 100-500 µm long, spindle shaped and have alateral or terminal spine and there is no operculum. The eggs of Schistosoma species differ in size and shape. The eggs of S. nasalis has boomerang (curved) shaped where as *S. bovis* has spindle shaped having terminal spine and *S.japonicum* has relatively small oval eggs with a small lateral spine [3].



a) *Schistosoma nasalis* b) *Schistosoma bovis*) c *Schistosoma japonicum*

Figure 2: Ova of Schistosoma Species

Source: [15]

Life Cycle

The dioecious and flatted body worms, Schistosoma parasites have an indirect life cycle, while water snail act as an intermediate host belong to the genera *Bullinus* and *Physopsis*. Embryonated eggs of Schistosoma are excreted through faeces, urine and nasal discharge from definitive host, depending on the localization of the species. When the eggs come into contact with water, they are hatched and the miracidium which is an active swimmer is liberated. It has a few hours to find and to penetrate the appropriate

susceptible snail and it is transformed to a mother sporocyst close to the site of penetration. Several hundred daughter sporocysts are formed within the mother sporocysts. The daughter sporocysts break out through the tegument of the mother sporocysts and migrate to the digestive glands and reproductive tract of the snail, in which they proliferate internally to produce cercariae with a forked-tail (furcocercariae) [2].

After the infective stage of the disease, cercariae is fully matured; they leave the snail and swim freely in the water, where they can survive about 48 hours [3]. Then the cercariae must find a suitable final host through skin or mucus membrane penetration in order to carry their life cycle further [16].

The visceral Schistosomasmature in the hepatic portal veins, mate and migrate to the mesenteric veins where egg production is started [4]. The female in the mesenteric vein insert her tail into the venule and then the eggs penetrate the venule endothelium aided by their spines and by proteolytic enzymes secreted by the un hatched miracidia that migrate to the intestinal lumen, urinary tract or the nasal cavity (*S.nasalis*) and are eliminated with faeces, urine and nasal discharge or disseminated while urinating, drinking or sneezing [2,3].

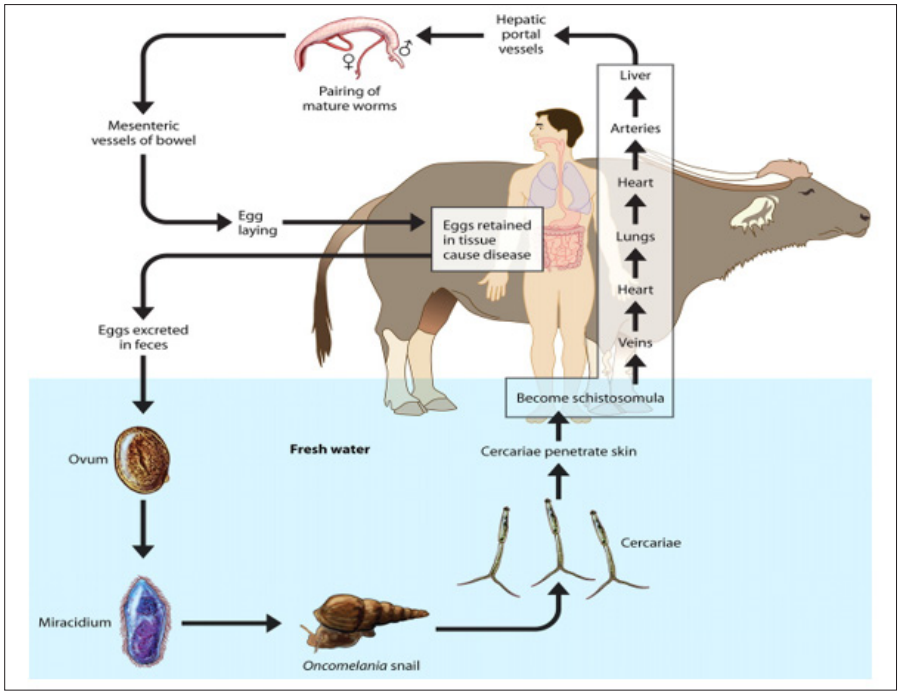


Figure 3: Life Cycle of Schistosomiasis

Source: [14]

Epidemiology and Transmission

Schistosomiasis is a common disease in many parts of the world which is prevalent in tropical and subtropical areas of Africa, Asia, Middle East and Southern Europe, especially in poor communities without access to safe drinking water and adequate sanitation [6,14]. The distribution of the disease varies from place to place. Some geographical areas like, small streams, ponds, swampy area around river and lakes and in irrigation sites can act as source of infection for Schistosomiasis. However, the distribution of the disease has been primarily determined by the distribution of snail intermediate host [3].

Various socio epidemiological factors are responsible for transmission of the disease and level of infection. Among such factors grazing site, migration and emergency of new foci, and socio economical status, sanitation, farming intensification, water supply patterns and levels of faecal contamination of water source are important [7]. Due to the nature of transmission Schistosomosis is a disease that commonly occurs in the proximity of water sources [2]. Water and high rain full are good predisposing factors for hatching of the Schistosoma eggs and for occurrence of these parasites [17].

Pathogenesis

Infection of the final hosts occur through skin penetration typically when they are watering, grazing, swimming, or washing with in contaminated water in which certain types of snails that can carry the parasite are present. Freshwater becomes contaminated by *Schistosoma* eggs when infected individuals urinate or defecate into the water. The penetration of the cercariae through the skin causes dermatitis, which is evident about 24 hrs after infection. The passage of the parasites through the lungs may also cause pneumonia in gross infection and in abdominal organs such as the liver may become congested during the early stage of the disease due to the arrival of immature worms in the intra-hepatic portal blood vessels. The adult Schistosoma can cause serious damage at the egg laying stage due to the irritation when the eggs are lodged in the tissues, which are forced to find their way through small venules to the epithelium and lumen of the gut [10].

The main infection site of the final host is through skin or mucus membrane penetration, infection through mouth is theoretically possible, provided the ingested furcocercaria has time to penetrate the stomach, since ruminants drink large quantities of water, they can be infected via the rumen [13]. Gross anatomical features and a complex set of vascular changes characterize Schistosomal-hepatopathy as a peculiar form of chronic liver disease, clinically

known as "hepatho-splenic Schistosomiasis". Intrahepatic portal vein obstruction and compensatory arterial hypertrophy render the hepatic Parenchyma vulnerable to ischemic insult. This may lead to focal necrosis, which may give place to focal post necrotic scars. These events are of paramount importance for the clinic-pathological evolutions of Schistosoma hepatopathy. Damage to muscular walls of the portal vein may be followed by dissociation of smooth muscle cells and their transition towards myofibroblast, which appear only as transient cells in Schistosomal portal fibrosis. A process of chronic hepatitis is a common accompaniment of portal fibrosis in schistosomiasis [18].

Clinical Signs

Schistosomes are found in the mesenteric and portal blood vessels, and the principal clinical signs are associated with the passage of the spindle shaped eggs though the tissue of the gut lumen. The young parasite can cause some damage during migration, but most of the lesions are due to irritation produced by the parasite eggs in the intestine and other organs [10].

Loss of body condition, unthrifthness, persistent diarrhoea stained with blood and mucus, pale mucus membrane, polypnea and nasal discharge (in *Schistosoma nasalis*), dehydration, sunken eyes are mainly encountered as clinical signs in the diseased animals [19,20].

Unlike human, animals are not susceptible to spleenomegally or esophageal varicose, but the presence of dead parasites can cause enlarged follicles or lymph nodes as well as venous thrombosis, with infarct of the organ. And Cattle also have developed obstructive phlebitis due to the presence of adult parasites in the vein [10].

Diagnosis

The diagnosis of Schistosomiasis is based on the clinico-pathlogical picture, seasonal occurrence and previous history of the disease in the area and identification of snail habitats with access to natural water bodies. Schistosomiasis is not always easy to diagnose based on symptoms because the symptoms of Schistosomiasis are not always pathognomonic [2].

The definitive diagnosis of Schistosomiasis is carried out by the detection of eggs from the infected animals'feces and/ or urine. Nevertheless, the parasitological methods of diagnosis have low sensitivities, especially with patients with the acute phase of illness or with low intensity infection [21]. Postmortem examination which reveals lesions and if mesentery is stretched the presence of numerous Schistosomes in the vein and serological tests like enzyme linked immune sorbent assay and electro immune transfer blot techniques are used to confirm the disease [3].

Public Health Importance

Schistosomiasis is one of the most prevalent parasitic diseases and an important public health problem in many developing countries. It is prevalent in tropical and sub-tropical areas, especially in poor communities that had low access to safe drinking water and adequate sanitation an estimated 779 million people are at risk of Schistosomiasis, of whom 106 million (13.6%) live in irrigation schemes or in close proximity to large dam reservoirs and the majority of these infections occur in Sub-Saharan Africa [22].

According to WHO Schistosomiasis is listed as "Neglected Tropical diseases" [6]. It is estimated that at least 90% of those requiring treatment for Schistosomiasis live in Africa including Ethiopia. The three main disease-causing species in humans are: *Schistosoma haematobium, Schisosoma japonicum, and Schisoso mamansoni*. The two other species, more localized geographically, are *Schisosoma mekongi* and *Schisosoma intercalatum*. Schistosomiasis in Africa is caused by an infection with S. Mansoni and S. haematobium whose eggs may be found in faeces or urine, respectively [23]. School age children who live in areas with poor sanitation are often most at risk because they tend to spend time swimming or bathing in water containing infectious cercariae [23].

Treatment

According to world health organization (2010), three new drugs have revolutionized for treatments of Schistosomiasis which are praziquantel, oxamniquine, and mentritonate. The drug of choice for all species of Schistosomiasis is praziquantel, but rapid re infection is the problem [24]. Although Schistosomiasis is not eradicable disease that, can be prevented and controlled with a single annual dose of praziquantel [25]. Oxamniquine is active against *Schistosoma mansoni* and metrifonate is also active against *Schistosoma haematobium* which are given orally [26]. In case of animals Praziquantel (25 mg/kg) is highly effective, although 2 treatments 3–5 weeks apart may be required.

Prevention and Control

Control measures of Schistosomiasis are applying based on interrupting the epidemiological cycle of the parasite by removing the adult parasites with chemotherapy, by eliminating the intermediate host (snail) with molluscicides and habitat modification and preventing access of definitive hosts to natural water course contaminated with cercariae [27]. Simple measures such as creating a barrier to prevent animals from gaining access to water contaminated by the snail vectors are very effective [2]. Understanding the life cycle of a parasite and the epidemiology of the disease caused by the parasite are fundamental to control the disease. There are four broad interventions that can be made to disrupt the life cycle of the parasite and hence its transmission [28].

The first is treatment of infected individuals to reduce, and remove morbidity, reduce mortality and reduce contamination of the environment with *Schistosoma parasite* eggs [28]. Chemotherapy of infected individuals is not only curative but also preventive that halts the production of eggs that contaminate the environment. In communities that have high prevalence of infection but limited economic resource, treatment can be restricted to the groups in the highest parasite burdens or individuals at risk in endemic areas [29].

Second, providing communities with adequate, appropriate sanitation to reduce environmental contamination and hence minimize the chances of miracidiae finding and penetrating the intermediate host snails. Environmental sanitation refers especially the provision of potable water and sanitary waste elimination in rural areas. Provision of adequate and accessible safe water is vital to reduce the chances of people and animal getting in contact with water that may be infested with cercariae and hence limits the chances of cercariae locating the human and animal host and infect them in its limited life span [28].

The third is snail control to minimize the chances of miracidiae finding an appropriate intermediate host and therefore significantly reducing the number of cercariae available for infecting people and animals at water contact sites. Controlling intermediate hosts can be achieved in a number of ways: by draining swampy land, removing vegetation from water bodies, improving irrigation system, and through the use of molluscicides, though expensive,

is a rapid and effective means of reducing transmission if it is combined with other measures especially chemotherapy [2].

The other measures available for control and prevention of Schistosomiasis are: education of people in endemic areas on the mode of transmission in order to make them aware of the dangers of watering their animals at sites where snail vectors are abundant and to inform them of how potential disease transmission can be reduced in this way and change the environment [2]. Health education consists essentially in teaching people to avoid contact with contaminated water and not to contaminate water with their own excreta. Changing the environment entails an improved standard of living for the population, more education, and healthier surrounding the measure described above are useful, when they are incorporated realistically within the frame work of a control program [30].

Conclusion and Recommendation

Schistosomiasis or Bilharziasis is a disease caused by trematodes of the genus Schistosoma with different species. Schistosomes are dioecious (separate sex) trematodes or flukes with flat bodies, which live in the vascular systems (mesenteric vein, portal vein), bladder and typically in other organs of their definitive hosts. The parasite primary parasitizes in the blood vessels of the alimentary tract and bladder of animals and humans. Schistosomiasis is common in many tropical and sub tropical areas as well as in Africa, Asia and India. *Schistosoma bovis Schistosoma mattheei, Schistosoma Intercalatum, Schistosoma spindale, S.nasalis and Schistosoma indicum* have significant veterinary important in livestock production in Africa, Asia, and south Europe.The definitive hosts of Schistosoma species are mammals. Mainly, cattle and sheep, as well as human beings and also the intermidate hosts of Schistosoma parasites are snails.

The dioecious and flatted body worms, Schistosoma parasites have an indirect life cycle, while water snail act as an intermediate host belong to the genera *Bullinus* and *Physopsis*.

the nature of transmission Schistosomosis is a disease that commonly occurs in the proximity of water sources. Water and high rain full are good predisposing factors for hatching of the Schistosoma eggs and for occurrence of these parasites. Schistosomes are found in the mesenteric and portal blood vessels, and the principal clinical signs are associated with the passage of the spindle shaped eggs though the tissue of the gut lumen. Schistosomiasis is one of the most prevalent parasitic diseases and an important public health problem in many developing countries. Control measures of Schistosomiasis are applying based on interrupting the epidemiological cycle of the parasite by removing the adult parasites with chemotherapy, by eliminating the intermediate host (snail) with molluscicides and habitat modification and preventing access of definitive hosts to natural water course contaminated with cercariae.

In light of this remarks, the following recommendation can be forwarded.

References

1. Dwight D, Bowman G, Georgis MO (2003) Parasitological for veterinarians. Elsevier (USA) 129-133.
2. Lefevre CP, Blancou J, Chermette R, Uilenberg G (2010) Infectious disease of livestock. 1st ed Paris: Lavoizer: 1699-1703.
3. Urquhart GM, Armour J, Duncan JL, dunn AM, Jennings FW (1996) Veterinary helminthology: Veterinary Parasitology. New York Churchill: Livingstone Inc: 114-116.
4. Bont JD (1995) Cattle Schistosomosis host parasitic interaction. PhD Thesis University of Gent: 23.
5. Aemro T (1993) Assessment of prevalence, economic significance and drug efficiency trial on bovine Schistosomosis in Bahir Dar, Ethiopa. DVM Thesis faculty of veterinary medicine Addis Ababa University DebreZeit Ethiopia.
6. WHO (2010) Schistosomiasis: Population requiring preventive chemotherapy and number of people treated in 2010. Wkly Epidemiology 87: 37–44.
7. Okpala HO, Agwu E, Agba MI, Chimezie OR, Nwobu GO, et al. (2004) A Survey of the Prevalence of Schistosomiasis among Pupils in Apata and Laranto Areas in Jos, Plateau State. J Health Allied Scs 3: 1.
8. Belayneh L, Tadesse G (2014) Bovine Schistosomiasis: A Threat in Public Health Perspective in Bahir Dar Town, Northwest, Ethiopia. Acta Parasitologica Globalis 5: 1-6.
9. Pichford RJ, Visser PS (1998) Schistosoma matches Veglia and Le Roux, 1929, egg out put from cattle in a highly endemic area in the eastern transval. Ann Trop Vet Res 49: 233-235.
10. Taylor MA, Coop RL, Wall RL (2007) Veterinary parasitology. 3rded Singapore: Black well publishing: 91-94.
11. Alemseged G (2010) Prevalence of bovine Schistosomiasis in Dembia District North west Ethiopia. Dvm thesis Faculty of veterinary medicine Gondar Ethiopia
12. Fraser CM, Bergeron JA, Maya A, Susan EA (1991) The Merck veterinary manual: handbook of diagnosis, therapy, and diseases prevention and control veterinarian. 7th ed USA: Merck and co Inc: 76-78.
13. Reinecke RK (1998) Phylum plathlminthes veterinary helminthology, prtoria: butt heresorths: 245-247,265-273.
14. CDC (Central Disease Control) (2012) Parasite and Health Schistosomiasis. https://www.cdc.gov/dpdx/schistosomiasis/index.html.
15. Brant SV, Morgan JAT, Mkoji GM (2006) An Approach to Revealing Blood Fluke Life Cycles, Taxonomy, and Diversity: Provision of Key Reference Data Including Dna Sequence from Single Life Cycle Stages. Journal of Parasitology 92: 77-88.
16. Aiello SE (2000) The Merck Veterinary Manual: A hand book of diagnosis and therapy for the veterinarian .8th edition USA: Merck and co Inc: 131-132.
17. Mandal SC (2006) Veterinary Parasitology. 1st ed India: Ibdc publisher: 136-144.
18. Andrade ZA (2004) Schistosomal hepatopathy. Rio de Janeiro Journal of Memorial Institute 99: 51-57.
19. Khan HC, Line S (2005) The Merck Veterinary Manual. 9th ed Philadelphia: National publishing Inc 1170-1189.
20. Zangana Ik, Aziz KJ (2012) Prevalence and Pathological Study of Schistosomiasis in Sheep in Akra/Dohuk province, Northern Iraq. IraqiJournal of Veterinary Sciences 26: 125-130.
21. Pardo J, Carranza C, Turientes MC, Perez Arellano JL, Lopez Velez R, et al. (2004) Utility of Schistosoma bovis adult worm antigins for diagnosis of human Schistosomiasis by Enzyme Linked Immune Sorbent Assay and Electro immune transfer Blot Techniques. ClinDiagn Lab Immuno 11: 1165-1170.
22. Akande IS, Odetola AA (2013) Epidemiological survey of human and veterinary Schistosomiasis. License InTech: 29-30.
23. Soulsby EJ (1999) Parasite Zoonoses clinical and experimental studies. 2nd ed Canada: Torontto: 117-119.
24. Gryseels B, Polman K, Clerinx J, Kestens L (2006) Human

Schistosomiasis. Lancet 368: 1106-1118.

25. Donald, G. and McNeil, J., 2005. Schistosomiasis (Bilharzias) control and prevention. The carter center Schistosomiasis control program. www.ghchs.com/.../APSL_Latin%20A.
26. Krauss, H., Albert, W., Max, A., Burkhard, E., Henry, D. I., Hans, G. S., Werner, S., Alexander, V. G.,and Horst, Z., 2003. Zoonoses, infectious diseases transmissible from animals to Humans, 3rd ed. printed in Canada, American Society for Microbiology: 325-328.
27. FAO (Food and agricultural organization), 1993. Agricultural statistical data statistics division Rome, Italy. https://openknowledge.fao.org/server/api/core/bitstreams/1f902e82-65de-44c3-8e5b-f492c9e38ca2/content.
28. Chimbari MJ (2012) Enhancing Schistosomiasis control strategy for Zimbabwe: Building on past experience. Journal of parasitology research 103: 2-5.
29. Farida SS, Shombe NH (2012) Socio-economic Effects of Schistosomiasis on Irrigation Rice Growers in Morogoro, Tanzania. American Journal of Experimental Agriculture 2: 395-406.
30. Tohon ZB, Mainassara HB, Garba A, Mahamane AE, Bosque E, et al. (2008) Controlling Schistosomiasis. Significant Decrease of Anaemia Prevalence One Year after a Single Dose of Praziquantel in Nigerien School children.PLoS, Neglected Tropical Diseases 2: 241-243.