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Epidemiology of schistosomiasis in animal and human in Ethiopia

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Abstract

Schistosomiasis is snail-borne trematode infection in man, domestic animals and wild animals. It is also highly prevalent in tropics and causes morbidity and mortality in developing countries including Ethiopia. The disease has long history in Ethiopia. It has high public health as well as economic importance in the country. It is caused by schistosoma species which need snail inter mediate host for its life cycle completion and to infect final host. The disease cause its pathogenesis after it get access of final host. In final host the adult female moves against venous blood flow in to small venules, where it deposits 200 to 2000 eggs. This cause slow damage of the host organs due to granuloma formation around the eggs in the tissues. This leads to the development of fibrosis and chronic inflammation in the liver and causes severe damage including bleeding, renal failures, and cancer.The disease transmitted through contact or drinking of water that contaminated with infected host feces or urine in the presence of snail intermediate host. The disease examined by fecal examination, serology and biopsy with the help of clinical sign and history. It treated by Praziquantel which is the drug of choice now a day. And it is controlled by eradication of the snail host, chemotherapy, health education and good sanitation. There fore the objective of my seminar is:-To give highlights on the prevalence and distribution of *Schistosomiasis* infection in human and animal in Ethiopia.

Keywords: Distribution, Ethiopia, Factor, Prevalence, Schistosomiasis and Transmission

Introduction

Schistosomiasis is a snail-borne trematode infection in man, domestic animals and wild animals in tropical and subtropical countries (Zangana and Aziz, 2012). In livestock sector, it is an economically important disease caused by several *Schistosoma* species, which inhabit the vascular system of final hosts (Lefevre *et al.*, 2010) and also it is well recognized as the major helminthosis of domestic animals in Africa and Asia (Islam *et al.*, 2011). It is a threat to 530 million cattle while it infects over 165 million cattle in Africa and the Middle East (Islam *et al.*, 2011). In animals, the disease can cause significant economic losses due to mortality and morbidity from severe infection and long-term effect of moderate- and long-standing chronic infection (Edward and Androwsi, 2002).

As livestock in Ethiopia represents major national resource and form an integral part of the agricultural production system and largest animal population amongst African countries with an estimated 35 millions tropical livestock unites (TLU), the economic benefit derived from the livestock sector does not commensurate with the potential (FAO, 1993).This is due to wide spectrum of diseases such like Schistosomosis. (Tewodros A. E and Alemseged G.A 2015).

In adition Schistosomiasis is one of the most prevalent parasitic diseases and an important public health problem in many developing countries. Globally, schistosomiasis ranks second among parasitic diseases of socio-economic and public health importance and is found in 48 African countries (WHO., 1999). 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 [Touré *et al.*,2008) .

Animal and human schistosomiasis is dependent on environmental factors such as moisture, rainfall, temperature, water bodies (stagnant ponds, swamps, streams, rivers, irrigation canals, marshes and dams) and snail intermediate hosts (Li *et al.,* 2012). Moreover, schistosome infection is closely associated with infested water bodies with traditional grazing and watering systems (Arshad *et al.,* 2011). These factors tend to be conducive of enzootic schistosomiasis, which is characterized by the high prevalence and significant losses of productivity in ruminant population. The impact of schistosomiasis is expected to increase in the future as a result of intensified animal husbandry and water conservation which create ideal conditions for schistosome transmission (Islam *et al.,* 2011; Kamanja *et al.,* 2011).

Human schistosomiasis is second only to malaria in mortality (WHO, 2010; Mutapi et al., 2017). An estimated 700 million people in 76 countries are at risk of schistosomiasis, and 240 million people are infected. About 85% of the infections occur in Africa with an estimated annual death of 280,000 people (Sady et al., 2013;WHO, 2010; 2019).

In endemic areas, children carry the largest burden of the disease characteristics of acute schistosomiasis are rarely seen; however, the adult population carries the chronic form of the disease characterized by periportal fibrosis, hepatomegaly, splenomegaly, portal hypertension, hematemesis and oesopheageal varices (Vennervald *et al*., 2004; Booth *et al*., 2004).

Morbidity and mortality due to schistosomiasis are largely due to the consequences of a host T cell-mediated immune response against parasite eggs trapped in the tissue. Antigens released from the egg stimulate a granulomatous reaction involving T cells, macrophages, and eosinophils that results in clinical disease. However, the magnitude of the resulting granulomatous and fibrosing inflammation varies greatly from individual to individual (Miguel, 2011).

The aim of this review was to bring together available data from primary research conducted so far on the epidemiology of schistosomiasis in animal and human in Ethiopia.

The history of schistosomiasis in Ethiopia

Schistosomiasis is a common helminthic infection in the tropics and subtropics, particularly in sub-Saharan African countries including Ethiopia. In these counties, *Schistosoma mansoni* infection is a significant public health problem due to the risk of reinfection and recurrent disease despite implementing several rounds preventive chemotherapy. *Schistosoma mansoni* was firstly identified in Ethiopia and reported in 1934. When it became wide spread on the high plateau of the country. But S. haematobium was identified much later and was known only in a few isolated localities (WHO, 1987). The wide distribution of the disease can be interpreted from various factors, including: expansion of irrigation facilities in the 1960's used for drinking, washing and watering of nomadic herds; building of the Koka Dam on the Awash river and associated supply and drainage canals conducive to

transmission; and migratory movements of pastoral nomads and agricultural workers (WHO, 1987). Surveys to measure the effect of irrigation construction on schistosomiasis prevalence corroborate These assumptions. Before irrigation schemes began in the 1950's in the Awash valley, S. mansoni was considered absent from the region; by 1976 prevalence estimates reached 9.0% in the upper valley. Similarly, irrigation started in 1954 showed prevalence rates rose after the first diagnosed case in 1964 from 7.5% in 1968 to 20% in 1980. In 1988 the prevalence amongst children in a village on that same irrigation scheme was estimated at 81.9%. A survey in 1997 showed that following the construction of small dams in the Tigray Region, disease prevalence increased from 29.7% to 48.4% (Steinmann *et al.*, 2006).

Etiology of schistosomiasis

Schistosomiasis is a chronic, debilitating parasitic disease of great public health importance, caused by trematode blood flukes of the genus Schistosoma. The three main schistosome species infecting humans are *Schistosoma mansoni, S. haematobium and S. japonicum. S. intercalatum, S. mekongi, S. malayensis* and S. *guineensis* (Webster *et al.*, 2006) are less prevalent.

Taxonomy of Schistosoma Species

Schistosomes are parasitic blood-dwelling fluke worms belonging to the genus Schistosoma; family, Schistosomatidae; order, Digenea; class, Trematoda; phylum, Plathyhelminths; and kingdom, Animalia. The genus Schistosoma contains six species that are of major pathological importance to final host, *Schistosoma haematobium (S. haematobium), S. mansoni, S. japonicum, S. mekongi, S. intercalatum*, and *S. guineensis* (Webster *et al.*, 2006). The species differ in their final location in the human host, the species of the intermediate (snail) host they use in their life cycle, the pathology they induce, and the number, size and shape of the eggs they produce. This Monograph is restricted to S. haematobium.

Morphology of Schistosoma Species

Schistosomes are dioecious (Unisexual) worms, which is an exception among the trematodes. They are thin, elongated fluke, up to 2 cm long primarily parasitize in blood vessels of alimentary and bladder (Urquhart *et al.* 2003) responsible to cause schistosomosis. Adult schistosomes are white or grayish worms with cylindrical body that features two terminal suckers, a complex tegument, a blind digestive tract, and reproductive organs. The male's body forms a groove or gynaecophoric canal, in which it holds the longer and thinner female (Gryseels *et al.*, 2006). The surface of the adult worm is covered by a living syncytial layer, the tegument, bounded by a complex multi laminate surface. This comprises a normal plasma membrane overlain by a secreted bilayer, the membranocalyx. The tegument is attached to underlying cell bodies by narrow cytoplasmic connections. The nuclei, ribosomes, endoplasmic reticulum, and Golgi apparatus are located in these cell bodies, and their vesicular products, the discoid bodies and multilaminate vesicles, traffic to the tegument syncytium via the connections (Braschi and Wilson, 2006). Adult females lay eggs.The eggs of schistosomes vary in their size and shape, their lateral or terminal spine. The *S. mansoni* egg measures approximately 140 by 61 µm and has a prominent lateral spine. The *S. haematobium* egg is approximately 150 by 62 µm with a prominent terminal spine. Both are ovoid. The *S. japonicum* egg is round, has a lateral spine that is often obscured, and is smaller than the other two types of eggs (60 by 100 µ m) (Ross *et al.*, 2002). The ova contain a characteristic ciliated miracidia that hatch and infect susceptible snails, which develop into a bifurcated cercariae having head and tail.

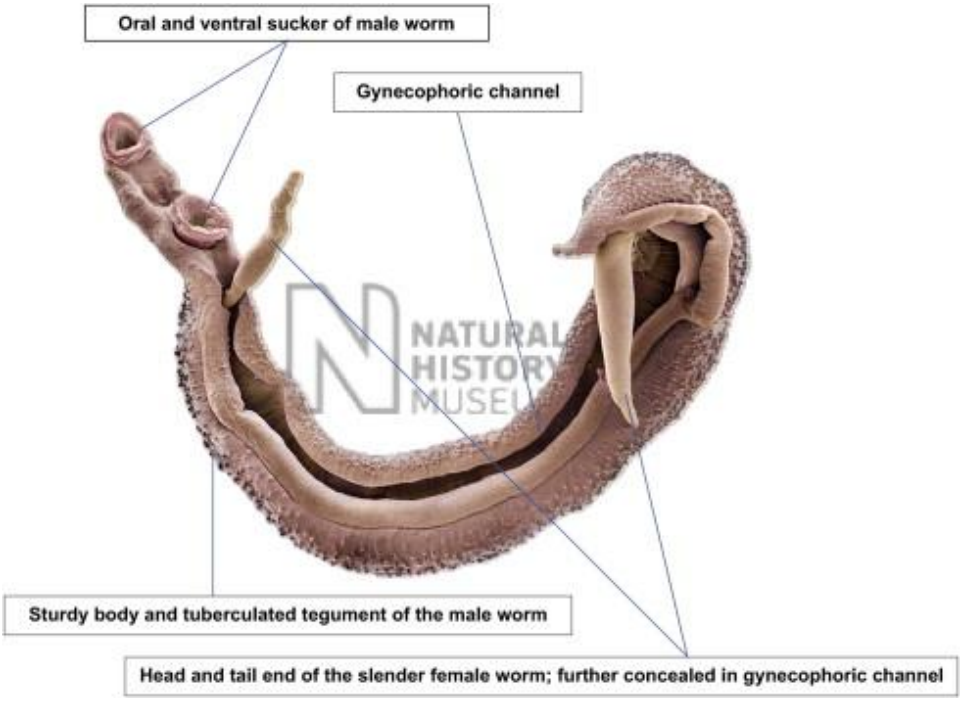

Figure 1-Mature Schistosome worm: female lying in the gynaecophoric canal of male (BrunoGryseel, 2012)

Life Cycle

Schistosome parasites are multicellular eukaryotic organisms with a complex life cycle that involves mammalian and snail hosts (LoVerde *et al*., 2007). The life cycle is completed when the eggs passed in the faeces hatch, releasing miracidia that, in turn, infect specific freshwater snails (McManus and Loukas, 2008). After two generations of primary and then daughter sporocysts within the snail, asexually produced cercariae are released. Intramolluscan development of larval digenetic trematodes is a complex process involving initial infection of the snail host by the free swimming miracidium, its subsequent transformation to a parasitic primary sporocyst stage, followed by asexual reproduction and release of secondary sporocysts or rediae, and finally the 10 eventual formation and release of cercariae, the next free-swimming stage in the life cycle (Wu *et al.*, 2009). The cercariae start leaving the snail 4-6 weeks after infection and spin around in the water for up to 72 hours seeking the skin of a suitable definitive host. Cercaria shedding is stimulated by light and occurs mainly during the day time. One snail, infected by one miracidium, can shed thousands of cercariae every day for months (Gryseels et al., 2006). The vertebrate endoparasitic life cycle begins when schistosome cercariae penetrate the skin of a host. By about three hours after penetration, the trilaminate outer membrane of the cercariae is replaced by heptalaminate membrane. The new membrane is formed at about 30 minute after penetration from small membranous vacuoles which originate in subtegumental cells and pass into the tegument. Schistosome parasites stay in the skin and after two days enter the circulation and move to the lungs where they stay for further development. They transform into schistosomules and establish as an endoparasites (LoVerde *et al.,* 2007). The parasites leave the lungs and move to the portal circulation of the liver where the male and female worms mate. These worm pairs then migrate to their ultimate vascular bed, i.e., superior mesenteric veins (*S. mansoni*), inferior mesenteric and superior hemorrhoidal veins (S. japonicum), or the vesical plexus and veins draining the ureters (*S. haematobium*).

Egg production commences 4 to 6 weeks after infection and continues for the life of the worm in the definitive host (McManus and Loukas, 2008). This stage of the parasite life cycle takes place in a milieu of host signaling molecules. To continue its development it must take advantage of signals from the host (LoVerde *et al.,* 2007).

Biology of snail intermediate hosts

The intermediate hosts of schistosomes in Africa are freshwater pulmonate snails, which belong to the Planorbidae family. The species belong to two genera, namely *Biomphalaria,* host for *S.mansoni,* and *Bulinus,* host for *S. haematobium* and *S. intercalatum* (Sturrock, 1993). All speciesof *Biomphalaria* and *Bulinus* are hermaphrodite, possessing both male and female organs in single organism **(**Gashaw, 2010). There are two species of the genus *Biomphalaria, B.sudanica* and *B.pfeifferi,* are known to transmit *S.mansoni* in Ethiopia (Erko *et al.,* 2006). Unlike, *B. pfeifferi*, which is known to have a wide geographical distribution, *B. sudanica* has very limited distribution in Ethiopia. Its presence has so far been reported from only three areas in Rift Valley, Ziway and Abaya Lakes and the interface between Tikur Wuha River and Awassa Lake (Birrie *et al.,* 1995). It seems, therefore, that *B.pfeifferi* has ubiquitous distribution, while *B. sudanica* is limited in its distribution. *Bulinus abyssinicus* and *B.africanus* are the only snail species found naturally transmitting *S. haematobium* in Ethiopia, even though about 10 bilinus species are expected to occur (Lo *et al*., 1988). From the previous studies it is established that *B. abyssinicus* is the intermediate host for *S. heamtobium* in Awash valley, whereas *B. africanus* transmit the disease in kurmuk (an area locating near to Sudan) (Kloos *et al.,* 1988).

Host range

S. haematobium, S. mekongi, S. intercalatum infect Humans only . *S. mansoni* primarily infects humans, but can infect mammals occasionally. *S. japonicum* infects humans and bovine species. Other *Schistosoma* species primarily infecting mammals only rarely infect humans *(*Murray *et al.*, 2003)

Pathogenesis

After copulation of male and female Schistosomes within the lumen of veins, adult female moves against the venous blood flow in to small venules, where it deposits 200 to 2000 eggs per day. The ova pass through the wall of blood vessel and then to adjacent tissues.The ova may be discharged in feces or urine and larger amount may be trapped in tissue of the final host (Jones *et al* ., 1997). In the water, eggs hatch and release miracidia which invade suitable water snails and develop in to the cercariae. When the cercariae are fully matured, they leave the snail and invade the final host through the skin or mucous membranes. After penetration, cercariae develop in schistosomula, which are transported through the lymph and blood to their predilection sites (Jones *et al* ., 1997). The migration of the eggs may cause mechanical damage and lesions. Moreover, *Schistosoma* eggs trapped in the tissue elicit granulomatous reaction that is mounted to destruct the eggs. These granulomas consist of several cell types, mainly eosinophils, macrophagesand lymphocytes (Olds *et al.,* 1980).. In the chronic stages of the disease, the pathology is associated with collagen deposition and fibrosis, resulting in organ damage and dysfunction (Kogulan, P. and R.D. Lucey, 2005).

For more when the cercariae penetrate human skin, they cause **acute symptoms** sometimes called ‘swimmer’s itch’. This occurs a few hours to days after infection and is probably related to the development of humoral and cellular immunity to the cercariae. A few weeks later, some patients experience a syndrome termed ‘Katayama fever’, in which cough, fever, urticaria and other symptoms occur. Katayama fever is thought to represent an immune complex disease, similar to serum sickness, as the immune response to schistosomal eggs begins.

The chronic features of schistosomiasis are organ-specific and relate to the host response to deposited eggs. Egg deposition starts about 6–9

weeks after infection. Although the eggs are released into the venous blood, many reach the lumen of the gut or the bladder. It is unclear whether this occurs by active enzyme secretion by the eggs or by the natural motion of fluid in the bladder and bowel. Eggs reaching the lumen are excreted and subsequently hatch to form miracidia, which may then complete the life cycle by infecting a snail. Eggs that are not excreted lodge in the mucosa of the bladder and bowel, and some reach the liver via the portal circulation. In the tissues, a cell-mediated response to the egg leads to granuloma formation. When the miracidium in the egg dies after about 6–8 weeks, the antigen load decreases and the granuloma tends to shrink. Healing leads to fibrosis. (Christopher P Conlon , 2005).

In general Schistosomiasis affects human host by slow damage of the host organs due to granuloma formation around the eggs in the tissues. This leads to the development of fibrosis and chronic inflammation in the liver and causes severe damage including bleeding, renal failures, and cancer (Harrison, T. 2005).

Clinical sign in animal and human

In cattle the clinical sign exhibited are emaciation, marked diarrhea mixed with blood or mucous, dehydration, pallor of mucus membrane marked weight loss, decreased production and rough hair coat (Bont, 1995).

Symptoms are related to the amount and location of eggs in the human host(Krauss *et al.,* 2003) and can cause acute and chronic schistosomiasis (Murray *et al.*,2003). Acute schistosomiasis is characterized by cercarial dermatitis and Katayama syndrome. Cercarial dermatitis is unusual among individuals exposed for the first time such as visitors and migrants, and is rare among endemic populations, travellers or migrants (Ross *et al.*,2007). The clinical presentation of acute schistosomiasis includes fever, headache, generalized myalgia, abdominal pain, vertigo, vomiting, bloody diarrhea, and fatigue (K., & Tisch .,2005). When eggs become trapped in tissue, and they fail to clear, they can produce chronic schistosomiasis (Murray *et al*.,2003).

The chronic disease, which is more prevalent in endemic areas, is due to a granulomatous response to parasitic eggs. Clinical presentation includes inflammation, hyperplasia, ulceration, and occult blood in feces. But when eggs are deposited in the liver, symptoms can include portal hypertension, hepatosplenomegaly, liver fibrosis, hepatic coma, ascites, and esophogeal varices (Murray *et al.,* 2003; Liu *et al.,*2008) which are late stages of pipestem fibrosis with liver cell function relatively preserved early in the disease course. *S. japonicum* and *S. mansoni* are primarily associated with hepatic and intestinal pathology, including diarrhoea, abdominal pain, and hepatosplenomegaly (Heymann *et al.,* 2008). Urinary schistosomiasis is caused by *S. haematobium,* and chronic *S. hematobium* infection is the major risk factor for urinary tract carcinoma (Heymann *et al.,* 2008). Its' clinical presentation includes dysuria, hematuria ,proteinuria, calcification in the bladder, obstruction of the ureter, renal colic, hydronephrosis, and renal failure (Murray *et al.,*2003). *S. haematobium* is also leading cause of bladder cancer (Samaras *et al*., 2010). Lung and CNS involvement can occur, producing lesions in the brain (*S. japonicum and S. mekongi*) and spinal cord (*S. mansoni* and *S. haematobium*) (Liu *et al.,* 2008). Clinical manifestations of cerebral schistosomiasis include seizure, headache, acute encephalopathy, hemiparesis, and hemianopsia (Liu *et al*., 2008). Worms may survive for 30 years in the host (Krauss *et al.,* 2003).

Epidemiology of schistosomiasis in Ethiopia

Prevalence and geographic distribution in animal and human

Schistsomiasis is one of the most prevalent trematode infections of ruminants in different parts of the world including Ethiopia (Ali *et al.,* 2006). Reports have also shown that schistosomiasis is highly endemic in Ethiopia (Getachew *et al.,* 2014). Epidemiological studies

conducted on bovine schistosomiasis are suggestive for this endemicity of the disease particularly in the area with large permanent water bodies and marsh pasture area. These studies has been reported on prevalence of *Schistosoma bovis* in different parts of Ethiopia from fecal sample examination due to its high prevalence and infection in animal are ; study conducted in Gewane, 1.5% and in Awassa, 5.5% (Lemma,1999), in Bahir Dar, 33.8% (Hailu, M., 1999) and 22.06% (Solomon, O., 2008) and 28% in Kemissei (Ameni *et al.,* 2001).

In general Schistosoma bovis has a localized distribution, which is found commonly in northern, eastern, southwestern and central parts of Ethiopia and prevalence ranges from 1.5% to 33.8% in ruminants (Mengistu *et al.,* 2012)

Schistosomiasis in human is considered endemic across the entirety of Ethiopia, in rural and urban settings. Currently, Schistosoma haematobium, the causative agent of the urinary form of the disease, is mainly present in the Lower Awash Valley along the border of Somalia and near the western border with South Sudan. Schistosoma mansoni, the fluke causing the intestinal form of the disease, is endemic in the Omo, Awash, and Blue Nile river valleys (IAMAT**,** 2015), and also in Tigray (Dejene and Petros, 2009), in Fincha valley,Western Ethiopia(Erko *et al.* 2009), in Babile Town Eastern Ethiopia(Girum, 2005),in Zarima Twon northwest Ethiopia(Alemu *et al.* 2016), in Haik, north east Ethiopia(Amsalu *et al*. 2015). But the prevalence and intensity of infection are higher in endemic areas, in children than adults (Davis, 2003). Early study shows prevalence of *S.mansoni* infection rates above 60% in endemic communities in different part of Ethiopia (Woldemichael and Kebede.,1996)

In general the disease is more prevalent and widely distributed in North, North West and Central region of the country (Birrie *et al*., 1998) and is recorded in all regions of the country and the prevalence is significantly higher than the previous (Rupiah *et al.,* **2015).** This increase in prevalence and spread of the disease in Ethiopia in human, as in other developing countries, is due to increasing water related projects, population migration and human behavior and luck of awareness (Chitsulo *et al*., 2000).

Transmission

Transmission occurs when animal or human contacted with water that contaminated with infected host feces or urine (Murray *et al*., 2003) and for the disease transmission to take place, the ecologies of the schistosomes, the aquatic snail intermediate host and the definitive host must converge in space and time in suitable water bodies. By affecting the transmission cycle of schistosome parasite directly or indirectly, numerous factors act to determine the transmission of schistosomiasis (Cox, 1993). These factors include biotic and abiotic factors, behavioral and socioeconomic factors.

Biotic factors

Such as aquatic vegetation and algal cover, presence and prevalence of the pathogenic worms and host snails largely influence the distribution of schitosomiasis. In addition to its role as main sources of nutrition, aquatic vegetation and algae also create favorable habitats for intermediate snail hosts (e.g. provide suitable surface for depositing egg masses (Boelee and Madsen, 2006).

The abiotic factors

such as climatic (temperature and rainfall), physical (e.g. water current velocity and water turbidity) and chemical factors, which affect the survival and development of the schistosome parasite and the snail intermediate host in turn affect transmission dynamics. For instance, various species of schistosomes have different water temperature, current, turbidity, and desiccation tolerances. Both *Biomphalari*a and *Bulinus* species prefer gradual changes in the water level, little turbidity and partial shade (Birley, 1991). Moreover, *Bulinus* and *Biomphalaria* spp. prefer water velocities below

0.3 m/s (Birley, 1991). Hence, transmission foci involving snail of these genera tend to be limited to still or slow flowing water bodies (Southgate and Rollinson, 1987). In addition, many intermediate snail hosts thrive on organic material and firm mud substrate. Population dynamics of snails and transmission is correlated more closely with climatic factors, especially rainfall and temperature, rather than with physicochemical factors and schistosome transmission usually is seasonal, primarily due to the variation in temperature and the water cycle (WHO, 1993).

Behavioral and socio-economic factors

Socioeconomic status and behavioral activities has a significant influence on the transmission and spread of schistosomiasis by affecting the exposure level of the local people to the schistosome parasite in endemic areas. As a behavior related disease, the risk of infection with schistosomiasis is associated to age, gender, and occupation of individuals. Human water contact studies to date have estimated exposure at the population level with either direct observational studies or interviews (Ross *et al*., 2001). These studies have revealed that intensity of infection is influenced considerably by many aspects of human contact with infective water including frequency, duration or time of day of contact. For example, water contact is greatest during the middle of the day or early afternoon, which is just the time that cercariae are released from the snail intermediate host (Azim *et al.,* 2008).

Population movement

It has been documented that population movements which may occur for various reasons have led to an important increase in the spread of schistosomiasis. Infected individuals carry parasites with them when they travel. Transmission of schistosomiasis may become more intense in manmade water bodies than natural water bodies due to population movement and the resultinghigher human population density. Migration does not only intensify infection in endemic areasbut also introduce new infection to previously non indemic areas given the presence of susceptible intermediate snail hosts (Steinmann *et al*., 2006).

Diagnosis

The diagnostic standard for active schistosomiasis is viable eggs in urine (S haematobium), faeces (S japonicum, S mansoni), or tissue biopsies. At present, the presence of infecting schistosomes cannot be ruled out definitively because of the low sensitivity of standard urine and faecal examinations (De Vlas *et al*.,1997). Microscopic examination of poly-carbonate filters for eggs in the urine, urine dipstick assays for heme, (WHO, 2006) or the Kato-Katz faecal examination for schistosome eggs (Feldmeier and Poggensee, 1993) are recommended by WHO for mapping and field-based control of schistosomiasis. Molecular techniques to detect schistosome DNA in faecal specimens have greater sensitivity than does microscopy (ten Hove *et al.,*2008) but they still su er from sampling limitations because of the irregular distribution of eggs in the excreta. DNA detection for serum or urine is also being assessed.(Ibironke *et al*., 2012; Wichmann *et al.*, 2013). Serological assays have proven useful clinically (Tsang and Wilkins, 1997) for diagnosis by detection of antibodies against schistosomal antigens, especially for symptomatic travellers, but for people in regions endemic for schistosomiasis, serology is unable to discriminate between active infection and past exposure. Detection of circulating schistosomal antigen overcomes this di culty, and a point-of-contact circulating cathodic antigen assay is commercially available (Rapid Medical Diagnostics, Pretoria, South Africa). This lateral flow cassette assay works on urine and seems to be more sensitive than the Kato-Katz assay for mapping of S mansoni-endemic regions (Colley *et al*., 2013). Its use permits on-site mapping of S mansoni without stool collections. In addition to these better diagnostic tests for schistosomiasis are still needed both in the field and in the clinic and new technologies are being studied. For example, PET scan (Salem *et al.,* 2010) have been used experimentally to detect adult parasites in vivo and micro fluidics now o er the potential to

miniaturise both antibody and parasite antigen detection assays (Chen *et al.*, 2013).

Treatment

Early treatments against schistosomiasis had severe and even lethal side-effects that had to be weighed against the benefits for the patient.(Olds and Dasarathy , 2000; Jordan *et al*., 2000). But now a day Praziquantel is the drug of choice in most cases. (Nawras *et al.*, 2015) that is active against all schistosome species, and the most widely used. It is mostly marketed as 600 mg tablets, with a recommended standard regimen of 40 mg/kg body weight in a single dose.(WHO, 2002).The drug acts within 1 h of ingestion by paralysing the worms and damaging the tegument but it has no effect on eggs or immature worms. Follow-up at 4-6 weeks is recommended with repeat of treatment in 6-12 weeks (Gryseels *et al.*, 2006) . Side effects are mild and include nausea, vomiting, malaise, and abdominal pain. In heavy infections, acute colic with bloody diarrhoea can occur shortly after treatment, probably provoked by massive worm shifts and antigen release.(Stelma *et al* ., 1995). Oxamniquine is the only alternative; where praziquantel is less effective. The use of oxamniquine is declining but is effective. (Danso *et al* .,2013). Corticosteroids and anticonvulsants may be needed as adjuvants to praziquantel in neuro- schistosomiasis (Gray *et al* ., 2011).

Treatment of schistosomiasis in general serves three purposes: reversing acute or early chronic disease, preventing complications associated with chronic infection, and preventing neuro-schistosomiasis. The goal of treatment is reduction of egg production via reduction of worm load; this reduces morbidity and mortality even in the absence of complete worm eradication (Richter, 2003).

Control and prevention

Effective control measure against schistosomiasis require a well planned, executed and integrated control program designed to target the parasite or snail intermediate host. Strategic and seasonal application of effective antihelmintics specific for schistosomiasis play important role in the control of disease.treatment of infective case, in particular provide the most effective short term method to reduce the rate of tansmition and morbidity associated with schistosomisis (FAO, 1994)

Prevention in travellers to tropical areas, schistosomiasis can be prevented by avoiding exposure to fresh water but in endemic areas, prevention by this is difficult. Provision of clean water and proper sewage control are probably the most important means of reducing the burden of schistosomiasis, in addition to improvements in the general socioeconomic status of the population. Molluscicides can be used to reduce snail populations in fresh water and thereby remove the intermediate host from the parasite's life cycle. Mass chemotherapy applied to villages has been shown to be effective. (Wagatsuma *et al.*, 1999).

As a whole the options available for the control and prevention of schistosomiasis include ***eradication of the snail host*** i.e. use of molluscicides like current available chemical Bayluscide (Niclosamide) and copper sulfate. In addition to these, a native Ethiopia plant, phytolaca dodecandora, locally known as "endod" is also an effective molluscicide (Shibru *et al.*, 1989)., The endod (Phytolacca dodecandra)-based schistosomiasis mansoni control project was implemented in Ethiopia between 1994 and 1999. The aim was to develop an effective, cheap and sustainable method of controlling schistosomiasis. The study conducted by Abebe *et al*. (2005) indicates that endod is an effective schistosomiasis control agent, particularly when combined with chemotherapy. The spray method is the simplest and the most effective method for application of endod.

Chemotherapy: Several drugs such as trivalent antimonials, hycanthone, nitridazole, trichlorphan, haoxon, amoscanate and praziquantel have been used to treat visceral and nasal Schistosomiasis with variable efficacy and toxicity (Bedarkar *et al.*, 2000). The drug praziquantel is drug of choice for all species of schistosomiasis (Ameni *et al*., 2001).

Health education and good sanitation i.e. fencing of dangerous waters, functional sewerage or provision of clean tap water. Often a combination of these methods has to be adopted to make any significant reduction in transmission (WHO 1993).

Chemotherapy is by far the most successful method used in the control of schistosomiasis, essentially because of the availability of safe and efficacious drugs such as praziquantel (Cioli 1998). The use of mass chemotherapy has considerably reduced the morbidity of schistosomiasis in many endemic countries (WHO 1993). But the ultimate strategy in the control of schistosomiasis is the development of a vaccine (Wilson & Coulson 1998). The fact that there is partial protection following a natural schistosome infection implies that vaccine development is both rational and feasible (Bergquist & Colley 1998). Radiation- attenuated cercariae vaccine consistently confers high protection in both rodents and non-human primates (Coulson 1997). However it is neither practical nor ethical to use irradiation-attenuated organisms as a vaccine in humans, but it has served to increase the knowledge of mechanisms of protection in animal models (Wilson & Coulson 1998).

Conclusion and Recommendations

Schistosomiasis is still has major pravalece and distribution with public health problem in Ethiopia. Species like schistosoma mansoni (intestinal schistosomiasis) and schistosoma haematobium (urinary schistosomiasis) are the two most important species that have high public health importance and high prevalence and distribution in the country. For this prevalence and distribution there are modifiable factors. These are education level, swimming habit, fishing activities, washing clothes and utensil using river water, working in an irrigated agricultural field with out any personal protection, water resources projects, crossing water bodies on bare foot and herding cattle near the stream. In addition due to these factors there are also recent discoveries of new transmission foci or area.

Based on the above conclusion the following recommendations are forwarded:

- Proper use of personal protection (for like fisher man, personal and farmer who have contact with water body and work in irrigated agricultural field)
- Health education and awareness at school and community level to bring behavioral change in order to improve hygienic practices and reduce fecal pollution of the environment
- Therapeutic intervention and Proper health impact assessment for new irrigation schemes and water resources projects should be done and apply.
- Great concern for the disease should be given and further study with the objective of addressing the disease impact and factors influencing distribution and transmission have to be done and there must be specific policy launched to decrease the disease burden especially in endemic areas.

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