

Review on the Epidemiology and Associated Risk Factors of Schistosomiasis in Amhara Region

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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 long-term effect of moderate- and long-standing chronic infection. It is a Neglected Tropical Disease (NTD) of profound medical and veterinary importance. Schistosomiasis is endemic in the tropical and subtropical countries of Africa, Asia and southern Europe. The geographical distribution of schistosoma species infecting cattle are mainly determined by the distribution of their respective intermediate host snails, level of infection and the frequency of water contacts. Shows that at least 235 million cases of schistosomiasis disease burden occur world-wide, with 732 million people at risk of infection and another 200,000 people died each year especially in sub-Saharan Africa where the disease is said to be endemic. Epidemiological studies conducted on bovine schistosomiasis are suggestive of the endemicity of the disease in Ethiopia particularly in the area with large permanent water bodies and marsh pasture areas of the country. Most infections in endemic areas occur at a subclinical level. However, it has been established that high level of prevalence of subclinical infections cause significant losses due to long-term effects on animal growth and productivity and increased susceptibility to other diseases. *S. bovis* has a localized distribution, which is found commonly in northern, eastern, southwestern and central parts of Ethiopia with varying prevalence ranging from 1.5 % - 33% in Gewene and Bahirdar respectively. The snail hosts favor intensive transmission of Schistosomiasis and the infection rate of the disease are mainly affected by host related factors, anthropogenic/ human factors like poorly designed irrigation projects, management and seasonal factors. Ruminants are usually infected with cercariae by penetration of the skin, although infection may be acquired orally while animals are drinking. Diagnosis is based primarily on the clinico-pathological picture, seasonal occurrence, previous history of schistosomiasis in the area or the identification of snail habitats with a history of access to natural water bodies, demonstration of characteristic eggs based on the species in the feces, postmortem examination and hematological tests. A pre-requisite for disease control/prevention is to screen factors facilitating identification of categories of animals that are at particular risk of developing an infection. So, an in depth understanding of the epidemiology of schistosomiasis is required to develop control strategies

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1. Introduction

Livestock production constitutes one of the principal means of achieving improved living standards in many regions of the developing world. In sub-Saharan Africa countries livestock plays a crucial role both for the national economy and the livelihood of rural communities. It provides draught power and raw material for industry (ILCA, 2007). Livestock in great horn of Africa is a vital resource in promoting development. They provide 20-30% of the gross domestic product (GDP) and at the farmer level as much as 70% of cash income is generated from livestock (Ali *et al.*, 2006).

In Ethiopia, recognized for its vast wealth in Africa, livestock contribute about 30-35 % of agricultural gross domestic product (GDP) and 12-16 % of total GDP (Singh *et al.*, 2006). Ethiopia is a

home for many livestock species and suitable for livestock production (Solomon *et al.*, 2003; Tilahun and Schmidt, 2012). However, the economic benefit derived from the livestock sector does not commensurate with the potential due to a number of complex and inter-related factors of which widespread diseases due to a number of bacterial, viral and parasitic disease occurrences are the major ones (Jabbar *et al.*, 2007; Negassa *et al.*, 2011). Parasitism is one of the major impacts on livestock development in the tropics. Among many parasitic problems of farm animals, schistosomiasis is one of the most prevalent trematode infections of ruminants in different parts of the world including Ethiopia.

Schistosomiasis (also called Bilharzias after the German tropical disease specialist (Lo and Lemma, 1973) is a snail-borne parasitic infection in man,

domestic and wild animals in tropical and subtropical countries due to trematodes of the genus *Schistosoma* (Singh *et al.*, 2004; Sumanth *et al.*, 2004; Islam *et al.*, 2011; Zangana and Aziz, 2012). As many as 10 different species of schistosomes; six have received particular attention mainly because of their recognized veterinary and public health significance. The geographical distribution of schistosoma species are mainly determined by the distribution of their respective intermediate host snails, level of infection and the frequency of water contacts. Age, sex, breed, season, immunity, anthropogenic/ human, farming system and environmental factors are also playing the role for the prevalence and occurrence of schistosomiasis infection rate in animals.

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). The adult worms inhabit the mesenteric vessels of the definitive host and the intermediate forms develop into snails from the genus *biomphalaria*, *bulinus* & *monocephala* (Kassai, 1999). It causes significant economic losses through mortality & morbidity from severe infection and long-term effect of moderate- and long-standing chronic infection (Edward and Androwsi, 2002). The disease is characterized by its chronic nature and affects the productivity and reproduction performances; and predisposes animals to other diseases (Dargie, 1980; McCauley *et al.*, 1983, 1984).

Schistosomiasis is one of the 15 neglected diseases in tropics and it is the second parasitic disease next to malaria. It is endemic not only in sub-Saharan Africa, but also in the Middle East, Far East, South, Central America and the Caribbean (Georg *et al.*, 2003; Taylor *et al.*, 2007). According to an estimate of the disease epidemiology, by the World Health Organization which shows that at least 235 million cases of schistosomiasis disease burden occur worldwide, with 732 million people at risk of infection and another 200,000 people died each year especially in sub-Saharan Africa where the disease is said to be endemic. Secondly, WHO report in 2007, estimate between 391 and 587 million people are reported to have active cases of schistosomiasis world-wide and between 1.7 to 4.5 million loss per annum of disability adjusted life years are due to schistosomiasis (Kabiru, 2017).

Epidemiological studies conducted on bovine schistosomiasis are suggestive of the endemicity of the disease in Ethiopia particularly in the area with large permanent water bodies and marsh pasture areas of the country. Most infections in endemic areas occur at a subclinical level. However, it has been established that high level of prevalence of subclinical infections cause significant losses due to long-term effects on animal

growth and productivity and increased susceptibility to other diseases. *S.bovis* has a localized distribution, which is found commonly in northern, eastern, southwestern and central parts of Ethiopia. In northwestern Ethiopia, its prevalence has been reported by a number of authors; 12.3-29% in Bahir Dar (Solomon, 1985; Aemro, 1993; Hailu, 1999; Yalelet, 2004; Almaz, 2007; Belayneh, L. and G. Tadesse, 2012), 28% in Kemissie (Ameni *et al.*, 2001), 26.9% in South Achefer, (Kerie & Seyoum, 2016) and Kassahun *et al.*, (2017) also reported 23.9% in north western Ethiopia.

These some reports indicate the prevalence of schistosomiasis in different area of north western Ethiopia appears to be spreading (Belayneh and Tadesse, 2014). Snail hosts favor intensive transmission of Schistosomiasis. These parasites are found in vast water lodged and marshy grazing field, a condition anticipated for being ideal for the propagation and maintenance of the intermediate host (snails) and hence high prevalence of trematode infection occurred (Fromsa *et al.*, 2011). The infection rate of the disease anthropogenic/ human factors like poorly designed irrigation projects, management and seasonal factors. The presence of different large water bodies lakes like Tana, river like Nile irrigation systems and other small streams, sugar projects do also play a similar role in the area. All those reports, scanty documentation indicates how much schistosomiasis is a problem which necessitates further reviews and research.

Hence, the objective of this paper is to review available epidemiological data with regard to associated risk factors in the area. Therefore, the review was done to compile the prevalence of bovine schistosomiasis in the north western part of Ethiopia; Amahara region, assess ecological related risk factors for the occurrence of bovine schistosomiasis in north western part of Ethiopia and identify the gaps and recommend the possible option.

2. Literature Review

2.1. Etiology

Schistosomiasis (blood fluke disease or bilharzosis) is an infection due to the genus schistosoma. Adult Schistosomes are obligate parasite of the blood vascular system of vertebrates. Schistosomes are dioecious (unisexual) worms, which is an exception among the trematodes. The mature female is more slender than the male and normally carried in ventral groove, the gynaecophoric canal which is formed by ventrally flexed lateral outgrowths of the male body. A total of 19 different species are described worldwide (Bont, 1995). They can be differentiated through their morphological features, life cycle, host specificity or enzyme; and

DNA and behavioral characteristics (Rollinson and Southgate, 1987). Out of 10 species reported to naturally infect cattle, six have received particular attention mainly because of their recognized veterinary significance. Some of the species are *S. metheei*, *S. bovis*, *S. cunasoni*, *S. spindale*, *S. indicum*, and *S. nasale* (Hira and Patel, 1981).

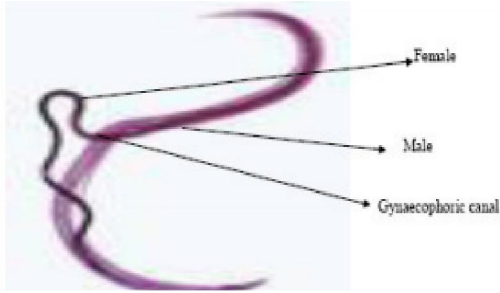


Figure 1: Mature Schistosoma worm: female lying in the gynaecophoric canal of male. (Urquhart *et al.*, 1987).

Blood flukes do not resemble most other fluke species. Instead of being flat and with an oval shape, they look very much like "normal" worms. Also unlike most other flukes Schistosoma is not hermaphroditic but bisexual, and males and females show a different form (sexual dimorphism). Males are about 10 to 20 mm long and 1 to 2 mm thick, whereas females are 20 to 30 mm long and <1 mm thick, i.e. significantly longer and thinner than males. The oral and ventral suckers are rather small. Each male has a special structure along its body, the gynaecophoric canal, where the adult female resides permanently. In fact it seems that females cannot mature in absence of the males. As in other flukes the digestive system of Schistosoma is blind, i.e. it has no anus but ends in a blind branch, the cecum. Schistosoma eggs have species-specific sizes (130-300x40-90 micrometers) and are oval to spindle-shaped, with or without spines (Kahn, 2011).

2.2. Life Cycle

Schistosomes are dioecious (unisexual) worms, which are an exception among the trematodes and have an indirect life cycle, while water snail act as an intermediate host belong to the genera *Bullinus* and *planorbis* (Brown, 1980).

The adult females lay eggs in the capillaries of the intestinal wall. The egg masses form abscesses that finally burst and release the eggs into the gut, which are transported outside with the host's feces. Once outside and in contact with water the eggs release small swimming larvae, the miracidia, which find a suitable snail and penetrate into its body. Inside the snail miracidia develop further during 1 to 4 months through two generations of sporocysts to asexually

produce dozens of cercariae. Mature infective cercariae leave the snail through its respiratory hole. Free-swimming cercariae actively search a final host. Their survival in the environment is limited to a few days. A single snail can release up to 3,000 cercariae (Kahn, 2011).

The infective stage for the disease is matured cercaria after they leave the snail invade the final host through the skin or mucus membranes penetration or are ingested with contaminated water when grazing in marshes, swamps, and otherwise humid vegetation. Ingested cercariae penetrate the rumen. Once inside the host's body they get into a blood vessel and start a species-specific migration (often passively transported with the blood) through various organs until they reach their preferred final locations where they complete development to adult flukes, copulate and start producing eggs. During this time they feed on red blood cells (Aiello, 1998).

Visceral Schistosomes mature in the hepatic portal veins, mate and migrate to the mesenteric veins where egg production starts (Bont, 1995). The female in the mesenteric vein insert her tail in to the venule. The eggs penetrate the venule endothelium aided by their spines and by proteolytic enzymes secreted by the unhatched miracidia (Urquhart, *et al.*, 1987). Egg lay by the female worm penetrate the wall of the veins and migrate to the intestinal lumen or the nasal cavity. They are retained inside the body and it is the retained eggs and their products that responsible for most morbidity from Schistosomiasis (Fekade *et al.*, 1989).

2.3. Pathogenesis

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, macrophages and lymphocytes (Olds and Mahamoud, 1980). In the chronic stages of the disease, the pathology is associated with collagen deposition and fibrosis, resulting in organ damage and dysfunction (Kogulan and Lucey, 2005). The intensity of lesions and signs depends on the duration of infection, number and location of eggs trapped in tissues, species of the parasite and with the immunity of the host.

At necropsy during the acute phase of the disease there is marked hemorrhagic lesions in the mucosa of the intestine, but as the disease progress the whole of intestine appears grayish, thickened and edematous due to confluence of the egg granulomata and the

associated inflammatory changes, on sections of the liver there is also evidence of granulomata and of portal fibrosis provoked by eggs which have, inadvertently, been swept into small portal vessels (Urquhart *et al.*, 1996). The young parasites cause some damage during migration, but the principal lesions and pathology are associated with passage of the spined eggs through the tissue of the gut lumen of intestine and other organs, and blood sucking habit of the helminthes worm (Soulsby, 1982). Generally, the pathologies of schistosoma infections are highly associated with the eggs and the intensity of the pathogenic effects depends on the duration of the infection and the number of Schistosomes present. Adult parasites in the vascular system can cause lesions. Cercaria induced skin lesions have been also described (Jones *et al.*, 1997).

2.4. Epidemiology

Although these parasites occur in many tropical and sub-tropical areas, the disease is important in livestock mainly in Eastern Asia, Africa and India. Schistosomiasis is one of the major diseases of man in tropics (Lemma, A., 1999; Dwight *et al.*, 2003; Lefevre *et al.*, 2010). The distribution of Schistosomiasis varies from places to places. Example: *S. bovis* the commonest species in Africa and Mediterranean region (Hailu, M., 1990; Lemma, A., 1999). However, *Schistosoma spinale*, *S. insium* and *S. nasalis* have been reported as the major causes of Schistosomiasis in Asia (Yalelet, W., 2004). *Bulinus*, *Indoplanorbis* and *Glanorbis* snail are intermediate hosts transmitting schistosomes to cattle (Bedarkar *et al.*, 2000; Thrusfield, 2005).

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 (Niaz *et al.*, 2010; 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.

A key determinant in the epidemiology of this infection is the relative abundance of the intermediate hosts and their ability to develop and survive in the environment. Contamination of water with schistosome eggs results when animal defecate in the water while drinking or if manure is used for feeding fish in ponds. Cattle become infected through skin penetration and the oral route. The type of watering facilities used by domestic stock is therefore a crucial factor in the maintenance and transmission of the infection (Pruss-Ustun *et al.*, 2004).

The geographical distribution of bovine schistosomiasis has been determined primarily by the distribution of snail intermediate host particularly *Bulinus* species which are important for the occurrence of disease in bovine species. *Schistosoma bovis* in central, eastern and west Africa, the Mediterranean area and the Middle East; *S. matthei* in central, southern and eastern Africa; *S. intercalatum* in central Africa; *S. japonicum* in the Far East (a species infecting humans but which may also cause schistosomiasis in ruminants and other host species), *S. nasalis* is found in the veins of the nasal mucosa of livestock in the Indian subcontinent (Urquhart *et al.*, 2003).

For this reason, the epidemiological situation of schistosomiasis must not however, be regarded as static, rather depending on the presence of intermediate snail hosts, their level of infection, and the frequency of water contacts (Kahn, 2011).

The increasing use of irrigation in agriculture and fish breeding facilitate to increase number of snails which carry Schistosome and as a consequence the human and animal incidence of schistosomiasis is increased. In addition to management risk factors, cattle schistosomiasis is dependent on environmental factors such as moisture, rain fall, temperature, presence of water bodies (stagnant, swampy, and marshy) and snail intermediate hosts. Husbandry practice such as grazing system, keeping animals whether they are kept all together and / or separately, feeding (contaminated pasture with larva) and drinking areas (Mersha *et al.*, 2012).

In Ethiopia, epidemiological studies conducted on bovine schistosomiasis are suggestive of the endemicity of the disease particularly in the area with large permanent water bodies and marshy pasture areas of the country. Animal schistosomiasis due to *S. bovis* has been reported and its prevalence ranges from 1.5% to 33.8% in ruminants (Lo and Lemma, 1973; Ameni *et al.*, 2001; Mengistu *et al.*, 2012). Reports have also shown that schistosomiasis is highly endemic in Ethiopia (WHO, 2010; Getachew *et al.*, 2014). Lo and Lemma who reported 1.5% and 5.5% prevalence in Gewanie and Awassa respectively. This is probably due to the ecological, management and climatic difference between the two localities. Moreover, the management system in practice could also be the probable reason for the variation of the prevalence study in Fogera, 12.4% by Amero, T (1993) and 10.93% by Almaz, H, (2007) respectively. It is, therefore, expected to cause high economic losses due to mortality, low fertility, retarded growth, weight loss, anaemia, low milk and meat yield, poor productivity (poor conversion rate), and increased livestock susceptibility to other diseases. Consequently, information about the disease in a given

area is essential in order to propose and establish cost-effective and practicable control strategies against the impact of the disease.

In northwestern Ethiopia consists of wetland fields and river banks that favor the breeding and development of *Schistosoma* species, and also the biological vectors (snails), there has been reports regarding the prevalence of schistosome infection in cattle and sheep in this area. In north Achefer overall prevalence of schistosome infection in cattle and sheep: was 26.9% while infection rate in the cattle and sheep were 32.4% and 9.5% respectively.

Table 1: Prevalence of bovine schistosomiasis in different parts of Ethiopia.

Author/s name	Study area	Prevalence reported	Year
Lemma	Awassaa	5.5	1973
Lo	Gewene	1.5	1973
Solomon	Bahirdar	33	1985
Haile	Bahirdar	33	1985
Aemro	Bahirdar	12.3	1993
Hailu	Bahirdar	34	1999
Mengistu et al.,	Fogera district.	10.17	2012
Ameniet al.,	Kamise	28	2001
Yalelet	Bahirdar	17.4	2004
Almaz	Bahirdar	10.93	2007
Solomon	Bahirdar	28.14	2008
Zelalem	Fogera district.	12.5	2010
Mersha et al.,	South Gondar	27.13	2010
Alemseged et al.,	Dembia district.	13.7	2011
Abebe et al.,	Jimma zone	13.46	2011
Miheret et al.,	Debre tabor	7.6	2015

As indicated by table 1 in and around Bahir Dar town by different author the prevalence of schistosomiasis ranges from 10.93 % (Almaz, 2007) to 34% (Hailu, 1999). However, milder prevalence was recorded in Fogera and Debre tabor.

According to Kassahun *et al.*, (2017) 23.9% were infected by *Schistosoma* in north western Ethiopia. The highest prevalence (29.8%) was observed in animals originated from district representing mid highland. The prevalence based on sex was 8.33 % in female whereas 12.05 % was recorded in male bovines Belayneh and Tadesse (2014). Based on age as risk factor, the prevalence in adults were relatively higher (25.6%) than that of young bovines (21.6%). Despite all risk factors have some degree of visible effect on the prevalence of schistosomiasis, the difference between all risk factors was not statistically significant.

2.5. Risk factors for infection

2.5.1. Host related risk factors

Age

Infection rate increased with the increase of age and peak infection occurred at the maturity of age (Bedarkar *et al.*, 2000). This might be due to a long exposure time because older animals move long distances in search of scarce pastures and water thereby increasing their chances of infection as well as becoming infected at overcrowded watering holes. On the other hand, the very young calf do not graze extensively as the older do, so they get less infection of cercariae unlike adult animals. Kassaw (2007) and Nagi *et al.*, (1999) also reported that the increased contact time with schistosome infested habitat increases the rate and endemicity of schistosomiasis.

Sex

Differences in susceptibility to infection between sexes have been observed by various workers. The observed disparity may not solely due to difference in susceptibility but may also depend on a sex-related variation in behavior that results in differences in exposure (Magona and Musisi, 2002). The reason seems to be related to social practice of keeping females under better management and feeding condition for milk production and breeding whether males are generally let lose to graze freely in pasture and infrequently used for draught purpose and also more stressed. Males are also fed relatively poor diet which increases the susceptibility to parasitic infection (Houdijk and Athana, 2003).

Breed

Alemseged *et al.*, (2010) reported as local breeds are more affected by schistosomiasis than cross breeds. This difference in prevalence of the disease does not appear to be due to the difference in susceptibility but due to the difference in exposure. Cross breeds are mostly kept for dairy or fattening purpose and they are mostly housed and supplementing good feed and clean water which reduce their access to the cercariae. However, the local once are mostly managed extensively to graze freely and get access to infective stage of the parasite.

Immunity

Cattle residing in endemic areas show a typical pattern in faecal egg counts. The faecal egg excretion usually starts between 4 and 8 months of life, counts increase rapidly to reach a maximum around the age of 6–15 months and then decrease markedly by the age of 18 months (De Bont and Vercruysse, 1997). In older animals, faecal egg counts remain low, tissue egg counts seem to follow the pattern of the faecal egg counts, while worm burden tends to increase with the age of the host (Vercruysse & Gabriel, 2005). This suggests the development of an acquired immunity, which mainly acts through a reduction of the fecundity

of the female worm, expressed as reduced faecal, and tissue egg counts, with few effects on worm burden. However, evidence is accumulating that with increasing duration of exposure to continuous challenge, cattle also become less susceptible to reinfection. Examination of naturally infected animals has shown that partial protection against reinfection also occurs, and acquired resistance to schistosomes is of major importance in the regulation of infection intensity in the field (Kahn, 2011). A few studies reported on heterologous resistance. Calves previously exposed to infection with the human schistosome *S. mansoni* and *S. haematobium* were partially protected against *S. mattheei* and *S. bovis*, and it was believed that this type of heterologous resistance might be of considerable importance in protecting cattle from the more serious effects of schistosomiasis (De Bont and Vercrusse, 1997).

2.5.2. Seasonal risk factors

Schistosome infection rate in cattle increases during rainy season. The highest infection rate in rainy season could be due to abundance of snails and their rapid multiplication and dispersion. Furthermore, dispersion of fecal matter occurs due to rain splashes. These factors may enhance the infection of snails by miracidia and cercarial contamination to adjacent areas through water. During this time conditions on the lands are suitable for the survival of the intermediate hosts and they become heavily infected with schistosome larval stages (Soulsby, 1982). But in dry season infection rate of schistosome parasite is low because of harsh dry conditions and less chances of infection due to unavailability of snail intermediate hosts as the water sources are scarce in this season (Kahn, 2011).

2.5.3. Management risk factors

Infection rate reported to be low in intensive farming system where animals are mainly stall fed. This might be due to the better management practices and sanitation. Belayneh and Tadesse (2014) highlighted the fact that proper management practices and policy change towards urban husbandry can minimize the schistosomiasis prevalence. They also reported that when cattle are slaughtered through back yard system and consequently the stomach and other intestinal contents including blood and washed materials are dumped into the nearby water bodies' prevalence of the disease also increases. In the semi-intensive system of rearing where animals grazing in the fields have more risks of getting contact with water and subsequently with the infective stage, cercaria. Moreover, increasing cattle mobility through trading and or rental potentially increases the possibility of spreading the disease or infection sources (Kahn, 2011).

2.5.4. Anthropogenic/human factors

Construction of water schemes to meet the power and agricultural requirements for development have led to increasing rates of transmission of schistosomiasis (Chitsulo *et al.*, 2000). The impact of prolonged available surface water in newly developed irrigation areas is a predisposing factor for water and vector-borne diseases. Areas that are periodically affected by schistosomiasis are exposed to continued year round attack due to suitable environment for snails' survival (Behailu and Haile, 2002). On the other hand, water stagnation and weed growing due to inadequate water management sustain the life of the snails to complete the life cycle of schistosomes (Boelee and Madsen, 2006). Many surface irrigation systems in Africa create favorable snail breeding conditions that facilitate the transmission of schistosomiasis (WHO, 2004). Irrigation schemes are dynamic agro-ecosystems that can transport snails a long way along the canals and where local events can either provide habitat-friendly conditions or inhibit snail populations (Dale and Polasky, 2007).

2.6. Transmission

Schistosomes live in the mesenteric and hepatic veins of the host (except for *S. nasale*, which lives in the nasal veins), where they feed on blood and produce eggs with a characteristic terminal or lateral spine. Eggs passed in the feces must be deposited in water, hatch and release miracidia, which invade suitable water snails and develop through primary and secondary sporocysts to become cercariae (Fraser *et al.*, 1991).

When fully mature, the cercariae leave the snail and swim freely in the water, where they remain viable for several hours. Ruminants are usually infected with cercariae by penetration of the skin, although infection may be acquired orally while animals are drinking. During penetration, cercariae develop into schistosomula, which are transported via the lymph and blood to their predilection sites. The prepatent period varies according to the species but is generally 45–70 days. The increased host range of the hybrid parasites and changes in host distribution seen in Africa may have a direct impact on transmission of these schistosomes. Laboratory hybrids acquire enhanced characteristics such as infectivity, fecundity, and growth rates (Kahn, 2011).

2.7. Clinical findings

The effects of schistosome infections of livestock are not easily recognized and the non-specific clinical signs are often overlooked by farmers. Infections may, however, result in severe clinical signs. The infections are often manifested by acute intestinal signs, 7-9 weeks after infection (the time when the females produce large numbers of eggs which penetrate the gut wall) (Kahn, 2011).

The principal clinical signs are associated with passage of the spined eggs through the tissue of the gut lumen. The young parasites cause some damage during migration, but most of the lesions are due to the irritation produced by the eggs of parasites in the intestine and other organs, and blood sucking habit of the helminthes worm. The helminthes worm may also enter the visceral veins and they may cause hematuria (Soulsby, 1982). 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). Signs associated with chronic hepatic disease may develop when eggs are washed back to the liver by the portal circulation during their penetration of the gut wall. The eggs become lodged in the liver and an intense immunological response results, followed by the formation of a granuloma. A large proportion of the liver may be destroyed and the liver function severely disturbed (Mersha *et al.*, 2012).

2.8. Diagnosis

Diagnosis is based primarily on the clinico-pathological picture, seasonal occurrence, previous history of schistosomiasis in the area or the identification of snail habitats with a history of access to natural water bodies, demonstration of characteristic eggs based on the species in the feces, postmortem examination and hematological tests (Urquhart *et al.*, 1997). Because signs and history alone are insufficient to distinguish visceral schistosomiasis from other debilitating diseases, diagnosis should be confirmed by the presence and identification of eggs in the feces of the infected animal. At necropsy, macroscopic examination of the mesenteric veins for the presence of adult worms or microscopic examination of scrapings of the intestinal mucosa or of crushed liver tissue (both for eggs) may prove easier.

2.8.1 Clinical signs

Cattle infected with *S. bovis* develop a syndrome characterized by weight loss, poor weight gain, diarrhoea, loss of appetite, roughness of the skin, and pale mucous membranes. These signs are usually observed by 6-7 weeks after exposure to the infective stage, the cercaria. The severity of these signs increases between the 7th and the 9th week, where the fecal egg counts are highest. However, the clinical signs of the disease are unreliable as other trematodes parasites may produce similar clinical signs (Kahn, 2011).

2.8.2 Parasitological techniques

Definitive diagnosis of an active *S. bovis* infection can be made only by detecting eggs of the parasite in feces or biopsy specimen of the infected animal. The eggs are characteristics in shape and size for each species. The Schistosomes eggs oval (as in *S. monsoni*, *S. haematobium*, *S. japonicum*) to spindle

shaped (*S. bovis*, *S. mattheei*) containing a single spined protruding from the shell (Jones and Hunt, 1997). The routine methods used for parasitological diagnosis include; fecal smear, filtration method, Sedimentation method, rectal and liver biopsy and miracidial hatching test. The most commonly used method for detection of fecal egg excretion under field condition is the sedimentation method. In general when schistosomiasis is suspected, diagnosis is best confirmed by a detailed postmortem examination which reveal lesion and if mesentery is stretched, the presence of numerous Schistosomes in the veins (Urquhart, *et al.*, 1987).

2.8.3. Postmortem findings

At necropsy, *S. bovis* infection can be diagnosed by finding thousands of visible adult worms in the mesenteric veins. Infected livers are diagnosed on the basis of the presence of macroscopic lesions of schistosomiasis visible as white-gray foci under the liver capsule and within the substance of the liver. However, in certain instances few lesions may be present and may not be detected and hence crush smears made from those livers are necessary for demonstration of *S. bovi* seggs to confirm the diagnosis (Hendrix and Robinson, 2006).

2.9. Economic and Public Health Significance of the Disease

In attempting to estimate the economic importance of schistosomiasis one is strongly confronted with a varied array of factors for most of which there are no adequate measurements, among these factors are geographical distribution, prevalence, intensity of infection, clinical gradients, morbidity and mortality, and transmission patterns, which are influenced by environmental conditions, the relative efficiency of intermediate hosts and agricultural practices (Wright, 2015).

Although few or no overt clinical signs may be recognized in the short term, high prevalence rates of chronic schistosome infections cause significant losses on a herd basis. These losses are due to less easily recognizable effects on growth and productivity, as well as increased susceptibility to other parasitic and bacterial diseases (De Bont & Vercruyssen, 1998).

According to (Cauley *et al.*, 1984) in addition to the high prevalence, outbreak of the disease and

increased susceptibility to other parasitic and bacterial disease, the disease has an economic impact like production losses due to *S. bovis* that result from mortality, delayed growth, partial liver condemnation and poor future reproduction performance and sub-clinical infections cause significant losses due to long term effects on animal growth and productive capacity or milk yield and draft power. Over 200 million people are infected over at least in 75 countries with 500 million or more people exposed to infection.

Schistosomiasis caused by *S. mansoni*, *S. haematobium* and *S. japonicum* secondary only to malaria and affect approximately 200 million people in Africa, Asia, and South America (Bowman, 2003). Cercarial dermatitis or swimmer's itch is a condition caused when cercariae of blood flukes that normally parasitize aquatic birds and mammals penetrate the human skin, sensitizing the areas of attack and causing pustules and an itchy rash. Since humans are not suitable definitive hosts for these flukes, the cercariae do not normally enter the blood stream and mature instead, after penetrating the skin, they are destroyed by the victim's immune response. Allergenic material released from dead and dying cercariae produce a localized inflammatory reaction. Humans may become sensitized and develop pruritic macula papular, then vesicular skin lesions at the site of penetration. Skin lesions may be accompanied by a systemic febrile response that runs for 5 to 7 days and resolves spontaneously (Kahn, 2011).

Cercarial dermatitis occurs worldwide. According to an estimate of the disease epidemiology, by the World Health Organization which shows that at least 235 million cases of schistosomiasis disease burden occur world-wide, with 732 million people at risk of infection and another 200,000 people died each year especially in sub-Saharan Africa where the disease is said to be endemic. Secondly, WHO report in 2007, estimate between 391 and 587 million people are reported to have active cases of schistosomiasis world-wide and between 1.7 to 4.5 million loss per annum of disability adjusted life years are due to schistosomiasis (Kabiru, 2017).

2.10. Control and prevention

A pre-requisite for disease control/prevention is to screen factors facilitating identification of categories of animals that are at particular risk of developing an infection (Thrusfield, 1995). So, an in depth understanding of the epidemiology of schistosomiasis is required to develop control strategies. The most effective way to control cattle schistosomiasis in endemic areas is to prevent contact between the animals and the parasite. Unfortunately, this is not always possible in parts of the world where nomadic conditions of management prevail (Bont, 1995).

Other methods of control include destruction of the snail intermediate host population at transmission sites, either by chemical or biological methods, or their removal by mechanical barriers or snail traps, ecological measures and management methods of controlling. From the current available chemical Bayluscide (Niclosamide) and copper sulfate are the choices for molluscicide. In addition to these, a native Ethiopia plant, *phytoplacadodecandora*, locally

known as "endod" is also an effective molluscicide (Shibru *et al.*, 1989).

3. Conclusions And Recommendations

Schistosomiasis is a chronic debilitating infection of humans and animals caused by different species of schistosomes. *S. bovis*, the agent of schistosomiasis in cattle is one of the major veterinary problems in many Mediterranean and African countries. Occurrence of bovine schistosomiasis is dependent on environmental factors such as moisture, rain fall, temperature, water bodies (stagnant, swampy and marshy) and snail intermediate hosts. Few epidemiological studies conducted on bovine schistosomiasis in Ethiopia indicate, the endemicity of the disease in the country. Although few or no overt clinical signs may be recognized in case of bovine schistosomiasis in the short term, high prevalence of chronic schistosome infections cause significant losses on a herd basis. Although the economic significance of the disease is mainly attributed to morbidity, mortality, liver condemnation, reduced productivity and poor subsequent reproductive performance, still there an imitation on detailed information of epidemiology; and various factors, which influence the host parasite relationship. The relation of schistosomiasis with the risk factors should be clear and an in depth understanding of the epidemiology of schistosomiasis is required to develop control strategies. Schistosomiasis should be taken into consideration as a one of the major limiting factor to livestock productivity in the area, Farmers should in need of awareness about the risk factors and its transmission at least to tell them not to graze in swampy area, Measures should be taken to minimize the risk through in depth understanding of the epidemiology of schistosomiasis is required to develop control strategies beside snail control options, Further study on the epidemiology of the disease and mapping high risk areas, destruction of the snail intermediate host population at their breeding sites, either by chemical or biological methods should be carried out for sound prevention and control of schistosomiasis.

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