DILLA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

COLLEGE OF NATURAL AND COMPUTITIONALSCIENCES

DEPARTMENT OF BIOLOGY

PREVALENCE OF SCHISTOSOMIASIS AND ASSOCIATED FACTORS AMONG PRIMARY SCHOOL CHILDREN IN SELADINGAY TOWN AND ITS SURROUNDING , NORTH SHEWA, AMHARA REGION, ETHIOPIA.

M.Sc. THESIS

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JUNE, 2023

DILLA, ETHIOPIA

PREVALENCE OF SCHISTOSOMIASIS AND ASSOCIATED FACTORS AMONG PRIMARY SCHOOL CHILDREN IN SELADINGAY TOWN AND ITS SURROUNDING , NORTH SHEWA, AMHARA REGION, ETHIOPIA.

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT OF THE DEGREE OF MASTER OF SCIENCE IN BIOLOGY

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DEPARTEMENTS OF BIOLOGY

SCHOOL OF GRADUATE STUDIES

DILLA UNIVERSITY

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This is to certify that this thesis prepared by **Shewayirga Belay, entitled: "Prevalence of schistosomiasis and its associated factors in and around Seladingay schools, North Shewa, Amhara Region, Ethiopia"** and presented to Biology Department, College of Graduate Studies, Dilla University in the partial fulfillment of the requirements for the Degree of Master of Science in Biology complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

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DECLARATION

I, the under signed, declare that this thesis is my original work and has not been presented for a degree in any other university and that all sources of materials used for the thesis have been duly acknowledged.

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ACKNOWLEDGEMENT

I wish to express my profound gratitude to my advisor Dr. Belayhun Mandefro, who supervise the research work starting from title selection and for his professional guidance and meticulous support in the construction of this thesis. No words to mention for his treatment, very kind approach, excellent cooperation and unreserved efforts. Special thanks and appreciation goes to Dilla University for financial support of this work. I also acknowledge all staff members of biology department and my friends for their kind help, encouragement and technical support during the study. I would also like to express my sincere appreciation to Mojana wodera woreda laboratory technicians and the health extension workers who provide the necessary baseline data and information to accomplish this study. I wish to thank the Mojana wodera woreda selected primary school directors, teachers, students parent and students who accepted this study to conduct on school children.

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LIST OF ABBRIVATION

AOR _ Adjusted Odd Ratio

CDC – Center of Disease Control and prevention

COR _ Crude Odd Ratio

EMA – Ethiopia Map Agency

MDA – Mass Drug Administration

MoH – Ministry of Health of Ethiopia

NTD –Neglected Tropical Diseases

SAC – School Aged Children

STH – Soil Transmitted Helminthiasis

WHO – World Health Organization

ABSTRACT

The burden of disease associated with schistosomiasis infections is enormous, with almost 240 million people affected globally, primarily infections occurring in sub-Saharan Africa. The highest rates of infection are often in children between the ages of 7 and 15 years. However, there is no available documented information on the prevalence of schistosomiasis infection and associated factors in the present study area. Therefore, this study was designed to determine the prevalence of schistosomiasis and to identify associated risk factors among primary school children in Seladingay Town and its surrounding of North Shewa Ethiopia. Across-sectional study was carried out from March to May 2022, including 214 school children aged 8–17 years. Simple random sampling technique was used to select school children who participated in the study. Stool samples were collected from school aged children subjected to detect the presences of eggs of Schistosoma mansoni using microscope examination. questionnaires were administered to the participating students to collect data on their interaction of schistosomiasis associated factors.The overall prevalence of Schistosoma mansoni infection in this study was 25.23%. The prevalence rates of Schistosoma mansoni among the schools were 11.53, 7.79, 3.43 and 2.49 in Asofe, Fela genet, Begoch gate and Seladingay respectively. The sex and age specific distribution showed that significantly higher infection rates were in males (15.88%) and school children aged between 11-14 years (P=<0.05). In addition, children living in rural area were more likely exposed for schistosome infection than children living in urban areas (p=0.000). The findings from this study conclude that repeated water contact activities such as swimming, infected water used for domestic purpose in open freshwater were the main risk factors (AOR) = 11.873, : 5.864–24.023, p= 0.001). The findings from this study conclude that Schistosoma mansoni was present in the study area and the school children should avoid to contact with open freshwater and also take mass drug administration treatment were recommended.

Keywords*: Endod; prevalence; risk factor; Schistosoma mansoni; Seladingay*

1. INTRODUCTION

1.1. Background of the study

Schistosomiasis is one of the most prevalent parasitic diseases and an important public health problem with in the tropics, especially among poor rural communities (Akande and Odetola, 2013; Limpanont *et al*., 2018). An estimated 779 million peoples are at risk, with 240 million infected cases and more than 200,000 death occurring each year due to schistosomiasis worldwide (WHO, 2014). It is caused by dioecious parasitic flatworm from the group trematode which is also called intestinal fluke. In Africa over 90% of the disease burden is high in sub-Saharan Africa and the two common *schistosoma* species found are *Schistosoma haematobium*, the causative agent of urogenital schistosomiasis and *Schistosoma mansoni*, the causative agent of intestinal schistosomiasis. It is estimated that 400 million school-age children who are infected are often physically and intellectually compromised by anemia, leading to attention deficits, learning disabilities, school absenteeism and higher dropout rates in south Saint lucia (Rajini and Gurdip, 2010).

Both *Schistosoma haematobium* and *Schistosoma mansoni* use snails as intermediate hosts to reach the infective larval stage in freshwater bodies, which become sources of infection to school children that come in contact with these sites (Campbell *et al*., 2017). The majority of schistosomiasis infections occur in Sub-Saharan Africa and particularly *Schistosoma mansoni* is widely distributed in Ethiopia (Awoke *et al*., 2013). Schistosomiasis is most prevalent in agricultural communities along streams in the altitudes between 1000 and 2000 m above sea level and it is reported from all administrative regions of Ethiopia. The prevailing poor environmental sanitary condition in rural localities and availability of ample aquatic habitats contribute for high prevalence of the disease in Ethiopia. There are an estimated 38.3 million people living in schistosomiasis endemic areas, comprising 4.4 million pre-school children, 12.3 million school-aged children, and 21.6 million adults in Ethiopia (Ministry of Health, 2016).

The motivation of the study to embark this area was observation of schistosomiasis associated problems such as accessibility of mass drug administration, open water contact activities for swimming, washing and the presence of intermediate host snails. There is no study conducted on occurrence of schistosomiasis and associated factors in Seladingay Town and its surrounding primary schools. Information on occurrence of schistosomiasis and associated risk factors in a given community is important to plan and implement appropriate control of the disease. The objective of the present study was to assess the prevalence of schistosomiasis and associated factors in the school aged children of this study area.

1.2. Statement of the problem

Schistosomiasis is the most predominant helminthic infection in tropics and subtropics mainly in sub-Saharan African countries including Ethiopia. Chronic schistosomiasis is a multifaceted debilitating disease of high morbidity affecting people in any age. School children up to 15 years of age are most affected groups. Schistosomiasis infection in childhood causes substantial growth retardation, anemia and impaired physical and cognitive developments (King *et al*., 2005). The schistosome infections occur much more focally, depending on local environmental conditions and on the distribution of suitable snail intermediate vectors by contamination of freshwater by open defecation, washing and bathing, swimming and children playing in the water (Steinmann *et al*., 2006).

Tropical climate and water bodies in Ethiopia including Seladingay offer a conducive environment for snail intermediate hosts and egg development school children have a usual open water contact activities to swim and bathe in vicinity water bodies to their school like ponds and streams. The avaliability of the water bodies and open defecation of faeces in the field also conducive for schistosomiasis transmission when they are repeatedly infested water contact activities. Schistosomiasis associated problems such as accessibility of mass drug administration, available of open water bodies and the presence of intermediate host snails in the area. The trends of disease contribute to impairing the cognitive performance and growth of children. However, there is no study conducted on occurrence of schistosomiasis and associated risks in Seladingay town and its surrounding primary school children. The researcher designed the study in this area to evaluate control and prevention strategies and to identify outbreaks helps to plan future intervention of the infections. Therefore, this study was conducted to determine the prevalence and identify associated factors of schistosomiasis in Seladingay Town and its surrounding primary school children.

1.3. Research questions

(i).What is the status of prevalence of schistosome infection among primary school children in Seladingay Town and its surrounding?

(ii).What are the associated factors of schistosomiasis prevalence?

(iii). What is the relation of gender and age with schistosomiasis prevalence?

(iv). What is the relation of gender and age of children with schistosome infection?

1.4. Objectives

1.4.1. General objective

To assess the prevalence and identify associated factors of schistosomiasisamong primary school children in Seladingay Town and its surrounding.

1.4.2. Specific objectives

I. To determine the prevalence of schistosome infection among the school children.

II. To identify associated risk factors of schistosomiasis prevalence.

III. To compare schistosomiasis prevalences between school children with their knowledge, attitude and practices

IV. To identify the major sex and age catagories of schistosome infected children

1.5. Significance of the study

Schistosomiasis is a public health concern. Information is not available about schistosomiasis prevalence and its associated risk factor on school children in the study area. Any intervention that improves the proper attending of education and making awareness for local sanitary maintenance is an important in improving physical and cognitive development in school aged children(king *et al.,* 2005). Therefore the significance of this study was to identify the associated factors and to assess the prevalence of schistosomiasis in the study area. Moreover, this study were helpful to take actions of prevention and control of the disease and the study may also serve as a source of information for further research in line with the present study.

1.6. Scope of the Study

Schistosomiasis was reported to be one of the public health concerns that need formulation of intervention strategy in Ethiopia especially among poor communities repeatedly contacted with infected water bodies. The study delimited to the prevalence of Schistosomiasis and associated risk factors at Seladingay School aged children. Because before this period there is no study under taken to determine the prevalence and associated risk factors in the present study area to show the impacts of the disease, evaluate control and prevention strategies and timely identify outbreaks and to plan future intervention and ultimate elimination strategies. Hence, researcher selects this study area for the assessment of Schistosomiasis prevalence and its associated factors in the school children.

1.7. Limitations of the study

The major limitations encountered to conduct this study were sample size variations, inconsistency of laboratory diagnostic methods used by the individual studies because of most of the students was from rural area afraid off to give their stool sample for examination during the study periods. The other limitation of this study is that infection intensity of *Schistosoma mansoni* not quantified quantitatively due to lack of equipment and only the presence/bsence of the parasite checked qualitatively by using light microscope .

2. LITERATURE REVIEW

2.1. The disease etiology

Schistosomiasis is caused by a trematode worm of the genus *schistosoma* which resides in the mesenteric and portal veins causing various pathologies mainly acute intestinal syndromes and chronic hepatic syndromes. From the six *Schistosoma* species known to cause disease in humans (Colley *et al*., 2014), The two common schistosomiasis in Sub-Saharan Africa are *Schistosoma haematobium*, the causative agent of urogenital schistosomiasis and *Schistosoma mansoni*, the causative agent of intestinal schistosomiasis (WHO, 2010). Both *Schistosoma haematobium* and *Schistosomia mansoni* use Mollusca snails as intermediate hosts to reach the infective larval stage in freshwater bodies, which become sources of infection to humans that come in contact with these sites (Couto *et al*., 2014 and Campbell *et al*., 2017). Water contact activities such as playing, bathing, swimming, and irrigation farming have been found to predispose people to schistosome infections, and male children are reported to be at higher risk of being infected than female children (Senghor *et al*., 2014 and Geleta *et al*., 2015). In Ethiopia *Schistosoma mansoni* is the most prevalent species nearly 90% reported among school children (Awoke *et al*., 2013). As school age children are more likely to make contact with these freshwater bodies, they have an increased risk of getting infected with schistosomiasis (Zida *et al*., 2016).

(Pardo *et al.,* 2014) have also stated that acute and chronic Schistosomiasis disease can occur in humans. Most intermediate hosts of human *Schistosoma* parasites belong to three genera, Biomphalaria, Bulinus and Oncomelania. The species involved can be identified by the shape of the outer shell. Simple regional keys are available for the determination of most species. The snails can be divided into two main groups: aquatic snails that live under water and cannot usually survive elsewhere (Biomphalaria, Bulinus), and amphibious snails adapted for living in and out of water (Oncomelania). In Africa and the Americas, snails of the genus Biomphalaria serve as intermediate hosts of *Schistosoma mansoni* while Snails of the genus Bulinus serve as the intermediate hosts of *Schistosoma haematobium* in Africa and the Eastern Mediterranean (Alemseged, 2010).

2.1.1. Taxonomic classification

Schistosomiasis is a parasitic disease caused by blood vessel-dwelling flukes of the genus *Schistosoma*. There are several species in the genus but primarily *Schistosoma haematobium* (causes urinary schistosomiasis), *Schistosoma mansoni,* and *Schistosoma japoni*cum (both cause intestinal schistosomiasis) infect humans. Humans are usually infected by cercariae invasion through the skin when they come into contact with contaminated freshwater during daily life activities (Gryseels, 2012). According to Soulsby (1982) the taxonomic classification of the organism that Cause schistosomiasis is present as follows:

Kingdom- Animal
Phylum- Platyhelminthes
Class- Trematoda
Order- Diplostomatidea
Family- Schistosomatidae
Genus- schistosoma
Species- mansoni

2.1.2. Morphology of the Schistosomes

The schistosome parasites are elongate, unisexual and dimorphic trematode, which inhabit the blood vessels of their hosts alimentary tract and bladder responsible to cause schistosomiasis (Webster *et al.,* 2006). The female is slender and usually longer than the male and the female is carried in the gutter –like groove, the gynaecophoric canal of the male (**Fig.1**).The average length of adult male was (16.7± 1.3mm) and it had two suckers (oral and ventral) and Distinct gynaecophoric canal and 3-6 testicles situated behind the ventral sucker, and in all specimens showed male holding the threadlike female in gynaecophoric canal. The small adult female lying permanently in a groove, gynaecophoric canal, in the body of the male.According to (Anyaegbunam, 2016) egg production begins 4-8 weeks after infection and adult worms normally live for 2-5 years although some may survive much longer (CDC, 2013). The egg was elongated spindle shaped with large lateral or terminal spine (Ross *et al.,* 2002).

Figure 1: Matured schistosoma worm(Gobert *et al.*, 2009).

The Schistosomes are different from most other members of the digenea in that the sexes are separate. The term Schistosome or Schistosoma means split body and refers to the fact that the males have a ventral groove called gynaecophoric canal (Marqurdt and Greive, 2000).

2.1.3. Life cycle of Schistosoma

Schistosomes have a complex life cycle involving both intermediate hosts and a definitive host (**Fig.2**). Schistosomes require fresh water snail as an intermediate host in order to complete their asexual life cycle (McManus and Loukas, 2008). The snail intermediate hosts for human *Schistosoma* species belong to the genus *Biomphalariai*, Bulinus, Indoplanorbis and Planorbis (Alemseged, 2010).

In Ethiopia *Biomphalariai pfeifferi, Bulinus truncatus,* and *Bulinus abysinicus* serve as the intermediate hosts of *Schistosoma*. *Biomphalariai* were identified harboring *Schistosoma mansoni* cercariae confirmed by the experimental infection of humans with these cercariae most commonly found in Ethiopia. Studies on the relationship between species and strains of parasite and their actual and potential snail hosts have revealed considerable variations in infection rates, duration of infection, cercariae production, and snail mortality. Such differences are due not only to differences in the susceptibility of the snail species but also to the infectivity of the parasite. Unlike other trematode species, Schistosoma species are dioecious (separate male and female worms) which undergo sexual reproduction in the definitive host. Schistosome eggs are produced and excreted into the environment via the faeces (*Schistosoma mansoni*) or urine (*Schistosoma haematobium*). Miracidia are released when the eggs come in contact with water and infect the snail host. Then, miracidia develops into mother sporocysts and undergo asexual reproduction to produce daughter sporocysts which produce cercariae. Infected snails shed cercariae into the water and upon locating a suitable definitive host (humans), penetrate the skin, transform into schistosomula and migrate through the circulatory system to the lungs, heart and liver where they mature into adult worms (**Fig.2**). The adult worms then exit the liver and pair up to mate in the mesenteric vessels of the bowel (*Schistosoma mansoni*) and urine (Schistosoma *haematobium*) of the final host. During the period of egg-laying, the female parasite enters the small vessels of the gut wall. The eggs, which have a sharp spine, penetrate the wall, enter the intestinal lumen and are passed out in the faeces (CDC, 2013). The daughter sporocysts break out through the tegument of the mother sporocysts and migrate to the digestive glands and reproductive tract of the mollusk, in which they proliferate internally to produce fork-tailed cercariae which are the infective stage of infection, escape from the snail into the water. Cercariae are released into the water beginning 4 weeks after the infection and it invade the final host through the skin or mucus membranes penetration when humans contact with open freshwater bodies (CDC, 2013).

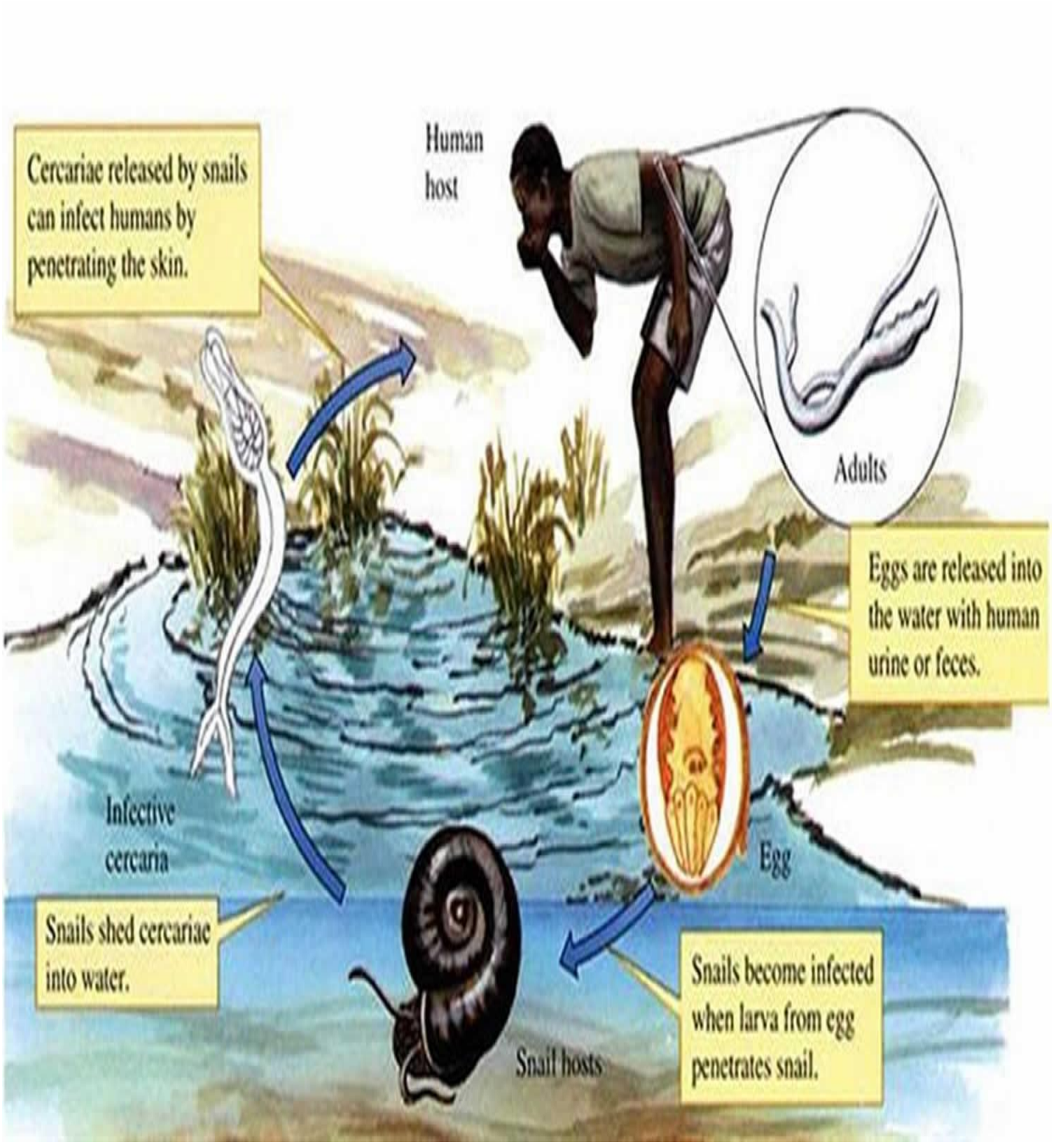

Figure 2: The live cycles of *Schistosoma mansoni* in an intermediate and definitive hosts
Source: (CDC, 2013)

2.1.4. Transmission and pathogenesis of Schistosomiasis

Transmission requires contamination of surface water by excreta from infected definitive hosts, specific fresh water snails as intermediate hosts which transmit the infective stage (cercariae) and human contact with contaminated water through activities such as farming, fishing, and domestic chores (WHO, 2013). Factors contributing for the occurrence of schistosomiasis infection include poor socioeconomic status, change in climate, human water contact behavior and ecological changes related to water resource development projects (WHO, 2004). Poor personal and environmental hygiene coupled with frequent water contact behaviors of school age children are reported to render them more vulnerable to schistosomiasis disease. Moreover, chronic schistosomiasis infection causes impaired physical and cognitive developments in children (King *et al.,* 2005).Various socio-epidemiological factors are responsible for transmission of schistosomiasis and level of infection. Among such factors are the following: distance from transmission site, migration, urbanization, socio-economic status, relative abundance of intermediate host snails, sanitation and intensification of farming, water supply pattern and level of fecal contamination of water source (Okpala, 2004).

The main infection site of the final host is through skin penetration with an infective cercariae stage of the parasite during contact with contaminated water. The epidemiology of schistosomiasis is characterized by a highly variable focal distribution that differs in prevalence and intensity of infection among school children in different areas which is governed by the interplay of the children, snail, and children-water contact (Donald *et al*., 2018).The worm migrates from site of infection to portal and mesenteric veins, intestinal sub-mucosa and sub-serosal veins and lesser extent in pancreatic and branches of pulmonary artery .The adult parasites are known to be haematophagus and the worm in the viscera can also causes tissue reaction when it is dead. The adult worms lay eggs in the mesenteric vein and the eggs laid retained inside the body, the retained eggs and their products that are responsible for most morbidity and mortality (Ross *et al*., 2002).

2.2. Diagnosis of schistosomiasis

Infections are conventionally diagnosed by the detection of fluke eggs in faecal or urine samples. Microscopic examination of stool or urine is the gold standard for diagnosis but requires the adult worms to be producing eggs (Gray, 2011). The extent to which eggs are shed varies therefore, for effective diagnosis, as many as three specimens of the first stool of the day, for three days are required in some patients. The eggs are sufficiently characteristic to facilitate specific diagnosis (Arora *et al.,* 2002). Diagnosis is done using a simple stool smear and staining technique using Lugol’s iodine and the characteristic eggs identified and counted.

Direct smears are done to identify the positive samples**.** The eggs of *Schistosoma* parasites differ in size and shape; the position of the spine on the egg shell is a distinguishing feature; Schistosome eggs typically have lateral or terminal spines and are easy to detect on microscopic examination of faeces. Lateral containing spine in ova of *Schistosoma mansoni* and terminal spines in others. *Schistosoma mansoni* eggs are large (114-180μ long by 40-70μ wide), brown or yellow in colour with a thin smooth shell, a rounded posterior end and the anterior end is somewhat pointed and curved. It also has a characteristic prominent lateral spine near the posterior end (Arora *et al.,* 2002). In general when schistosomiasis is suspected, diagnosis is best confirmed by detailed postmortem examination which reveal lesion and if mesentery is stretched, the presence of numerous Schistosomes in the veins (Ross *et al*., 2002).

2.3. Distribution of Schistosomiasis

Schistosomiasis affects mankind in 76 countries causing an estimated annual mortality rate of 280,000, 779 million people at risk of infection, 240 million people with active infections, and 440 million people with residual morbidity. Globally, schistosomiasis ranks second among parasitic diseases of socio-economic and public health importance and is found in 48 African countries (WHO, 2010). The disease burden is largest throughout sub-Saharan Africa accounting for greater than 90% caused by the clinically most relevant human-pathogenic species *Schistosoma mansoni* and *Schistosoma haematobium* (Webster *et al*., 2020).The prevalence of schistosomiasis is highest in areas where poor sanitation in many locations such as Portugal, the Nile Delta, North Iran, parts of China and the Andean highlands of Ecuador, Bolivia and Peru. The infection rate is higher enough to make schistosomiasis serious disease. Previously it was limited to population with in well-defined watershed boundaries. Recently however, urbanization, migration and development practice such as dam building and irrigation have increased the risk and the incidence of human infection (WHO, 2013).

Schistosomiasis is a major source of morbidity and mortality for developing countries in Africa, South America, Caribbean, Middle East and Asia. It is widely distributed in the tropical and sub-tropical region of the world. The species *Schistosoma haematobium* and

Schistosoma mansoni use Mollusca snails as intermediate hosts to reach the infective larval stage in freshwater bodies, which become sources of infection to humans that come in contact with these sites (Campbell *et al*., 2017).Water contact activities such as playing, bathing, swimming, and irrigation farming have been found to predispose people to schistosome infections, and male children are reported to be at higher risk of being infected than female children. As school age children are more likely to make contact with these freshwater bodies, they have an increased risk of getting infected with schistosomiasis (Zida *et al*., 2016).

2.3.1. Distribution of Schistosomiasis in Africa

In Africa the great majority (80-85%) of schistosomiasis is found in sub-Saharan Africa (WHO, 2006) where *Schistosoma haematobium* and *Schistosoma mansoni* are endemic. However, the two main causative species of schistosomiasis are *Schistosoma haematobium* and *Schistosoma mansoni*. In this sub-continent, approximately 393 million people are at risk of infection from *Schistosoma mansoni*, of which 54 million are infected. A previous estimate for *Schistosoma haematobium* infection showed that about 436 million are at risk, of which 112 million are infected (Van der *et al*., 2003). 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 poor Sub-Saharan Africa (Tourt *et al.*, 2008). It is prevalent in tropical and sub-tropical areas, especially in poor communities that had low access to safe drinking water and adequate sanitation. It is estimated that at least 90% of those requiring treatment for schistosomiasis live in Africa (WHO, 2006). The three main species infecting humans are *Schistosoma haematobium*, *Schistosoma mansoni* and *Schistosoma japonicum*. Two other species, more localized geographically are *Schistosoma mekongi and Schistosoma intercalatum.* Schistosomiasis in Africa is caused by an infection with *Schistosoma mansoni* and *Schistosoma haematobium* whose eggs may be found in faeces or urine respectively (CDC, 2012).

2.3.2. Distribution of Schistosomiasis in Ethiopia

Ethiopia has a wide range of the topographic diversity and climatic heterogeneity resulted in the formation of a multitude of agro-ecological zone classified based on altitude and rainfall

(Alemu, *et al*., 2016). In Ethiopia, about 5.01 million peoples are infected with schistosomiasis and 37.5 million people are at risk of the parasite (Steinmann *et al*., 2006). *Schistosoma mansoni* is widespread and its presence has been recorded in all administrative regions and is rapidly spreading in connection with water resource development (WHO, 2010). The optimal altitude category for the transmission of *Schistosoma mansoni* is between 1000 and 2000 meters, and most endemic localities in the country are located in this altitudinal range and its prevalence was reported as high as 90% in the country (Kabatereine *et al*., 2004). Two species of fresh water snails (*Biomphalaria pfeifferi* and *Biomphalaria sudanica)* are responsible for the transmission of this parasite in Ethiopia *(*Savioli and Daumerie, 2013). Sporadic outbreak of schistosomiasis may occur among school aged population who spent around contaminated water area and usually related to sudden change in climatic condition that boost the life cycle of either the parasite or the snail, or both (WHO, 2006). Various epidemiological study results on schistosomiasis are available for different parts of Ethiopia and new transmission foci have also been reported from different parts of the country from time to time. The reasons for the spreading of the disease to new localities seem to be an extensive population movement and water resource development. In Ethiopia, the prevalence of schistosomiasis infection varies from localities. Hygiene and play habits make children more vulnerable to the infection. Previous studies showed that the prevalence of *Schistosoma mansoni* among school children was 85% in Zarim, 73.9% in Waja timuga (Abebe *et al*., 2014), 67.6% in Fincha valley (Haile *et al.*, 2012), 67% in Gorgora (Moges *et al*., 2001), 45% in Hayk town (Amsalu *et al*., 2015),34.9% around lake Tana(Hailegebreal *et al*., 2021), 23.9% in Mekelle city (Assefa *et al*., 2013), 20.6% in Gorgora (Essa *et al*., 2013), 14.3% in Ayder referral Hospital North Ethiopia (Alemu *et al*., 2018), 8.2% Amibera District(Awoke *et al*., 2013) and 5.95% in Tigray (Dejenie and Asmelash, 2010).

2.4. Risk factors in schistosomiasis infection

The study of epidemiology of helminthes in humans thus encompassed the factors that affect the prevalence and intensity of helminthes infection. The available of large number of susceptible definitive and intermediate hosts will increase the parasite ability to produce and result in high parasite abundance. Schistosomiasis is highly pathogenic disease of clinical importance which causes a cosmopolitan infection. Demographic factors such as Gender, age, residence in the study area, previous history of schistosomiasis treatment, family occupation, water source, frequency of water contact and reasons for water contact like swimming, cross water bodies, working in irrigated agricultural filed, bathing and distance of home from water bodies were significantly associated with Schistosome infection. Open defecation remains a common phenomenon in schistosomiasis-endemic countries and is strongly associated with transmission. The epidemiology of schistosomiasis is not necessarily uniform with in an endemic country and it cannot be compared between countries. The endemicity of schistosomiasis depends on the disposal of urine and faeces containing *schistosoma*, the presence of suitable snail hosts and human exposure to cercariae. Water resource development project for irrigation and agricultural purpose can change the epidemiology in an endemic area from seasonal and high focal transmission of schistosomiasis to intense, widespread and constant transmission. Prevalence of the infection has been reported in many countries including Nigeria, Pakistan, China, United States of America and Iran (WHO, 2006).This may be exacerbated when majority of the humans become susceptible to parasite infection because of inadequate sanitation and poor playing habits around intermediate host of snail in water body area (Alemu *et al*., 2011).

Schistosomiasis is closely associated with large permanent water bodies such as ponds, lakes and marshy. 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 humans defecate in the field especially around the water. School aged children most likely spent their time around infected water areas become infected by parasitic flat worms through skin penetration when repeated contact with infested fresh water. The type of watering facilities used by humans is therefore a crucial factor in the reservoir and transmission of the infection (Aiello, 2000).

2.5. Socioeconomic impact of schistosomiasis

It is the most important disease in terms of its public health and socioeconomic impact after malaria in many developing countries of the tropics including Ethiopia (Akande and Odetola, 2013).The burden of the disease is as high as 80-85% principally in sub-Saharan Africa(

Bergquist ,2002). Schistosomiasis causes morbidity and mortality (WHO, 2010). Most of the damage is caused by the eggs and not the adults and most of the pathology is caused by the host immune responses. In Ethiopia, human schistosomiasis has been known to be endemic and causes substantial public health and socio-economic impact (Kloos *et al*., 1988). As opposed to urogenital schistosomiasis which is limited in distribution and occurring mainly in low lands of Ethiopia, intestinal schistosomiasis is found widely distributed and largely confined to high lands within an altitudinal limit of 1000 m-2000 m above sea level. Children are at a greater risk of acquiring the infection as well as re-infection, and this might cause growth retardation, anemia and low school performance. It is estimated that 400 million school-age children who are infected are often physically and intellectually compromised by anemia, leading to attention deficits, earning disabilities, school absenteeism and higher dropout rates in Saint Lucia (Rajini and Gurdip, 2010). Hygiene and play habits among male children especially make them vulnerable to schistosome infections. The disease burdens and reduces the quality of life of those people infected. Deaths occur, mainly through bladder cancer and renal failure driven by urinary schistosomiasis and liver fibrosis due to intestinal schistosomiasis (Tallo *et al*., 2008). Schistosomiasis can substantially reduce labor productivity. In Egypt, for example, labor output dropped as much as 35% among infected groups whereas, in Nigeria, the disease reduced worker productivity, cash income, rates of land clearing and farm size (Umeh *et al*., 2004).

2.6. Treatment and control

Control of schistosomiasis is normally aimed at reducing infections and morbidity by interrupting the parasite life-cycle. This can be achieved through different methods directed on the hosts, parasites and the environment (CDC, 2012). According to world health organization (WHO, 2004) three new drugs (praziquantel, oxaminiquine and metrifonate) have revolutionized treatment of schistosomiasis. The best prevention and control can be achieved with a single annual dose of Praziquantel drug, which is effective early immature and adult *schistosoma* (Ismail *et al*., 2014).

School or community-based mass drug administration (MDA) using praziquantel is the major control strategy for schistosomiasis (WHO, 2013). Similar to other endemic countries, the

MDA strategy in Ethiopia mainly focuses on school-aged children (SAC) via yearly school-based treatment. This campaign started in 2015 and is currently targeting 6.4 million children in endemic areas countrywide. The Ethiopian Ministry of Health (MoH) has planned to achieve the elimination of schistosomiasis-related morbidity by 2020 and to break the transmission by 2025 (WHO, 2013). Short-term targets of the elimination program are to cover at least 75% of school-aged children with MDA, to extend MDA to all adolescents and adults in high-endemic districts, and to decrease infection rates by 65-90% compared to baseline estimates (stothard *et al*., 2009).

Public health education is a very effective way of controlling schistosomiasis diseases. Educating communities on: proper disposal of human waste, wearing shoes while in the fields and dangers of bathing, swimming, washing clothes or fetching water in canals and slow moving streams is effective in controlling schistosome infection (WHO, 2014). According to Brown (2005), the other most frequent used public health intervention to control of intermediate host snail is the application of plant source to disease of population. Molluscicides have been particularly popular because they also decrease transmission of many other medically important trematode. Different plants have effects used as killing the intermediate host of schistosomiasis. For example, *Phytolacca dodecandra* is the most powerful plant-derived Molluscicides known as by Ethiopian name “Endod”, its berries used in field trials at Adwa in Northern Ethiopia (Tadesse Eguale, Getachew Tilahun, 2002).

3. MATERIALS AND METHODS

3.1. The study area and design

A cross-sectional study design was conducted to determine the prevalence of schistosomiasis and its associated risk factors among school children in and around Seladingay town during the period of March to May 2022. Seladingay is the main town of Mojana wodera woreda of North Shoa zone in Amhara regional state of Ethiopia. It is located about 202 km North of Addis Ababa and 72 km from Debre Berhane, the capital city of North Shoa zone in Amhara region. In Seladingay district the climatic condition alternate between along summer rain and winter dry season with mean annual rain fall of 1500-2200 mm. The mean temperature is between 21-27 °C. Altitude ranges from 1300 to 1500 m above sea level. Astronomically, the Woreda is located between 9°51'0"N to10°1' 0" N latitudes and 39° 20'0" E to 39°40' 0’’E longitude in Amhara National Regional State(**Fig. 3**).

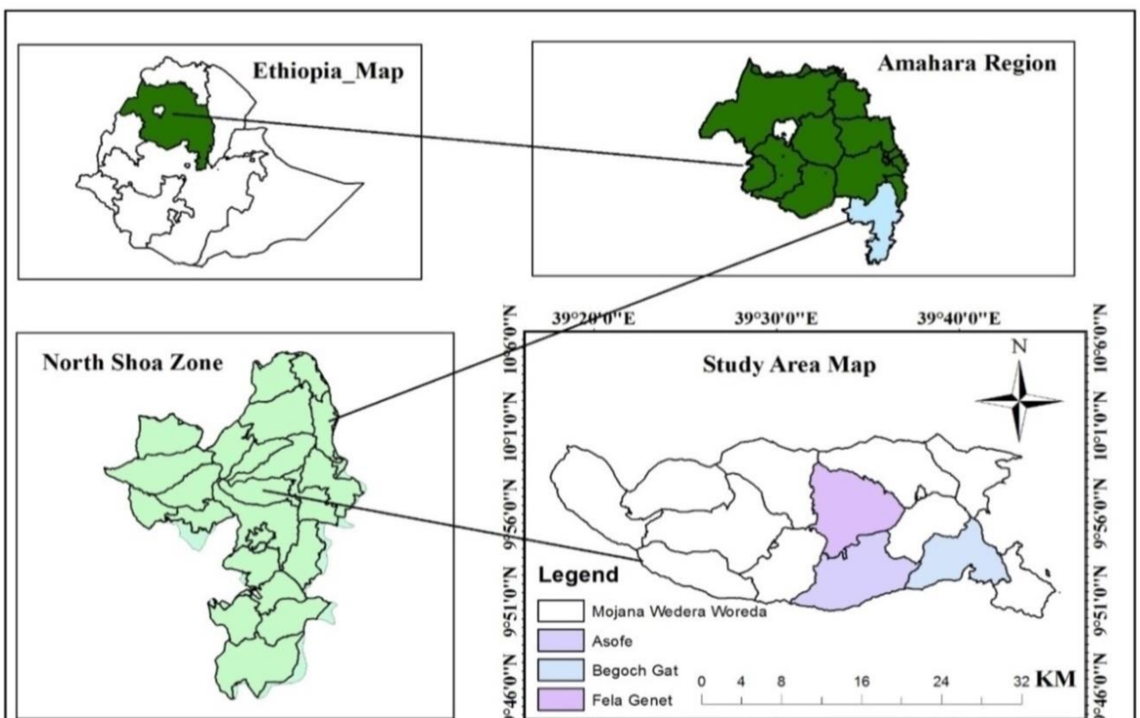

Figure 3: Map of the study area**(**EMA, 2021)

The major occupations of the inhabitants include civil service, business, daily labor and agriculture. Agriculture is the main economic sector in the study area. In this woreda of Mojana Wodera there are two higher and preparatory secondary schools and fourteen primary schools with a total of 21741 students. Out of these, four schools are selected for the studies which are two schools from those having link with water and two schools from those do not closely contact with water bodies. The relative location of the study area is bordered by three Woreda namely Basona worana to the south east, Debre sina woreda to the north east and Menz Mama Midir to the North. In the district, there are different water sources which the populations frequently use for domestic and irrigation purposes, swimming and washing in open water bodies could have a be potential risk for infection with *Schistosoma mansoni*. The study area of two primary schools(Asofe and Fella-genet) neighbours to water sources irrigation scheme and school children seek repeated contacts to these freshwater. There is also a poor sanitation as a result of open defecation around water bodies and this poses danger of transmission of schistosomiasis disease.

3.1.1. Sources of population

Based on 2021 students registration form conducted by Mojana wodera educational sector total population of students that have been registered to learn was 21741 of whom 8230 were boys and 13511 were girls.

3.1.2. Study population

From a total of 21741 students registered in 2021 the researchers study population consists of 1500 students from four primary schools, two primary schools from those having link with water and two from those do not. All children enrolled to Schools during 2022 academic year in the selected four schools of Mojana Wodera district, whose age was 8–17 years and who were in school during the study period, were included in this study. However, schoolchildren who were clinically ill and absent at the time of recruitment were excluded. Hence, for the case of factors analysis researcher was selected 306 school children from a study population of 1500 students based on simple random sampling from each four schools pick out until sampled population reached. Selection of students enrolled in the study was based on the number of sections per grade and the number of students per sections. The study variable for the assessment of schistosomiasis risk factors includes origin (urban/rural), distances of home from water bodies, previous history of schistosomiasis treatment, frequency of water contact (crossing water bodies), working in an irrigation field, use toilet or field in faeces removal, presence/absence of susceptible snail around their residence, questionaries' related to the way of control and treatment methods of the disease.

3.1.3. Inclusion criteria

Inclusion criteria were pupils in the selected schools of ages 8-17 years, who were willing to participate in the study and signed an ascent form after getting informed consent from their parents and the school directors.

3.1.4. Exclusion criteria

Exclusion criteria were pupils from the sampled schools not willing to participate in the study and those below or above the specified age (8-17 years). School children who were clinically ill and absent at the time of recruitment were also excluded from this study.

3.2. Sampling method and sample size determination

School children infection survey can be used as an index for assessing prevalence of schistosomiasis in Seladingay Town and its surrounding primary school children. From a total sixteen schools only four schools were enrolled in the study. Cross-sectional study was conducted on children of the selected schools from the period of March to May 2022, who were attending classes during sample collection. Simple random sampling technique was used to select school children who participated in the study because of its cost effective, no interviewer bias and enabled to collect information from the sample without influencing the study population. The selection was based on proportional allocation of students from the four schools using class roaster/attendance that contains complete list of students from the schools before commencing data collection. The total number of students enroll in the four schools were 1500. To select the sample children, the students were first stratified according to their educational level. A quota was allocated for each grade and each class room. Finally, the sampled children were selected using simple random sampling techniques by using class rosters as the sample frame of 214 school children with age range from 8 to 17 years old. In each school, students stratified according to three age groups (8–10years, 11–14 years and 15–17 years). Below is the figure indicating how the students were proportionally allocated and selected from the four schools and two schools nearby rivers in and around Seladingay town (**Fig. 4**).

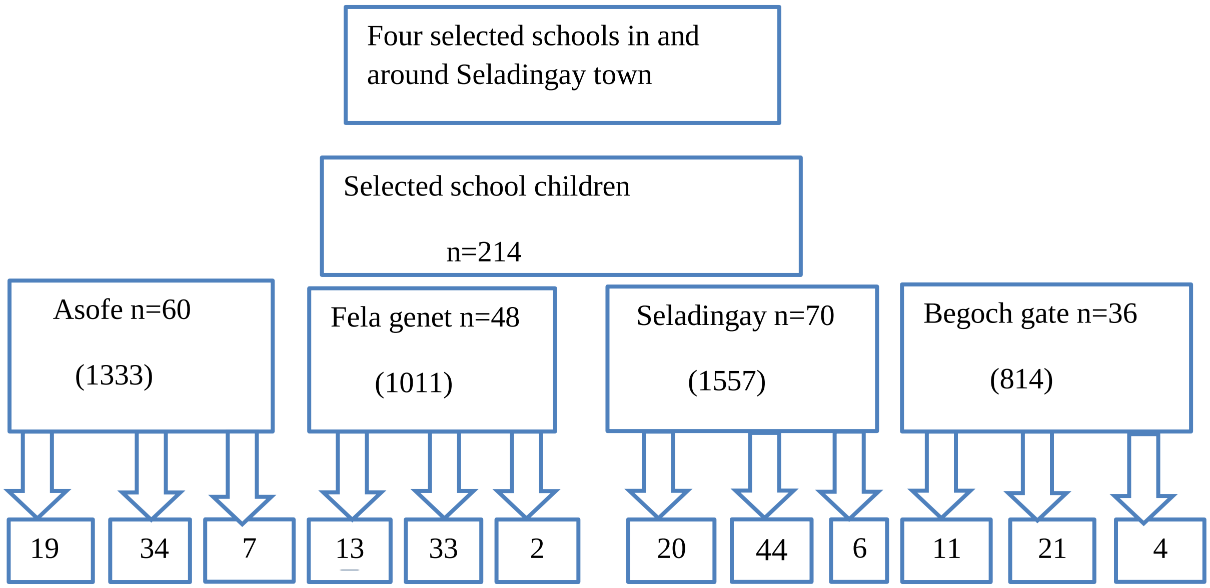

Figure 4: The proportional allotted number of students selected from four schools

During sampling of the study the risk factors of disease prevalence were organized in to school children information on origin, sex, approximate age of individual students, socio economic status, fulfillment of sanitary facilities, previous history of schistosomiasis treatment, frequency of water contacts, presence/absence of susceptible snails for intermediate host of the flat worm around their residences and other relevant information were recorded. The desired sample size of this study was calculated according to the Cochran formula given by Cochran (1977). To calculate the sample size, the expected prevalence of a population which has 50% was considered, with 95% confidence interval at an absolute precision of 5%.

$$n = (Z)^{2}{}_{(P*q)/d}{}^{2}$$

$$n = \frac{(1.96)^{2} \text{ x } p_{exp} (1-p_{exp})}{d^{2}}$$

Where, n= required sample size.

$P_{exp=}$ expected prevalence.

P= Prevalence

d^2= desired absolute precision (margin of error)

z = standard normal variable that the confidential level of 95%

Therefore, 384 students were taking for this study

q = 1-p

n = (1.96)2(0.5*0.5)/ (0.05)2

n = 384

Modification for the Cochran formula for sample size calculation in smaller population

n = no/ (1+ (no-1)/N)

Where no = Cochran sample size recommendation

N = Population size

n = adjusted sample size

n =384/ (1+ (383/1500))

n =305.97=306

So from this study population (1500), included 306 sampled populations and to minimize sampling error during sample collection, considering 5% of the estimated value adds as contingency for non-response and missing data. The final participated sample size the children were 214 in order to assess the knowledge, attitude and practice of community related to schistosomiasis prevalence and associated risk factors due to missed students stool sample collection with voluentarily. Thus a total of 214 children were taken as minimum sample size. Accordingly, 60, 48, 70 and 36, from Asofe, Fela genet, Seladingay and Begoch gate school, respectively were selected by simple random sampling technique using class roster. Among the selected students, 120 were males and 94 were females, with ages ranging from 8-17 years. The prevalenceof *Schistosoma mansoni* was presented in percent. The association between *Schistosoma mansoni* infection and associated risk factors were statistically tested using binary logistic regression and the level of significance was set at P-value <0.05.The magnitude of association was measured using adjusted odds ratio (AOR), at 95% Confidence interval.

3.3. Methods of data collection and procedures

3.3.1. Questionnaire Survey

Semi-structured questionnaires that include variables on socio demographic characteristics, source of infection, access to water and sanitation, recreational and occupational activities, and awareness of knowledge, attitude, practice related questionnaire to the disease transmission, control and treatment was used for data collection to achieve the desired goal of survey. The questionnaires were prepared by their mother tongue of Amharic language to ensure reliable information (**Appendix II**). It consists of two parts one for water contact patterns the other information about demographic factors on health conditions related to the disease prevalence. Semi structured questionnaire were carried out with 214 participant population from four schools which the allocation should be based on the school children population size using simple random sampling.

3.3.2. Direct microscopic examination of stool

Parasitological surveys were undertaken from March to May 2022 to determine the prevalence and associated factors of schistosomiasis among primary school children in Seladingay Town and its surrounding. Stool samples were collected from school children by simple random sampling after obtaining ethical clearance and written consent. Because this simple random sampling gives each and every element of the student population has an equal chance of being selected in the sample. Selection of students who were included in the study was based on the number of sections per grade and the number of students per sections (relatively small number of students per section were selected if the number of sections per grade were high and high number of students per section were selected if the number of sections per grade were small and with high number of students per section). The selected children were then advised how they should bring their stool sample without exchanging and contaminating with the soil, and supplied with a piece of paper to bring about 3gms of their own stool sample. A unique identification number was given to each participant student. Each participant student was provided with a labeled stool cup with an applicator stick for a sufficient stool sample collection. The collected stool samples were diagnosed using microscopic examination to detect the presence or absences of *Schistosoma mansoni* parastitic eggs in the students stool sample (**Appendix III**). Microscopic examination of the specimen was done by preparing a wet mount to demonstrate worm eggs (Arora *et al*., 2002; Gray, 2011). A drop of normal saline was placed at the center of the left half and a drop of Lugol's iodine solution at the center of the right half of the slide. About 1-2 mg of stool sample was picked using an applicator stick and mixed with the two solutions then Direct smears were done . The slide was covered using a cover slip that was dropped at angle to avoid trapping air bubbles. The slide was examined systematically under the light microscope at ×10 and also at ×40 magnification for the eggs. Samples that were found to have the *Schistosoma mansoni* worm eggs were recorded as positive.

3.4. Data analysis

The data were first enter into Microsoft excel Data sheet imported in to SPSS statistical software for windows, version 26 (SPSS, Chicago, IL, USA) used for all statistical analysis and computation. Parasitic infections were defined as positive for *Schistosoma mansoni* where an egg was identified in a stool sample. Prevalence of *Schistosoma mansoni* infection were reported in percentage. Risk factors associated with *Schistosoma mansoni* infection among the school children were analyzed by bivariate logistic regression and a multiple logistic regression model. The magnitude of association was measured through odds ratio at the 95% confidence interval p-values less than 0.05 were considered to be statistically significant. The prevalence of *schistosoma mansoni* infection in school children was determined as a percentage, by dividing the number of infected specimen to the total number of examined specimen and multiplying the result by hundred. The results were presented using tables, figures, and text form.

3.5. Ethical consideration

The thesis approved by Dilla University ethical committe and actual data collection permission was obtained from the Seladingay and other schools admministratives. Additionally, after explaining the objectives of the study, an informed written coensent was obtained from the study participants parent/teacher. An assent was also taken from the school children. Those children who were positive results in *Schistosoma mansoni* were recommend to get treatment from health center.

4. RESULTS OF THE STUDY

4.1. The Demographic variables of school aged children schistosomiasis exposure cases

From a total of 214 school aged children, 56.1% (120) were males and 43.9% (94) females from four schools and two of these schools were located nearby rivers in and around Seladingay town were involved in this study. Students from the age group of 8–17 years with mean age of 12.5 were participated in the study. The largest proportion 133(62.2%) of study participants were selected from the age group of 11-14(**Table 1**).

Table 1. Demographic characteristics of school children in the study area

Demographic variables	Percentage (%)
Sex	
Male	120(56.1)
Female	94(43.9)
Age groups (years)	
8–10	63(29.4)
11–14	133(62.2)
15–17	18(8.4)
Schools	
Seladingay School	70(32.7)
Begoch gat School	36(16.8)
Fela genet School	48(22.4)
Asofe School	60(28.1)

4.2. Prevalence of schistosomiasis infection in school aged children

Stool samples were collected from 214 school children and examined for presence of *Schistosoma mansoni* eggs. From 214 Schools aged children involved in this study the overall prevalence of *Schistosoma mansoni* in four selected schools nearby rivers in and around Seladingay was found to 25.23% (54/214). The prevalence was 28.33% (34/120) and 21.28 % (20/94) between male and female children respectively. School children age group11-14 (62.96%) was more infected. The prevalence varies from 8.57% to 38.33% among the schools with the highest prevalence 38.33% (23/60) in Asofe School and the lowest prevalence 8.57% (6/70) in Seladingay School (**Table 2**).

Table 2. Prevalence of *schistosoma mansoni* infection in school aged children

Demographic variables	No. infected (%)	No. uninfected (%)	Total
Sex			
Male	34(28.33)	86(40.19)	120(56.07)
Female	20(21.28)	74(34.58)	94(43.93)
Age			
8–10	12(19.35)	50(80.65)	62(28.97)
11–14	34(25.37)	100(74.63)	134(62.62)
15–17	8(44.44)	10(55.56)	18(8.41)
Schools			
Asofe	23(38.33)	37(61.67)	60(28.04)
Fela genet	16(33.33)	32(66.67)	48(22.43)
Seladingay	6(8.57)	64(91.43)	70(32.71)
Begoch gate	9(25.0)	27(75.0)	36(16.82)

4.3. Prevalences of intestinal schistosomiasis with respect to age

Prevalence of *Schistosoma mansoni* infection with respect to age group revealed that the highest prevalence (62.96 %) of *Schistosoma mansoni* infection was in children with ages ranging from 11-14 years followed by children with ages ranging from 8 - 10 and 15 - 17 years 22.22% and 14.81%, respectively ($\chi 2$= 23.21, P = 0.000) (**Fig.5**).

Table 3. Total prevalence of intestinal schistosomiasis with respect to age

Age(year)	No of examined	Total infection(%)
8-10	62	22.22%
11-14	134	62.96%
15-17	18	14.81%

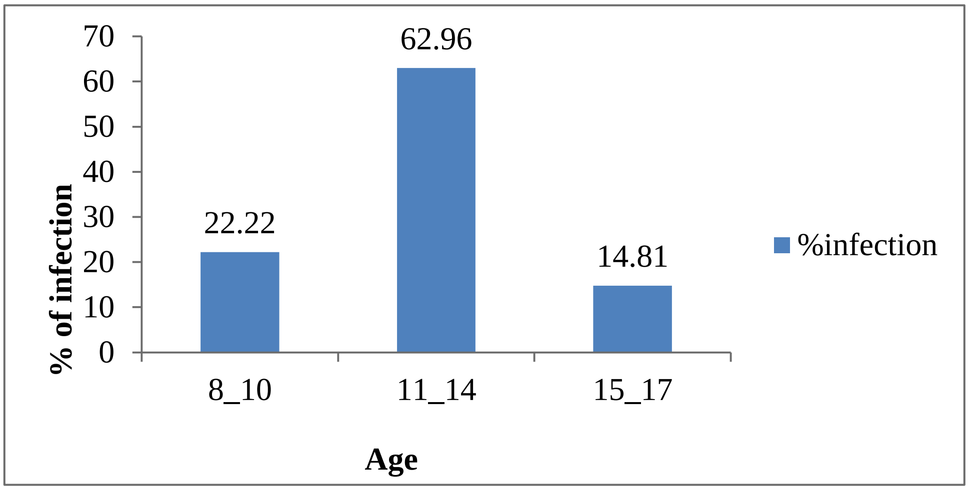

Figure 5 : Age specific prevalences of *Schistosoma mansoni* on school children

4.4. Prevalences of intestinal schistosomiasis with respect to sex

The Prevalence of *Schistosoma mansoni* infection was expressed in terms percent according to sex showed that higher infection (27.78%) was in males than (21.99%) in females ($\chi 2$= 7.36, P = 0.001) (**Fig.6**).

Table 4. Prevalence of schistosomiasis infection with respect to sex

Schools	Number of examined children			Number(%) of infected children		
	M	F	T	M	F	T
Asofe	35	25	60	14(40.0)	9(36.0)	23(38.33)
Fela genet	27	21	48	10(37.04)	6(28.57)	16(33.33)
Seladingay	37	33	70	4(10.81)	2(6.06)	6(8.57)
Begoch gate	21	15	36	6(28.57)	3(20.0)	9(25.0)
Total	120	94	214	34(27.8)	20(22.0)	54(25.23)

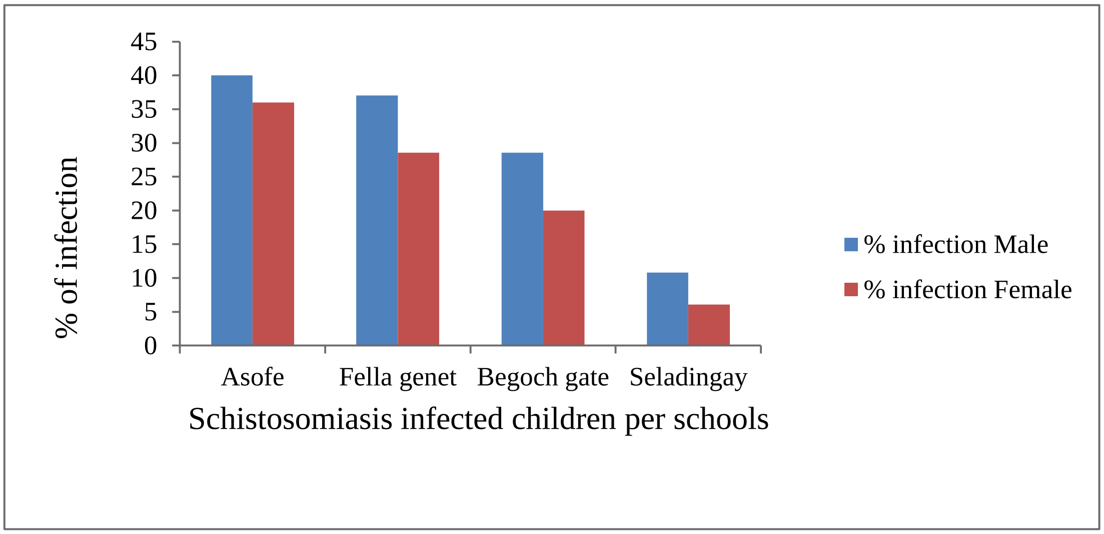

Figure 6: Sex specific prevalences of *Schistosoma mansoni* on school children

4.5.Knowledge, attitude and practice of school aged children on schistosomiasis disease

4.5.1. Knowledge related characteristic with different variables in related to schistosomiasis transmission and prevention

Most of the respondents (65.0%) participated on these questionnaire survey was from grade five up to grade eight and the rest(35.0%) from grade one up to grade four . Among the respondent (42.1%) had good knowledge regarding to the schistosomiasis control and prevention and (57.9%) had poor knowledge. Most of the respondent belief that cause of schistosomiasis disease were snails (59.3%), bacteria (24.3%) and flat worm (16.4%) respectively. Regarding to disease transmission, (44.0%) repeated contacted with infested fresh water bodies, (31.3%) of respondents believed that transmitted by eating contaminated food and the rest (24.7%) by insect bite. According to the question, 60.7% of respondents were not new for schistosomiasis where as 39.3% of respondents did not have awareness about schistosomiasis disease. Some of the respondents (44.0%) know risk of getting schistosomiasis infection when there is repeated contact with in infectious water bodies whereas most of them (56.0%) do not know getting schistosome infection in contact with infectious water habitats. In most of the respondent's residence (64.0%) the intermediate snails host were available around irrigated agriculture areas and 36.0% of the respondent's not the presences of snail around their home. Only 37.3% of respondents express the fatality of schistosome infection and 60.7% of them not considers as fatal at all (**Table 5**).

Table 5. Knowledge related characteristics associated with schistosomiasis disease

Knowledge related variables	Number of Respondents	Percentage (%)
Do you have awareness about schistosomiasis disease? A)Yes	130	60.7%
B) No	84	39.3%

What is the cause of schistosomiasis disease		
A)Flat worm	35	16.4%
B)Snails	127	59.3%
C)Bacteria	53	24.3%
Do you know how bilharz iasis disease transmitted?		
A) Yes	60	28.0%
B) No	154	72.0%
Is there presence of snails around your home of irrigated agriculture?		
A) Yes	137	64.0%
B) No	77	36.0%
Fatality of schistosomiasis?		
A) It is fatal	80	37.3%
B)It is not fatal	130	60.7%
How bilharziasis disease is transmitted?		
A) Eating contaminated food	67	31.3%
B)By insect bite	53	24.7%
C) Repeated contacted with infested fresh water	94	44.0%
Know how to control and prevent schistosomiasis infection? A) Yes	90	42.1%
B) No	124	57.9%
Educational status of respondents? A) 1–4	75	35.0%
B) 5–8	139	65.0%

4.5.2. Attitude related characteristics associated with schistosomiasis transmission and prevention

Among the attitude related variables, most of respondents (69.6%)were voluntary to take mass drug administration against parasitic helminthes without disease symptoms developed. and around 30.4% of the respondents not voluntary to take mass drug administration vaccination without symptoms of disease developed (**Table 6**). Most of the respondents (58.9%) not agree with regard to the best action taken to prevent schistosomiasis infection by reducing the intermediate host snail population due to lack of awareness about the transmission and prevention ways of the disease. Forty one percent of the respondents believed that the risk of schistosomiasis infection was reduced by controlling snail population.

Table 6. Attitude related characteristics associated with schistosomiasis infection

Attitude related variable	Number of Respondents	Percentage (%)
Would you volunteer to take MDA against parasitic helminthe ?		
A) Agree	149	69.6 %
B) Disagree	65	30.4%
Controlling snail population reduces schistosomiasis?		
A) Agree	88	41.1%
B) Disagree	126	58.9%
Schistosomiasis is a problem		
A) Agree	137	64.0%
B) Disagree	77	36.0%
Awareness creation reduces schistosomiasis transmission		
A) Agree	129	60.3%
B) Disagree	85	39.7%

4.5.3 Practice related variables associated with schistosomiasis disease

From questionnaire survey of the respondent's parent occupation involved on farmers (75.2%) and civil servant (24.8%) respectively. Among the total respondents on frequency of repeated fresh water contact activities (42.4%) of them have daily fresh water contact activities and the rest (57.5 %) of them have a weekly repeated fresh water contact activity frequency. Most of the respondents (67.3%) live in rural areas and the rest of the respondents (32.7%) live in urban area (**Table 7**). From the rural respondents 61.7% of the school aged children were linked with the presence of irrigated agricultural activity around their residences. Most of the respondents (76.3%) have obtained mass drug administration before and the rest (23.8%) does not obtained mass drug administration.

Table 7. Practice related variables associated with schistosomiasis infection

Practice related variable	Number of respondents	Percentages (%)
Parents' occupation		
Farmer	161	75.2%
Civil servant	53	24.8%
Where were you live?		
A) Urban	70	32.7%
B) Rural	144	67.3%
Presence of irrigated agricultural activity around your residences?		
A) Yes	132	61.7%
B) No	82	38.3%
Frequency of repeated freshwater contact activities? A) Daily	91	42.5%
B) Weekly	123	57.5%
Took of previous treatment for schistosomiasis disease A) Yes	163	76.2%
B) No	51	23.8%

4.6. Association of risk factors with schistosomiasis infection

Bivariate factor analysis was carried out to determine *Schistosoma mansoni* infection associated factors among school children such as sociodemographic characters (age, gender, residence), socioeconomic status, previous history of schistosomiasis treatment, sanitary facilities, frequency of water contact and reasons for water contact, swimming and awareness about schistosomiasis. Based on the bivariable logistic regression, the sociodemographic information of age groups 11 to 14 (COR, 2.449; 95% CI, 1.191-5.038; P = 0:000) and 15 to 17 (COR, 2.0; 95% CI, 0.654-6.110; P = 0:001), gender males, (COR, 1.36; 95% CI, 0.732-2.509; P = 0:001), and the residence(rural) (COR, 0.13; CI, 0.054-0.312, P = 0:003) were risk factors for *Schistosoma mansoni* infection (**Table 8**). The overall prevalence of *Schistosoma mansoni* in this study was found to be 25.23%. The highest prevalence of intestinal parasitic *schistosoma mansoni* was observed in the age range of 11–14 years (25%), followed by 8–10 years (20.21%).The highest prevalence of *Schistosoma mansoni* was obtained from rural areas 34.3% (74/216). 27.78% of males and 21.99% of females were found to be positive for *Schistosoma mansoni*. *Schistosoma mansoni* infection was statistically associated with high prevalence in rural areas and school grade level 5 to 8(**Table 8**).

Table 8. Distribution and association of *schistosoma mansoni* with sociodemographic data

Sociodemographic data	Total(n= 214)	(*S. mansoni*) Positive	Nega.	AOR [95%CI]	COR [95% CI]	*P* value
Sex						
Male	120(56.07)	33	87	1.36	1.36(0.732-2.509)	0.001*
Female	94(43.93)	21	73	1.00		
Age						
8–10	63(29.3)	9	53	1.00	1.00	
11–14	133(62.3)	40	93	2.449	2.449(1.191-5.038)	0.000*
15–17	17(7.9)	5	14	2.0	2.0(0.654-6.110)	0.001*

Residences Urban	70(32.7)	5	65	0.13	0.13(0.054-0.312)	0.003*
Rural	144(67.3)	49	95	1.00		
Schools						
Asofe	60(28.1)	24	36	2.388	2.388(0.939-6.068)	0.126
Fela genet	48(22.4)	17	31	2.072	2.072(0.769-5.590)	0.212
Seladingay	70(32.7)	5	65	0.987	0.987(0.337-2.889)	0.08
Begoch gate	36(16.8)	7	29	1.00	1.00	

Abbreviations: AOR= adjusted odds ratio ;COR= crude odds ratio; CI= confidence interval
* Significant association ($p < 0.05$).

Based on bivariate logistic regression model analysis the odds of infection by *Schitosoma mansoni* in school children was significantly associated with repeated open water contact experience, Swimming habit, water sources used for domestic purposes, Presence of intermediate host snails near residences, the children had knowledge about the correct modes of transmission and control of schistosomiasis, Access to obtained mass drug administration, and the educational level of students(**Table 9**). The odds of infection by *Schistosoma mansoni* were 3.7 times higher among students with swimming habit experience compared to the counter parts (AOR = 3.704; 95% CI: 1.858-7.374) and also the odds of infection by *Schistosoma mansoni* were11.8 times higher among students with daily open water contacts compared to weekly(AOR = 11.873; 95% CI: 5.864-24.023). The odds of infection by *Schistosoma mansoni* were 56% less among piped water usage compared to drainage for domestic purposes (AOR = 0.435; 95% CI: 0.226-0.837) . In addition, the odds of infection among students to know bilharziasis transmission ways were 75% less compared to the counter part (AOR = 0.248; 95% CI: 0.125-0.492).

Table 9. Bivariate logistic regression model analysis of variables in the school children

Schistosomiasis associated factors	*Schistosoma mansoni* (%) Positive	Nega.	AOR (95% CI)	COR [95% CI]	P value
Swimming habit					
A) Yes	43	81	3.704	3.704(1.858-7.374)	0.009*
B) No	11	79	1.00		
Agricultural activities with bare foot in irrigate areas					
A) Yes	37	95	1.434	1.434(0.772-2.662)	0.374
B) No	17	65	1.00		
Repeated contacts in open water					
A) Daily	45	46	11.873	11.873(5.864-24.023)	0.001*
B) Weekly	9	114	1.00		
Water sources to use	13	69	0.435	0.435(0.226-0.837)	0.002*
A) Pipe	41	91	1.00		
B) Drainage					
Control of snails to reduces bilharziasis					
A) Agree	18	70	0.643	0.643(0.344-1.202)	0.22
B) Disagree	36	90	1.00		
Presence of snails near residence?					
A) Yes	44	93	2.913	2.913(1.447-5.859)	0.007*
B. No	10	67	1.00		
Know how bilharzia sis transmitted? A)Yes	11	83	0.248	0.248(0.125-0.492)	0.002*
B) No	43	77	1.00		

House hold latrine					
A) Have	13	62	0.517	0.517(0.27-1.0)	0.064
B) Have no	41	98	1.00		
Awareness about bilharzia disease?					
A) Have	37	93	1.627	1.627(0.869-3.043)	0.228
B) Have no	17	67	1.00		
Distance of your home from water habitat?					
A)Nearby	38	91	1.785	1.785(0.946-3.366)	0.153
B) Far away	16	69	1.00		
Know control and prevent of infection?					
A) Yes	41	49	7.466	7.466(3.881-14.353)	0.001*
B) No	13	111	1.00		
Access to obtain mass drug administration					
A) Able to obtain	48	115	3.098	3.098(1.39-7.33)	0.036*
B) Unable to obtain	6	45	1.00		
Parents' occupation					
Farmer	37	123	0.667	0.667(0.355-1.249)	0.377
Civil servant	17	37	1.00		
Educational level of respondents?					
A) 1–4	24	115	0.309	0.309(0.169-0.564)	0.013*
B) 5–8	30	45	1.00		

Abbreviations: AOR= adjusted odds ratio; COR= crude odds ratio; CI= confidence interval

* Significant association ($p < 0.05$).

In a multivariable analysis, sets of water contact pattern,educational level and drainage water usage variables were tested for strength of relation with schistosome infection.The odds of infection by *Schistosoma mansoni* were 62% less among piped water usage compared to drainage for domestic purposes (AOR = 0.381; 95% CI: (0.226-0.837) (**Table 9**). In addition, the odds of infection among students educational level between one up to four were 78% less compared to five up to eight (AOR = 0.22; 95% CI: 0.169-0.564).The odds of infection by *Schistosoma mansoni* were 7.35 times higher among students with repeated open water contact experience compared to the counter parts (AOR = 7.35; 95% CI: 5.864-24.023).

Table 10. Multivariate analysis factors associated with schistosomiasis.

Associated factors	Schistosomiasis (n=214).				
	+	-	COR 95% (CI)	AOR 95% (CI)	P value
Repeated open water contact experience					
Have	45	46	11.873(5.864-24.023)	7.357	0.001
Have no	9	114	1.00		
Water sources to use					
A) Pipe	13	69	0.435(0.226-0.837)	0.381	0.02
B) Drainage	41	91	1.00		
Educational level					
1-4	24	115	0.309(0.169-0.564)	0.219	0.011
5-8	30	45	1.00		

Abbreviations: AOR= adjusted odds ratio; COR= crude odds ratio; CI= confidence interval

+ = Presence ; **-** = absence

5. DISCUSSION

The findings from this study suggest that the prevalence of schistosomiasis among school children was highest due to repeated exposure to infested water bodies.The present study is aimed to assess the prevalence and associated factors of *Schistosoma mansoni* infection in Seladingay town and its surrounding primary school children. The overall prevalence of *Schistosoma mansoni* infection in this study was 25.23%. The finding of this study with regarding to the present study sites of Asofe and Fela genet primary schools have higher rates of schistosomiasis prevalence with 11.53% and 7.79% than Begoch gate and Seladingay primary schools with a prevalence of 3.43% and 2.49% respectively. The reason behind this difference could be the proximity of the former two schools located near to water bodies more likely the students exposure to schistosome infection. The overall prevalence of this study area (25.23%) was similar to the findings of previous reported from different part of Ethiopia by Assefa *et al*.(2013) of 23.9%; Degarege *et al*. (2015) of 26.65%; Feleke *et al.*(2017) of 23.3%; Bekana *et al.*(2021) of 25.6%. However, it is lower than the prevalence rate reported by Essa *et al.*(2013) of 50.3%; Abebe *et al*. (2014) of 73.9%; Mathewos *et al.* (2014) of 33.71%; Alemayehu and Thomas(2015) of 81.25% ;Amsalu *et al*.(2015) of 44.79%. But it is higher than the prevalence rate reported by Awoke *et al*.(2013) of 8.2%; Alemu *et al*.(2018) of 12.5%; reported.This variation could be due to difference in geographic condition, presence/absence of susceptible intermediate host snail, awareness of the school children about the disease, environmental and biological factors for the transmission of the parasite and water body presence to complete its life cycle.

In this investigation, the prevalences of *Schistosoma mansoni* infection in relation to sex showed that the higher infections were in males (27.8%) than females (22.0%) [AOR= 1.36(0.732-2.509), 95%CI, P = 0.001],(**Table 4**). The possible explanation of this result males at these age range have a highly contact activities in open water than females. This result is in line with study reported by Assefa *et al*.(2013) with 30.71% male and 14.12 % female from Mekelle; Dufera *et al*.(2014)from with 66.81% males and 33.19% females from Finchaa; Bajjiro *et al*.(2017) from Jimma town; Tefera *et al*.(2020) with 39.3 males% and 12.95% females from Jimma town. However, report by Awoke *et al*.(2013)from Amibera district

Northern Ethiopia and from other country such as Nigeria (Ekpo *et al*., 2010) reported that no sex related difference in infection prevalence of *Schistosoma mansoni* among school children. The observed sex related variation of infection prevalence of *Schistosoma mansoni* in the present study mostly due to repeated engagement of males participated in swimming, playing in water the higher chance to acquire more infection and re-infection with schistosomiasi*s* than females.

In this investigation, the peak prevalence registered for Schistosoma mansoni infection in the age group 11-14 years, and followed by the age group 8-10 and the lowest in the age group 15-17years. In this age group related study as the age increase the prevalence of S. mansoni was increase 8 to 14 years and thereafter decreased (**Figure 5**). Children at range from 11 -14 category were the most significantly associated with *Schistosoma mansoni* infection with [AOR = 2.449(1.191-5.038), p = 0.000] (**Tables 8**). The more often children taken to river water for swimming were statistically associated with higher Schistosome infection rate [AOR = 11.873(5.864-24.023), p = 0.001] (**Tables 9**). This might be due to higher rate of water contact among those children with ages from 11- 14 and the least infection in the age groups 8 - 10 and 15 -17 which might be due to low outdoor water contact activities.This is in agreement with reports from different parts of Ethiopia by Tadesse and Beyene(2009); Assefa *et al.(2013);*Dejenie *et al*. (2013); Tadesse Hailu and Mulat Yimer(2015). In contrast to this, some reports described that the highest infection prevalence of *Schistosoma mansoni* in children to be age range from 15 - 19 (Essa *et al*., 2013; Amsalu *et al*., 2015*)* and the least prevalence to be in children with ages range from 10 –14 (Tadesse and Beyene, 2009). This difference might be due to the water contact pattern of different age groups in different areas are different.

In the current study residence was identified as a risk factor of *Schistosoma mansoni* infection. In this study, the prevalence of *Schistosoma mansoni* infection in rural settings was higher than urban settings. The rural setting schools of Asofe and Fella genet are proximity to natural freshwater bodies as an important risk factor for intestinal schistosomiasis to occur than the other two schools. This concurs with the report of a systematic review from Kinshasha, Kongo (Madinga *et al.,* 2015) and from Kalu, Fogera and Dembia district in

Amhara region by (Bekana *et al*., 2021). The higher prevalence from rural settings may be due to increased exposure to water through different activities such as high irrigation practice, swimming and fishing, limited access to health-care services and lack of safe water for the rural population.

Frequency of water contact was identified as risk factor for *Schistosoma mansoni* infection. That is the number and duration of daily contacts with water played an important role in determining the relative risk of *Schistosoma mansoni* infection and correlated significantly with the number of infected children(AOR=11.873; 95% CI: 5.864-24.023, p=0.001). This could be due to children who have frequent water contact activities may have high rate of vulnerability to *Schistosoma mansoni* infection. Previous history of intestinal schistosomiasis treatment was also associated with *Schistosoma mansoni* infection. Children who were not treated before were at higher risk of infection than those who were treated. This is similar to finding from previous studies by Assefa *et al*. (2013). This treatment by effective drugs cannot prevent reinfection instead it reduce the output of eggs in the infected individuals and reduce transmission at community level Ahmed *et al*. (2012).

The other significant factor associated with *Schistosoma mansoni* infection in this study was the grade level of the study participants. Students with grade levels of five to eight were more likely to be exposed to Schistosome infection than grade levels one to four. The possible reason might be that students at this age needs keep their personal hygiene in unsafe open water sources had higher exposure to the infection. This finding was in agreement with the findings of (Awoke *et al*., 2013; Essa *et al*., 2013). Although this study has motivated schistosomiasis infection controls on school children in the area, it also had some limitations encountered to conduct this study were sample size variations of studies because of most of the students were from rural area refused to give their stool sample for examination during the study periods and to tackle these problems the researcher replaced with other voluntarily students as possible.

6. CONCLUSION AND RECOMMENDATION

6.1. Conclusion

The findings established that the increased prevalence rate of schistosomiasis infection were great public health concern unless appropriate control measures are designed. This study measures the prevalence and associated risk factors of schistosomiasis in Seladingay Town and around its surrounding primary school children in 2022. The study revealed *Schistosoma mansoni* infection is prevalent in the study area with a prevalence of a 25.23%. In this study the school children were at moderate risk of morbidity caused by *Schistosoma mansoni* (prevalence ≥ 10% and < 50% according to WHO threshold). The prevalence rates of *Schistosoma mansoni* among the schools were 11.53, 7.79, 3.43 and 2.49 in Asofe, Fela genet, Begoch gate and Seladingay respectively. According to the finding students frequently visiting open water bodies are at highest risk of *Schistosoma mansoni* infection where infected snails are present in the environment. The results would assist public health authorities to refine control measures and to get mass drug administration service.

6.2. Recommendation

The following are recommendations derived from this study

To reduce the overall parasitic infections of schistosomiasis take a control measures are better than treatment based on interrupting the epidemiological cycle of the disease by

- Eliminate the intermediate host snail with molluscides of *Phytolacca dodecandra* (*Endod*) with habitat modification
- Prevent access of school children for repeated open water contact and swimming
- Give appropriate health education for the school children about the risk of schistosome infection , the modes of transmission and prevention methods

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8. APPENDICES

SCHOOL OF GRADUATE STUDIES

COLLEGE OF NATURAL AND COMPUTITIONALSCIENCES

DEPARTMENT OF BIOLOGY

PREVALENCE OF SCHISTOSOMIASIS AND ASSOCIATED FACTORS AMONG PRIMARY SCHOOL CHILDREN IN AND AROUND SELADINGAY TOWNS, NORTH SHEWA, AMHARA REGION, ETHIOPIA.

BY: SHEWAYIRGA BELAY

JUNE, 2023

DILLA, ETHIOPIA

Appendix I. Questionnaire variables on schistosomiasis filled by school children

Dear respondents

My name is Shewayirga belay and I am a master student at Dilla University of college of natural and computational sciences department of biology graduate program. I am carryout a research study on" prevalence of schistosomiasis and its associated factors in and around Seladingay schools," of Mojana wodera woreda, North Shoa Zone, Amhara region. The purpose of this questionnaire is to collect the relevant information regarding" prevalence of schistosomiasis and its associated factors in and around Seladingay schools," serves to prepare my graduation paper (thesis) for the partial fulfillment of the requirement of the degree of Master of Science in biology. So in light of you feel circle correct answer your genuine responses is very helpful to the successful completion of this study. Thank you for your honesty and consistent answer in advance.

General Instruction:

- All questions mentioned here are equally important to achieve the objectives of the study.
- If you fill without understanding or fail to complete any of questions, it will negatively affect the result
- Please read the questions carefully and encircle the multiple choices and provide your opinion.
- You don't need to write your name and sign.
- Please try to give your best response to the questions provided as much as possible
- In the case of questions where alternatives are given choose one from the rest by circling (mark sign)
- Please you don't leave the questions not answered
- Please fill your personal information's before answering the questionnaire
- Thank you in advance for your cooperation.

Name of your school———————————————————

Sex ———   Age ——

1. is there irrigated agriculture around your residences?   A) Yes   B) No

2. Where you prefer to remove faeces and urine?   A) In the field   B) in the toilet

3. Is there presence of snails around your home of irrigated agriculture?   A) Yes   B) No

4. Where were you live?   A) Urban   B) Rural

5. Are you crossing water bodies with bare foot?   A) Sometimes   B) Usually   C) Not at all

6. Are you bathing in the rivers to swim or wash your body?   A) Yes   B) No

7. Do you heard about bilharziasis disease before?   A) Yes   B) No

8. Frequency of repeated water contact activities?   A) Daily   B) Weekly

9. Would you have accesses of obtaining vaccination (mass drug administration) against parasitic helminthes without symptoms of disease before?   A) Yes   B) No

10. Distances of your home from water habitat?   A) Nearby   B) Far away

11. How you crossing water bodies regularly?   A) By wearing shoes   B) Without shoes

12. Do you know about the cause of bilharziasis disease?   A) Yes   B) No

13. If yes what is the causative agent of schistosomiasis (bilharziasis)?

A) Snails   B) flatworms   C. Bacteria

14. What is the fatality of schistosomiasis disease?

A) Very fatal   B) less fatal   C) not fatal at all

15. Do you know how bilharziasis disease is transmitted?   A) Yes   B) No

16. Which of the following way exposure school aged children for bilharziasis disease?

A) Eating contaminated foods B) Repeated contact with infested water

C) By insect bite

17. Which of the following individuals more exposure to schistosomiasis infection?

A) Males B) Females

18. Do you know how to control and prevent schistosomiasis infection? A) Yes B) No

19. Do you know that you and your Family are at risk of getting Schistosomiasis infection if there is contact with in infested fresh water? A) Yes B) No

20. Would you agree that controlling snail population reduces schistosomiasis infection?

A) Yes B) No

21. What is the occupation of your Parents?' A) Farmer B) Civil servant

22. Who can get Schistosomiasis (Bilharzia)? A) Infants B) Children C) Elders

23. Schistosomiasis is a problem in your school and in your kebeles? A) Agree B) Disagree

24. Educational status of respondents? A) 1–4 B) 5–8

25. Would you agree that to take (mass drug administration) vaccination against parasitic helminthes without the symptoms of the disease? A) Agree B) Disagree

Appendix II. Dilla University post graduate Amharic translated questionnaire

ዲላ ዩኒቨርሲቲ የድህረ ምረቃ ት/ቤት ቁጥር መጠይቅ መልስ

1. ጾታ 1. ወንድ 2. ሴት

2. አሁን የሚማሩበት የትምህርት ቤትዎ ስም---------------------------

3. እድሜ ---------------

4. የእርስዎ መኖሪያ ቦታ የት ነዉ ? ሀ. ከተማ ለ. ገጠር

5. የእርስዎ የትምህርት ደረጃ ሀ. 1–4 ለ. 5–8

6. በእርስዎ መኖሪያ ቦታ የመስኖ እርሻ አለ ወይ? ሀ. አለ ለ. የለም

7. ስለ ብልሀርዝያ በሽታ ከአሁን በፊት ሰምተዉ ያዉቃሉ ወይ? ሀ. አዎ ሰምቻለሁ ለ. አልሰማሁም

8. የብልሃርዝያ በሽታ መንስኤ ምን እንደሆነ ያዉቃሉ? ሀ.አዎ አዉቃለሁ ለ. አላዉቅም

9. የብልሃርዝያ በሽታ መንስኤ ምንድን ነዉ? ሀ.ባክቴርያ ለ. ቀንድ አዉጣ ሐ. ጠፍጣፋ ትል

10. የብልሃርዝያ በሽታ አብዛኛዉን ጊዜ የሚያጠቃዉ የቱን ነዉ?

ሀ. ያደጉ ሀገራትን ለ. ያላደጉ ሀገራትን

11. የ ቀንድ አዉጣ ብዛትን መቆጣጠር በተዘዋዋሪ የብልሃርዝያ በሽታ ስርጭትን ይቀንሳል?

ሀ. አዎ እስማማበታለሁ ለ. አልስማማበትም

12. የእንዶድ ዛፍ የቀንድ አዉጣ ብዛትን ለመቆጣጠር እና ለመግደል ያገለግላል ፤ ሀ. እዉነት ለ.ሀሰት

13. እርስዎ እና ቤተሰብዎ በተበከለ ዉሀማ አካባቢ አዘዉትረዉ የሚያሳልፉ ከሆነ ለብልሃርዝያ በሽታ እንደሚያጋልጥዎ ያዉቃሉ? ሀ. አዎ አዉቃለሁ ለ. አላዉቅም

14. በዉሀ ዉስጥ ወንዝ ሲሻገሩ እንዴት ነዉ? ሀ. በጫማ አድርጌ ለ. በባዶ እግሬ

15. ሰገራ የሚወጡት የት ነዉ የሚጠቀሙት? ሀ. ሽንት ቤት ለ. በየሜዳዉ የትም

16. የብልሃርዝያ በሽታ አብዛኛዉን ጊዜ የሚያጠቃዉ የቱን ጾታ ነዉ? ሀ. ወንድን ለ. ሴትን

17. የብልሃርዝያ በሽታን እርስዎ እንዴት ያዩታል? ሀ. በጣም አደገኛ ለ. አደገኛ ሐ. አደገኛ አይደለም

18. የብልሃርዝያ በሽታ እንዴት እንደሚተላለፍ ያዉቃሉ? ሀ. አዎ አዉቃለሁ ለ. አላዉቅም

19. የብልሃርዝያ በሽታ መስፋፋትን እንዴት መቀነስ እና መቆጣጠር እንደሚቻል ያዉቃሉ?

ሀ. አዎ አዉቃለሁ ለ. አላዉቅም

20. አብዛኛዉን ጊዜ ለትምህርት የደረሱ ልጆች ለብልሃርዝያ በሽታ የሚያጋልጣቸዉ የትኛዉ ምክንያት ነዉ? ሀ. የተበከለ ምግብ በመመገብ ለ. ለተደጋጋሚ ጊዜ ከተበከለ ዉሀ ጋር መገናኘት

ሐ. የነፍሳት ንክሻ

21. የእርስዎ መኖሪያ ወይም ሰፈር ከዉሃማ አካላት አንጻር ያለዉን ርቀት እንዴት ያዩታል?

ሀ. ቅርብ ነዉ ለ. ሩቅ ነዉ

22. ከአሁን በፊት ጸረ ጥገኛ ትላትል መድሀኒት ወስደዉ ያዉቃሉ ወይ?

ሀ. አዎ ወስጃለሁ ለ. አልወሰድኩም

23. በወንዝ ዉሀ የመዋኘትና ገላን የምታጠብ ልምድዎ አለዎት?

ሀ. አዎ አደርጋለሁ ለ. አላደርግም

24. በባዶ እግርዎ ወይም ያለ ጫማ በዉሀማ አካባቢዎች የምታሳልፉት ጊዜ

ሀ. አልፎ አልፎ ለ. አብዛኛዉን ጊዜ ሐ. አላሳልፍም

Appendix III. Microscopic examination of schistosoma mansoni eggs in stool samples

Microscopic examination of the specimen was done by preparing a wet mount to demonstrate worm eggs (Arora *et al*., 2002).

1. A drop of normal saline was placed at the center of the left half of a microscope slide and a drop of Lugol's iodine solution in the center of the right half of the slide.

2. Picked about 1-2 mg of stool sample using an applicator stick and mixed with Lugol's iodine solution and an equal portion mixed with normal saline.

3.Direct smears were done to identify the positive samples.

4.The slide was covered using a cover slip that was dropped at angle to avoid trapping air bubbles.

5. The slide was examined systematically under the light microscope at ×10 and also at ×40 magnification for the eggs.

6.Samples that were found to have the *Schistosoma mansoni* worm eggs were recorded as positive.