PREVALENCE, INTENSITY AND ASSOCIATED RISK FACTORS OF *Schistosoma mansoni* INFECTION AMONG PRIMARY SCHOOL CHILDREN OF ZEGIE PENINSULA, BAHIR DAR CITY ADMINISTRATION, AMHARA REGIONAL STATE, ETHIOPIA

MSc. THESIS

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Prevalence, Intensity and Associated Risk Factors of *Schistosoma mansoni* Infection among Primary School Children of Zegie Peninsula, Bahir Dar City Administration, Amhara Regional State, Ethiopia

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BY

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As research advisors, we hereby certify that we have read and evaluated the thesis prepared by Belete Mekuria under our guidance, which is entitled "Prevalence, Intensity and Associated Risk Factors of *Schistosoma mansoni* Infection among Primary School Children of Zegie Peninsula, Bahir Dar City Administration, Amhara Regional State, Ethiopia". We recommend that the thesis be accepted as fulfilling the thesis requirement.

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Final approval and acceptance of the thesis is contingent upon the submission of its final copy to the Council of Post Graduate Program (CPGP) through the candidate's graduate committee (DGC or SGC).

DEDICATION

This Thesis work is dedicated to my beloved mother, father, sisters and brothers.

STATEMENT OF THE AUTHOR

First, I declare that this thesis is my own work and that all sources of materials used for the thesis work have been duly acknowledged. This thesis has been submitted to Haramaya University in partial fulfillment of the requirements for the Degree of Master of Science and is deposited at the Library of the University to be made available to borrowers under the rules and regulations of the Library. I solemnly declare that I have not submitted this thesis to any other institution anywhere for the award of any academic degree, diploma, or certificate.

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BIOGRAPHICAL SKETCH

The author was born on January 19, 1982 G.C in Kullubi Town, East Harargie Zone, Oromia Regional State. He attended his elementary and secondary school education at Kullubi Gedam between 1982-1989 and Harar Senior Secondary School between1998-2001, respectively. Upon successful completion of his high school studies, he joined Harar Teachers Training Institute in 2006 and graduated in 2008. After graduation, he taught Biology in two different places, South Gonder and West Gojjam, Bahir Dar City Administration up to now. He joined the summer programme in Dire Dawa University in 2009 and graduated with Bachelor of Science in Biology in July 2013. Soon after graduation, the author has been teaching in Zegie Secondary and Preparatory School. Then, he was recruited for postgraduate study (MSc.) by the Ministry of Education in July 2015 to join the Summer Program of the School of Biological Sciences and Biotechnology, Haramaya University.

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ACRONYMS AND ABBREVIATIONS

CDC	Center for Disease Control
CSA	Central Statistical Agency
EPG	Eggs per Gram of Faeces
FEC	Formol Ether Concentration
NCCLS	National Committee for Clinical Laboratory Standards
SPSS	Statistical Package for Social Sciences
μM	Micro Meter
WHO	World Health Organization

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Prevalence, Intensity and Associated Risk Factors of *Schistosoma mansoni* Infection among Primary School Children of Zegie Peninsula, Bahir Dar City Administration, Amhara Regional State, Ethiopia

ABSTRACT

S.mansoni infection is one of the major public health problems in many developing countries including Ethiopia. The objective of this study was to determine the prevalence, intensity and associated risk factors of S. mansoni infection among primary school children of Zegie Peninsula. A cross-sectional survey was carried out and a total of 403 school children were selected from a total of 1946 students using stratified random sampling technique from three primary schools that are found in Zegie Peninsula. A structured questionnaire was administered to respondents to generate information on socio-demographic characterstics and risk factors. In addition stool samples were collected and processed for microscopic examination using the Direct-Wet Mount and Formol-ether concentration methods. Data were analyzed using SPSS statistical software version 20.0. The result of the study showed that the prevalence of S. mansoni infection in both sexes of school children in age group 5-9, 10-14 and 15-18 years old were 60.6%, 46.1% and 56.3%, respectively. The prevalence of S. mansoni infection in males and females school children were 62.7% and 38.1%, respectively. The overall prevalence of S. mansoni infection was 50.1%. This finding also indicated that children with age group 5-9 years old were highly affected by S. mansoni infection.The intensity of S. mansoni infection in terms of mean ± SD egg counts per gram of faeces for males and females school children were 190.7±1.359 and 265.8±1.847 EPG, respectively. Accordingly, the results revealed that S. mansoni infection was significantly associated with swimming habit at any time, water source for drinking, water contact while crossing the stream or lake and regular shoe- wearing habits ($p<0.05$). Hence, community-based intervention, particularly school-based deworming program, water sanitation and hygiene programs are recommended to students of the study area.

Keywords: Aetiology, Inflammation, Intensity, *Schistosoma mansoni*, Zegie Peninsula.

1. INTRODUCTION

Archeological evidence in Africa and China indicates that the parasitic trematodes infection, schistosomiasis has been part of human life for at least four millennia. In 1852, Dr. Theodore Bilharz, a German physician working in Egypt, first described the presence of adult worms in postmortem examinations of affected patients and since then, the disease is often referred to generically as 'Bilharziasis. (Utzinger, 2003)

Schistosomiasis, also known as Bilharziasis (snail fever), is among the oldest known infections of man. Human schistosomiasis is a water-borne parasitic disease caused by five *Schistosoma* species, each with its own unique epidemiology and geographic range. These are *Schistosoma mansoni*, *S. japonicum*, *S. haematobium*, *S. mekongi* and *S. intercalatum* (Brunwald *et al*., 2001). *Schistosoma hematobium* causes urinary schistosomiasis; and *S. mansoni, S. japonicum, S. intercalatum, and S. mekongi* are the causative agents of intestinal schistosomiasis and other forms of the disease (Narain *et al.,* 2000).

Schistosomiasis is one of the world's major health problems; particularly, it is one of the most important human parasitic diseases in terms of socio-economic and public health importance in tropical and subtropical areas. It ranks second to malaria, the most prevalent water borne disease and one of the greatest risks to health in rural areas of developing countries. *S. mansoni* is endemic throughout Africa and the Middle East. It was brought in the fifteenth and sixteenth centuries to South American and Caribbean by slave trade. The *S. haematobium* is confined to Africa and the Middle East, while *S. japonicum* and *S. mekongi* are found only in Asia (Bergquist *et al.,* 2002)

Reports of WHO showed that 74 tropical countries are endemic for schistosomiasis, over 200 million people in the rural and agricultural areas are estimated to be infected, and 500 to 600 million people are considered to be at risk of becoming infected (WHO, 2010). Globally, *Schistosoma mansoni* is the most prevalent of the *Schistosoma* species that affect the intestine and liver. *S. mansoni* is known to occur in 52 countries, including sub-Saharan Africa (where around 85% of the global burden is concentrated), North African and Eastern Mediterranean countries, South American countries (Brazil, Venezuela, Surinam) as well as several

Caribbean Countries (Saint Lucia, Montserrat, Martinique, Guadeloupe, Dominican Republic and Puerto Rico) (Wang , 2009).

The occurrence of schistosomiasis depends on the presence of suitable intermediate hosts (freshwater snails). Human infections result from contact with standing or slow-moving bodies of water (freshwater) when *Schistosoma* cercariae penetrate the skin. Aquatic freshwater snails that prefer standing or slow-moving bodies of water are the intermediate hosts for *S. hematobium, S. mansoni, S. intercalatum*, and *S. mekongi* (Laikemariam *et al.*, 2005).

The life cycle of *Schistosoma mansoni* involves a phase of sexual reproduction by the adult schistosomes in definitive host and asexual phase in intermediate snail host. The male and female *Schistosoma mansoni* live in the veins of the portal system, where they mate and the female start to lay 100-300 eggs per day. About 50% of eggs pass the colon, and are excreted in faeces, while some are trapped within the intestinal wall and lead to inflammation, granulomatous reactions which result in abdominal pain and blood in faeces (George and Mohb, 2000).

The epidemiological study conducted in Adwa in the late 1960s using formol-ether concentration method reported the overall prevalence of 83.8%, for *S. mansoni* infections, for school age children 7-15 years (Birrie *et al.*, 1996). Schistosomiasis pilot control trial using mainly the molluscicides, *Endod* (*Phytolacca dodecandra*) and *Bayluscide* was instituted in Adwa town in Northern Ethiopia from 1962 to 1972 and resulted in decreases in the prevalence of *Schistosoma mansoni* infection from 64% in 1969 to 43.3% in 1972 and even more sharply in 1-6 years old children.

In many peasant association of the rural parts of Ethiopia, the resident are forced to use unprotect water from lakes, rivers, streams, irrigation channel, ponds and stagnant water. In such areas, the possibility of infection with water borne diseases such as schistosomiasis is expected to be high, because infected people releases schistosome egg in their excreta after reaching water the eggs hatches in larvae that infect aquatic snails, where they develop further until they are released as free- swimming in mature parasite (cercariae) that can penetrates the

skin of human host and develop into adult worms. People acquire the infection during the course of bathing, swimming, playing, washing utensils and clothes, walking bare foot during irrigation in agriculture or fishing (CDC, 2009). Although this infection could occur at all age levels, they are most common among teenage years (Vercruysse *et al.,* 2001).

A comprehensive control strategy for schistosomiasis should include: ensuring wide availability of anti-schistosomiasis, ensuring good case management of symptomatic cases; regular treatment of all children at risk, through school and community base initiatives, ensuring safe water supply and adequate sanitation facilities in all schools, ensuring provision of adequate water and sanitation facilities at household/ community level; promoting good hygiene and sanitation practices among school children; caregivers and to the communities (hand-washing, use of latrines; use of footwear) through community capacity development activities (WHO, 2006).

Even though a number of studies were conducted on the distribution of intestinal schistosomiasis in different parts of Ethiopia, there are still many localities for which adequate epidemiological information is not available. Hence, the present study was conducted to fill this existing gap and would enable decision makers to focus on prevalence, intensity and association risk factors of schistosomiasis at Zegie Peninsula, Bahir Dar City Administration, North-West Ethiopia.

General objective

The main objective of this study was to determine the prevalence, intensity and associated risk factors of *Schistosoma mansoni* infections among primary school children in Zegie Peninsula, Bahir Dar City Administration, North west Ethiopia.

Specific objectives were:

1. To determine the prevalence of *Schistosoma mansoni* infection among the primary school children of the study area.

2. To determine the intensity of *Schistosoma mansoni* infection among the school children of the study area.
3. To identify the association major risk factors for *Schistosoma mansoni* infection among school children of the study area.

2. LITERATURE REVIEW

2.1. Aetiology of human schistosomiasis

Intestinal schistosomiasis is caused by blood fluke *Schistosoma mansoni* and infections are acquired by contact with fresh water containing parasite larvae. The disease is hyper-endemic in the Great Lakes region of East Africa, owing to the favorable habitat for snails of the *Biomphalaria* genus, which are the intermediate host (Morgan *et al.,* 2001). The burden of disease caused by schistosomiasis continues to be debated. In 2004, WHO estimated that morbidity caused an equivalent of 1.7 million (WHO, 2008). The disability weight of 0.5% used in WHOs calculations for the average case of infection may be an underestimate; others have estimated greater disability weights (King *et al*., 2005). Schistosomiasis results in severe organ pathology, anemia, malnutrition, stunted growth, impaired cognitive development and reduced capacity to work (King *et al.,* 2008). Chronic intestinal schistosomiasis progresses from abdominal pain and bloody diarrhea to hepatosplenomegaly, portal liver fibrosis and portal hypertension. Urogenital schistosomiasis, which results in haematuria, dysuria, hydronephrosis, calcification of the bladder and other serious sequelae, is also associated with bladder cancer (Parkin, 2008).

Worldwide, the disease is affecting over 200 million people while 500 to 600 million people are at risk of becoming infected and have a mortality rate of 300,000 per year. Among those infected, 120 million are asymptomatic and 20 million have severed clinical diseases (Fitzpatric *et al.*, 2008). *S. haematobium* and *S. intercalatum* infect snails of the *Bulinus species*, while *S. mansoni* infects *Biomphalaria species*. *Bullins* and *Biomphalaria* snails do not breed well outside the tropical environment and thus limit the potential geographical range of *S. mansoni* and *S. haematobium* (Markell, 1988). About 95% of cases are due to *S. mansoni* and *S. haematoblism* infections' and the remainder to *S. japonicum, S. intercalatum* and *S. Mekong* and behavioral determinants of exposure to infection in rural Assam.(Steinmann, 2006).

2.2. *Schistosoma mansoni* Infection

Morphologically, adult male and female schistosoma measures 6-13 millimeters and 10-20 millimeters in length respectively. The schistosomes remain in copula throughout their life span, the uxorious male surrounding the female with its gynaecophoric canal. The male is actually flat but the sides roll up forming the groove. The cuticle of the male is cover with minute papillae. The female only possess these at the anterior and posterior end as the middle section, which is cover by the male body. Oral and ventral suckers are present, with the ventral one being lager serving to hold the worms in place, preventing them carry away by the circulatory current. *S. mansoni* produces 100 to 300 eggs per worm per a day (Jordan *et al.*, 2003).

The adult worms of *S. haematobium* are longer than *S. mansoni*. The adult males and females measure 10-15 millimeters and 16-26 millimeters in length, respectively. *S. haematobium* produces 20 to 300 eggs per worm per day. The ova are relatively large, to *S. mansoni* measuring 110-170 μm in length and 40-70 μm in width. They have an elongated ellipsoid shape with a prominent terminal spine (Jordan *et al*., 2003). The egg of *S. mansoni* has long lateral spine. The adult worms of Schistosoma species differentiate into male and female, but have no body cavity. They develop suckers for attachment to venules. It is transmitted by skin penetration of the infective cercaria during bathing where the water bodies contain this cercaria released from the snail, intermediate host. Reservoirs host for Schistosoma species include monkey, cattle, rodents, dogs, and cats; while Snails are the intermediate hosts in which asexual stage develops. The snail species are specific to each species of *Schistosoma* e.g. *Biomphalaria* for *S. mansoni* (Damtew Feyissa, 2010).

2.2.1. Life cycle of *Schistosoma mansoni*

The life cycle of *S. mansoni* involves a phase of sexual reproduction by the adult schistosomes in definitive host and asexual phase intermediate snail host. The male and female worms of *S. mansoni* live in the veins of the portal system, where they mate and the female start to lay100-300 eggs per day. About 50% of eggs pass the colon, and are excreted in feaces, while some are trapped within the intestinal wall and lead to inflammation,

granulomatous reactions. This results in abdominal pain, blood in feaces. Other eggs are carried away and finally trapped in portal system of the liver and may cause hepatosplenomegaly. In later stage these lesions may result in per portal fibrosis of the liver (George and Mohb, 2000).

Embryonated eggs excreted from the body in urine or feaces and deposit in water hatch to liberate the free-swimming miracidia larvae. The larvae swim seeking a host, attracted by body heat in the water. Larvae can survive up to 48 hours in water but their infectiousness drops after four hours of leaves in the snail. The oral sucker of the larvae attached in human skin. Enzymes assist the parasite to migrate through the epidermis in to the blood stream. In the other ways the worm migrate along the pulmonary, capillary to enter the left side of heart. Schistosomula parasite with a protective shell is carried the arterial blood flow through the aorta to the mesenteric arteries splanchnic capillary and portal veins. Mature in the blood vessels in the liver, they pair with opposite sex (Roberts and Janovy, 2009).

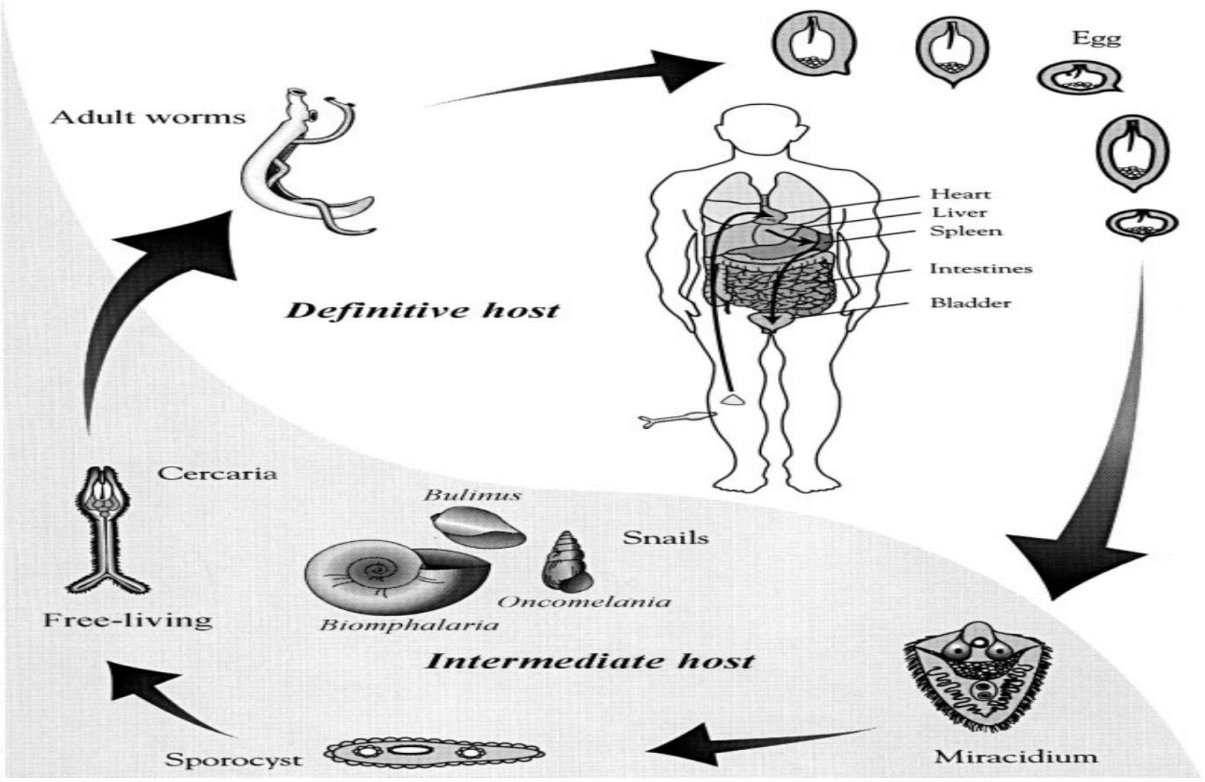

Figure . Life cycle of Schistosoma species (CDC, 2009).

Eggs are released into the water (1). The eggs hatch releasing miracidia (2) which infect fresh water snails (3). Sporocysts migrate to the snail's hepato pancreases (4) and asexually produce free-swimming cercariae (5), which in turn penetrate the skin of humans (6). The cercaria now termed Schistosomula (7) mature in the host (8) and lay eggs. (9, 10) Which are either trapped in the surrounding tissue or are released into the environment via faces and urine (CDC, 2009).

The eggs produced have a definitive lateral spine that aid in identifying S. mansoni from other species during diagnosis. For example, *S. haematobium* has terminal spines on their eggs. When the eggs come into contact with a water source, osmolarity promotes the eggs to hatch and release the mature miracidium from within. This "hatching" action begins by experiencing a change in the pH of the environment. This promotes cilliary action from the miracidium within the egg. A vent opens on the side of the egg allowing the miracidium to emerge (Roberts, 2009).

This process usually takes around 30 minutes to complete. Once within the snail, the ciliated epithelium is shed and mother sporocysts (primary sporocysts) are formed from germ cells of the miracidium. Once the sporocysts are formed in the snail, they develop sensory and digestive organs. The mother sporocysts travel to the digestive gland, and after approximately two weeks daughter sporocysts (secondary sporocysts) are formed through asexual reproduction (CDC, 2009).

2.2.2. Epidemiology

Schistosomiasis is most prevalent in sub-Saharan Africa, where more than 90% are infected (WHO, 2008). About 62% of all cases live in 10 African countries. In the Caribbean Islands and Suriname, endemicity has been reduced by development and ecological changes. In the Bolivarian Republic of Venezuela and in Brazil, transmission continues despite achievements made in controlling the disease (Wang, 2009).

Although ninety species of the genus Schistosoma are currently recognized, the majority are parasites of animals other than humans. Most infections in humans can be accounted by *S.*

mansoni, S. haematobium and *S. japomicum*, together with a minor contribution from *S. intercalcatum* and *S. mekongi* (Gryseels *et al*., 2006b). *Schistosoma mansoni* is the most pathogenic intestinal parasite, which is geographically located in tropical Africa (Sudan, Kenya, Madagascar, South America, Middle East, Brazil, India and Ethiopia), South West Asia, South America and Caribbean Islands; *S. haematobium* is found in Tropical Africa and South West Asia; and *S. japonicum* is previously found in Japan and now mainly in China and Philippines. *S. intercalatum* is found in West Africa; and *S. mekongi* is found around the Mekong River in Asia mostly Laos and Cambodia (Steinmann , 2006).

The study conducted in Brazil, the prevalence of *S. mansoni* was 38.8% and 9.7% and the geometric mean intensity of infection was117.8 EPG and 62.3 EPG, which were found in the rural and urban areas, respectively (Ebrahim *et al*., 1997). The prevalence of *S. mansoni* in school-children in Coted I'voire, boys (59.4%) were significantly more often infected with *S. mansoni* than girls 46.7% (Utizinger, 2000). Among the infected children, the median intensity of boys (156 EPG) was significantly higher than that of girls (108 EPG). One study investigated in Cameroon, the prevalence of *S. mansoni* eggs in stool samples was 54.4% (98 of 180)and the mean ± SD intensity of infection was 100.3 ± 114.7 EPG (Moyou-Somo *et al*.,2003).

Two forms of human schistosomiasis occur in Ethiopia: *S. mansoni* transmitted by *Biomphalaria pfeifferi* and *Biomphalaria sudanica* and *S. haematobium* transmitted by *Bulinus abyssinicus* and *Bulinus africanus* (Laikemariam *et al*., 2005). *Schistosoma mansoni* found at 2000 meters above sea level mainly in the south-west and western part of the Ethiopia, but it was reported from all administrative regions. The major sites are small streams and fresh water lakes. The infection is more common in rural than urban communities and it is more important in developing countries, as are nearly all other parasitic diseases, not solely because of greater dependence on agricultural products produced mostly by irrigation and the fact that most people are engaged in agricultural practices (Tadesse *et al*., 2004). In Ethiopia, the overall prevalence of intestinal schistosomiasis in 2005 is ranging from 15-25% (Damtew, 2010). Study conducted at Jigiga town, *S. mansoni* was identified in 80 households and the overall prevalence rate in the sample population was 37.7% and Jimma town the

prevalence rate in children between 5-15 years of age groups were 28.6% (Tedesse *et al*., 2004).

The overall prevalence of *S. mansoni* infection in Tigray region school children ranged from 5-59%. On the other hand, another survey conducted for *S. mansoni* in the 1992 showed an over- all prevalence of 18.4%. Another survey on *S. mansoni* was conducted in1998. Of 2,078 stool samples in villages near micro dams in Tigray 7.2%, was found to be positive for S. mansoni (Woldemichael and Kebede, 1996). The prevalence (81.3%) of *S. mansoni* infection observed among Demba Girara primary school children of Damot Woide district(Assefa 2013), Wolaita Zone, is in line with the prevalence (82.8%) reported from other parts of Ethiopia (Terefe *et al*., 2011).

2.2.3. Signs and symptoms of intestinal schistosomiasis

Acute schistosomiasis starts with worm maturation and the beginning of egg production. This stage is characterize by chills, fever, headache, dermatitis, eosinophilia, hepatosplenomegally and generalized lymhadenopathy (known as katayama fever). The syndrome is probably due to strong host immune response to large amounts of antigenic materials, which are suddenly released from schistosome worms and eggs (Brunwald *et al.,* 2001).

Clinical manifestations of schistosomiasis occur in three stages. During the first phase of cercarial invasion, a form of dermatitis, so called “swimmer’s itch*”* most often occurs two or three days after invasion as an itchy maculopapular rash on the affected area of the skin. Cercarial dermatitis is a self-limiting clinical entity. In the invasion stage of human schistosome cercariae dermatitis, fever, malaise, cough, and generalized allergic reactions may occur. Secretion, excretions, and breakdown products of cercariae and Schistosomula induce the syndromes. These manifestations frequently occur in tourists infected in endemic areas. In endemic communities, these manifestations are rarely observed (Brunwald *et al.,* 2001). In the established stage, intense egg deposition and excretion takes place. Eggs are primarily responsible for the pathologic changes. Eggs of *S. mansoni* and *S. japonicum* break through the intestinal wall and cause bloody diarrhea (Brunwald *et al.,* 2001).The main clinical manifestations of chronic intestinal schistosomiasis include intestinal and

hepatosplenic disease as well as several manifestations associated with portal hypertension. During the intestinal phase, which may begin a few months after infection and may last for years, symptomatic patients characteristically have colicy abdominal pain and bloody diarrhea, fatigue and growth retardation in children. The Hepatosplenic phase of disease manifests early (during the first year of infection, particularly in children) with enlargement of liver due to parasite induced granulomatus lesion. Moreover, portal hypertension may lead to esophageal varice, splenomegally and ascites. Bleeding from esophageal varices may however be the first clinical manifestation of this phase (Brunwald *et al.*, 2001).

2.2.4. Typical risk factors of *Schistosoma mansoni* infection

Contact with contaminated fresh water is the major risk factor of infection (Jordan and Webbe, 1993). Many other environmental factors influence the distribution, prevalence, intensity of infection, morbidity and mortality of Schistosomiasis (WHO, 1993). Among these are type and size of intermediate snail host population density and behavior in relation to fresh water bodies, climatic and hydrological features. Infection may be constant in endemic areas owing to repeating contact with water, particularly among children. Susceptibility to infection is influenced by genetic factors (Abel *et al.*, 1991), but genetic differences between parasites are not known to influence their infectivity. The absence of health services providing affordable anti schistosomal drug, lack of awareness of schistosomiasis in the population and population movements to endemic areas are additional risk factors (Berhane *et al*., 2005).

The high prevalence of *S.mansoni* infection in developing countries is mainly due to deficiency of sanitary facilities, unsafe human waste disposal system, inadequacy and lack of safe water supply, and low socio-economic status (Ali *et al*., 1999). Immigrants may also be partially responsible for spreading schistosomiasis among the local population Low educational standards and overcrowded living conditions have an effect on the distribution of *S. mansoni* infection. Geographical distribution of schistosomiasis is influenced by the requirements of suitable hosts and condition like animal and insects, soil, irrigation sewage, rainfall, humidity, and temperature. Virulence of *S. mansoni* infection of human being may be

related to several human factors such as, age, sex, occupation, defecation, and habitats (CDC, 2010).

Two forms of schistosomes occur in Ethiopia; intestinal schistosomiasis caused by *S.mansoni* and urinary schistosomiasis caused by *S. haematobium*. The former is widely distributed and transmitted by two freshwater *Biomphalarid species* (*B. pfeifferi* and *B. sudanica*); while the latter is restricted to some low and arid areas of Ethiopia, such as the Awash valley and transmitted by two bulinid species (*B. abyssinicus* and *B. africanus*) (Erko and Tedla, 1993). The geographical distribution of the Schistosomes roughly corresponds to the distribution of susceptible snail hosts, which are present in many tropical and sub-tropical regions. In addition to this temperature and altitude are the main factor for snail host distribution. Temperature appears to be the major factor that affects distribution of Schistosomiasis species in Ethiopia (18^0C - 32^0C). It mainly found at altitude ranging mainly from about 1000m to 2200m and the disease is particularly prevalent in the northern and north-western administrative regions of the country (Birrie *et al*., 1998).

2.3. Diagnosis

The association of signs and symptoms is less clear-cut for *S. mansoni* and *S. japonicum*: other causes must be rule out, especially for diarrhea and bloody diarrhea. Hepatosplenomegaly and splenomegaly, detected clinically by palpation, often occur in high transmission endemic areas, and indicate significant Schistosoma pathology (Kardoff, 1995).

Formol-ether concentration techniques slides chamber with water and dry top and bottom on paper towels. Immediately pipette (using 1 ml syringe or eye dropper) a sample of the suspension and fill both sides of counting chamber. Count all eggs inside of grid areas (greater than 2 of egg inside grid) using low power (10x) objective. Focus on the top layer, which contains the very small air bubbles (small black circles, if numerous large air bubbles are visible, remove the fluid and refill). Count eggs (oval shaped, ~ 80-90 microns long). Once filled, the chambers can sit for no longer than 60 min before counting without causing problems. Longer than this and drying/crystal formation may begin (Ross *et al.*, 2007). Total egg count (both chambers) x 50 = EPG (eggs per gram). After the feces film has cleared, *S.*

mansoni eggs in the entire film count and the number of eggs of each species reported is multiply by the appropriate multiplication factor to give the number of eggs per gram (EPG) of feces. When using a 50 mg template, the multiplication factors is 20; and for a 20 mg template, the factor is 50 (Garcia, 2001). The use of a template holding 41.7mg of feces, and with a multiplication factor of 24. In addition to this Routine, Laboratory Testing using Kato-Katz is other diagnostic method choice (WHO, 2000).

2.3.1. Parasitological test

The best method for diagnosing infection with mature, egg producing adult *S. mansoni* is to demonstrate the presence of eggs in the feces. In routine medical practice, diagnosis is usually quantitative. Then stool sample centrifuged or filtered to concentrate the eggs, while eggs in faecel samples are frequently concentrated by the formal-ether technique. For most epidemiological purpose, however, eggs are counted, although the sensitivity is limited owning to small sample size (Devias and Gryseels 1992).

2.3.2. Kato-Katz method

Kato-Katz techniques are useful for the quantitative estimation of worm burdens (Markell *et al.*, 1999). It is especially useful for field surveys for *S. mansoni* infection since it provides estimates of the intensity of *S. mansoni* infection. The technique entail the examination of a standard sample (determined by the size of template) of fresh faeces pressed between a microscope slide and a strip of cellophane that has been soaked in glycerin.

Kato template, which made from stainless steel, plastic and card board; and they have different sizes produce indifferent countries. A 50mg template has a hole of 9mm on 1mm thick template; a 41.7mg template of 6mm on a 1.5mm thick template; and a 20mg template has a hole of 6.5mm on a 0.5mm thick template (Ibrahim *et al*., 1970).

The Kato technique for examination of faeces for the eggs of schistosoma involves use of glycerin-impregnated cellophane, cover slip over a measured volume of stool, ranging from 1 to more than 400mg light, moderate and heavy infection can be distinguished reliably by the

available faecel examination techniques in study area. The limitation of their sensitivity has been well discovered (Savioli *et al.*, 1990; Devias and Gryseels, 1992).

2.4. Prevention Strategies of Schistosomiasis

2.4.1. Chemotherapeutic treatment

Safe, effective chemotherapy has been available for the past 20 years against all the schistosomes that affect man (WHO, 1993). The most versatile drug Praziquantel, which is effective in a single oral dose against all species schistosomes (and some other trematodes and cestodes). But Praziquantel and oxamniquine, are effective only against *S. mansoni* (Pearce, 2003).

2.4.2. Improved sanitation

Improved sanitation is aimed at controlling transmission by reducing water contamination sanitation is the only definitive intervention to element Schistosomiasis, but to be infected it should cover a high percentage of the population. Therefore, because of the high costs involved implementing this program is difficult where resources are limited. Moreover, when used as the primary means of control, it can take years or even decades for sanitation to be effective (Brooker *et al.*, 2004).

Also Schistosomiasis is considered as diseases of the less developed society characterized by poverty, lacking basic services, awareness and instruction. Particularly, the scarcity of latrines enhances transmission probabilities through indiscriminate defecation habits. Under poor hygienic condition, faeces and urine often enter water body occurring near human habitations and this enhances transmission (Wadood *et al.*, 2005).

Drinking and recreational water includes swimming pools, hot tubs, jacuzzis, fountains, lakes, Rivers, springs, ponds, streams and oceans and it can become contaminated with sewage from humans or animals, therefore physical and chemical treatments of water is essential before it used. Currently there are different groups of drugs available to that giardiasis and other human intestinal protozoan parasitic infections (Gardne and Hill, 2001).

Community and household water treatment systems are the two methods for treating water. A household water treatment system is achieved by boiling, household slow sand filter and domestic chlorination. Community water-treatment system achieved is by storage and sedimentation, up-flow roughing filter, slow sand filtration and chlorination in piped water-supply systems. High concentrations of fluoride can damage bones and teeth during water treatment. Low-cost treatment methods include the Nalgonda system, which uses lime to soften the water, and using alum as a coagulant. With either treatment, the water is then left to settle at the same time it is being chlorinated (WHO, 2000).

2.4.3. Health education

Health education and promotion of healthy behavior can play key role in reducing the incidences of *S. mansoni* infection. However, the effectiveness of those activities in reducing transmission of infection varies according to different reports. In some case, health education can decrease costs, increase levels of knowledge, and decrease re- infection rates. Health educations efforts can builds trust and engage communicate aspect that are crucial to the success of public health initiatives (Lansdown *et al.*, 2002).

2.5. Snail control strategies

The major intervention used to control the disease is treatment with praziquantel, accompanied by the provision of safe water, adequate sanitation and, where possible, snail controls (Gryseels *et al*., 2006; Steinmanm, 2006; Wang, 2009). Treatment for schistosomiasis has been limited by the availability of Praziquantel (Hotez and Fenwick, 2009). Children of school age are the most heavily infected, and treatment targeted at this group prevents future pathology (Kjetland *et al*., 2008). Children can be reached through schools, but the proportion of children attending school is often variable, with girls and children from poorer families being underrepresented. Women of childbearing age are excluded from public-health programmes; WHO recommends that women who are pregnant, lactating or of childbearing age should be offered Praziquantel during treatment campaigns (Allen, 2002).

The intermediate hosts of schistosomes in Africa are fresh water pulmonate snails, which belong to the *Planorbidae* family. The species belong to two genera, namely *Biomphalaria*, host for *S. mansoni*, and *bulinus*, host for *S. haematobium* and *S. intercalatum*. All species of *Biomphalaria* and *Bulinus* are hermaphrodites, possessing both male and female organs in single organism (Sturrock, 1993).

2.5.1. Physical method

Snails tolerate temperatures from 18 -32^{0}C and develop best at a temperature of 25^{o}C. As a rule, snails do not tolerate water velocities higher than 0.7m/s, nor turbulences and wave, and seldom are found in water depth greater than 1.5m, some snail species are adapted to the drying –up of water bodies. Such snails may survive where water is present for only three months in the year. Some species are semi- aquatics and can survive in marshes. They are well adapted irrigation systems, rice fields, and especially to drainage canals and detaches (WHO, 1988).

2.5.2. Biological method

The population of the vector decreases due to predation, competition or “accidental” physical disturbance or damage. Biological control has the advantage over molluscicides in that the reduction in snail populations is of longer duration; it increases the area's ability to withstand re-infection; it is cheaper with respect to management and labor; and it eliminates any chance of toxicity to animal or plant life. The disadvantages are the relatively slow rate of action when compared with the molluscicides, and possible adverse effects of an exotic species on the local aquatic environment (Lee *et al*., 2002).

2.5.3. Chemical method

Snails are very tolerant to dissolved matter in water including chlorides, minerals and salt. They may be found in water of a wide range of p- values (5 to 10). However, water containing barium, nickel or zinc is toxic for snails (Tucker, 2001). Water contamination moderately polluted water with faecal and/or organic plant material is most favorable for the development of snails. The absence of health services providing affordable anti schistosomal drug, lack of

awareness of schistosomiasis in the population and population movements to endemic areas are additional risk factors (Berhane *et al*., 2005).

3. MATERIALS AND METHODS

3.1. Description of the study area

The study was condacted at Zegie Peninsula. It is found in Amhara Regional State, at a distance of 574km North-West of Addis Ababa, the capital city of Ethiopia. It is located 12^0N latitude and 37^0E longitude. It is located on the southern shore of Lake Tana (figure 1). The climate is warm with annual average temperature of 19.6^0c and the mean annual rain fall ranges from maximum of 2086mm to the minimum of 895mm, and the area is found within the elevation 1840m-1999m above sea level.There are thirty-seven islands on the lake shelter. Among these, 19 were Churches and Monasteries, and 15 are peninsula along the shore of the lake. Zegie was one of the largest peninsulas on the lake, still covered with very dense forest and mainly by the endemic plant like coffee. There are two ways of transport system, aquatic and terrestrial. The size of population in Zegie peninsula was estimated above 9325 of these 4498 was males and 4827 were females, (Municipality, 2017).

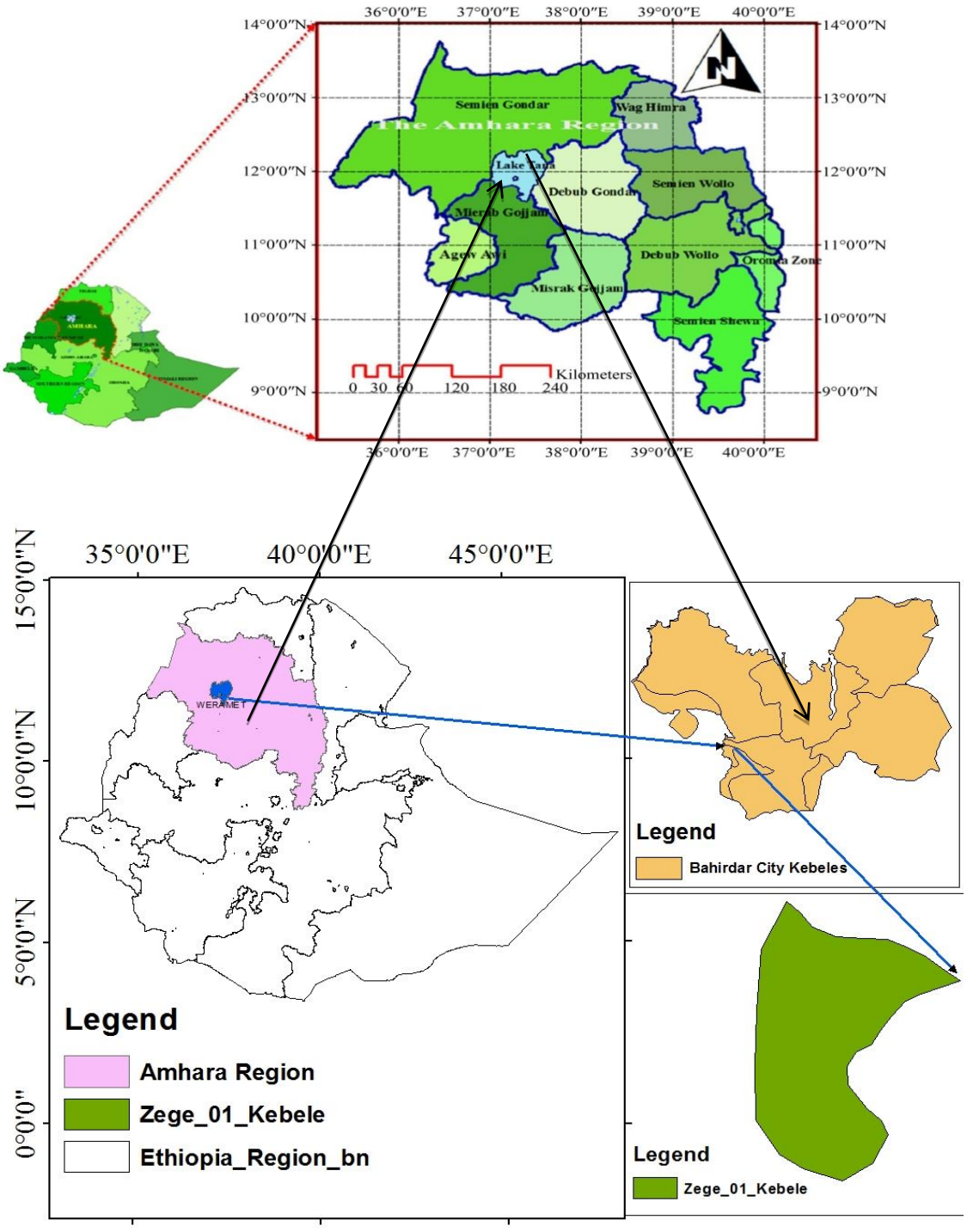

Figure . Map of the study area

3.2. Study Design

School based cross-sectional survey was conducted between Nov-June 2018, to determine the prevalence, intensity and association risk factors of *S. mansoni* infection. The study involves parasitological examinations of stool samples which were processed using formol-ether concentration, direct wet mount techniques and structured questionnaire was also used. The questionnaire was focused on socio-demographic characteristics of respondents such as age, sex, water sources (the place where the people fetch water or washing their clothes, bathing and swimming), and the presence of toilet facility around residential areas.

3.3. Study Population

The study was conducted at Bahir Dar City Administration in Zegie Peninsula. information obtained from the three primary schools in the District (Zegie, Ura and Eganda), the total number of students from grade 1-8 that were enroll in the 2017/2018 academic year was 1946, out of these 947(48.7%) were males and 999(51.3%) were females, respectively. The primary schools were based on their accessibility and their closeness to the water body. Constituted study population of school children and the sample size involved in the present study were summarized in table 1.

Table . Total population of the school children and sample size of the study from the three primary schools, Nov-June 2017/2018.

Name of the primary school	Grade level	Total number of students			Sample population (%)		
		Male	Female	Total	Male	Female	Total
Zegie 1-8	1-8	679	667	1346	141(35%)	138(34.2%)	279(69.2%)
Ura 1-8	1-8	125	183	308	26(6.5%)	38(9.4%)	64(15.9%)
Eganda 1-8	1-8	143	149	292	29(7.2)	31(7.7%)	60(14.9%)
Total		947	999	1946	196(48.7)	207(51.3%)	403(100%)

3.4. Sample Size Determination and Sampling Method

Based on the 95% confidence limits and 5% sampling error, the sample size was calculated using the following formula for the single population proportion (Naing *et al.,* 2007).

$$n = \frac{Z^2 P (1-P)}{d^2}$$

$$n = \frac{(1.96)^2 (0.5)(0.5)}{(0.05)^2} = n=384$$ Where;

n = number of sample size

P= is the proportion of positive individuals (p = 0.5).

d= marginal error between the sample and population (0.05).

Z= critical value at 95% certainty (1.96), considering 5% non-responsive rate.

Since the overall prevalence rate (P) of schistosomiasis is not known the study areas, p was taken to be 50%, for the calculation, a 95% confidence interval (Z) and a 5% margin of error (d) was used. Therefore, 384 school children were considered as the size of the sampled population. To minimize errors arising from the likelihood of non-compliance, five percent of the sample size was added to the calculated sample size. Therefore, four hundred three school-children were chosen to participate in the study.

Stratified random sampling method was applied to get the above sample population. The students were first stratified according to their grade levels (1-8). A proportion was allocated for each grade and each class room. A random sampling technique was employed to select students from each grade and class room by lottery method, based on roster as sampling frame. Sampling with probability; proportional to size of respective schools were used to select study subjects using the master list of each school (Montresor *et a1.*, 1998). The first step was selection of sections from each primary school with proportional allocation to size and the second step was selection of study subjects using simple random sampling /lottery method.

3.5. Data Collection Procedures

3.5.1. Clinical and physical examination

Each participant was examined by health professionals, physical and clinical conditions of the participants were recorded on appropriately designed and developed formats for this purpose.

3.5.2. Questionnaire survey

A questionnaire was developed to obtain socio-demographic characteristics of the study participants such as age, sex, defecation practices, source of water for drinking and other purposes, etc. The questionnaire was prepared in English language and translated into Amharic language (Appendix 1). Five local grade 12 completed students were trained by the investigator to collect the data. The questionnaire was completed before specimen collection. A total of 403 school children from three primary schools were involved in the questionnaire survey.

3.6. Stool Sample Collection

During stool sample collection, the school children were provided with small stool cups and clean wooden applicator stick. And clear instructions on how to collect stool sample was given to the selected participants. Accordingly, each study participant brought about 3 grams of their own stool sample. The name, age and sex of each study participants were registered after the samples were collected and labeled. The samples were taken to laboratory for examination.

3.7. Laboratory Parasitological Examination Procedures

3.7.1. Direct wet mount

With a marker the study identification number was written at one end of the slide and a drop of physiological saline was placed on the center of the slide. With a wooden applicator stick, a small portion of stool specimen (approximately about the size of a match head) was taken and added to the drop of saline and was thoroughly emulsified to make a thin uniform saline suspension not too thick that faecal debris may obscure organisms, and not too thin that blank

spaces may be present. The suspension was carefully covered with a cover slip in a way as to avoid air bubbles. Then the slide was placed on the microscope stage, and the specimen was examined systematically under the low power objective (10x) so that the entire cover slip area was scanned for parasite. The high power objective (40x) was used to see more the detailed morphology of the object for confirmation. Lugol's iodine staining was also done to observe cysts of the intestinal parasites (WHO, 1993).

3.7.2. Formol-ether concentration method

Apportion of observed stool sample were processed by formalin and ether concentration method as described by Ritchie (1948), with some modification. The collected stool was transferred to 15ml of test tube, and then 8ml of 10% formalin and 3ml die ethyl ether was added and shaked for one minute and then centrifuged for two minutes at 200rpm (revolution per minutes). Supernatant was discarded and the residue was transferred to microscope slide to detect the presence of ova using light microscope at the magnification of 10x and 40x.

3.7.3. Microscopic examination

After all samples were collected, a drop of fresh physiological saline was placed on a slide. Using a piece of stick, a small amount of specimen, about 3 mg was mixed with saline solution. By making smooth thin preparation and covering it with a cover glass. Then examined systematically the entire saline preparation for schistosoma eggs using the 10x and 40x objective lens. The number of eggs per gram were counted and classified as light, moderate and heavy intensity of *S. mansoni* infection.

3.8. Data Analysis

The quantitative data generated from clinical, physical examination and questionnaire, were performed using SPSS window version 20 software. Statistical analysis was done using Pearson's chi-square to compare association of *S. mansoni* infection and different risk factors. Bivariate analysis between schistosomiasis and risk factors for transmission of human schistosomiasis was used to calculate the odds ratio. Odd ratio (OR) was used to determine the strength of the association of schistosomiasis with the risk factors. The 95% Confidence

interval was used to show the accuracy of data analysis. The percentage of infected individuals was calculated to express the prevalence of *S. mansoni* by dividing the number of students infected and to the number tested. One way ANOVA for comparing the mean counts of egg in the three age categories. P-value was used verify association between infection and different exposure factors. Values were considered to be statistically significant when the p-value obtained was less than 0.05.

3.9. Data Quality Control

To ensure data quality control, all the laboratory procedures including collection and handling of specimen were carried out in accordance with standard protocols. To ensure general safety, disposable gloves were worn and universal bio-safety precautions also followed at all times (WHO, 1991; NCCLS, 2002). Reagents were checked by known positive and negative samples from the clinic before stool samples preparation and examinations were made. At the end of the day, all the questionnaires were checked for accuracy and completeness by the investigator. All specimens were also checked for their label and quality. The use of different techniques, direct wet mount, formol ether concentration and microscopic stool examination for diagnosis of the *S. mansoni* ensures quality control.

3.10. Ethical Consideration

Ethical clearance paper was obtained from the Research Ethics Review Committee, Bahir Dar City Administration Health Office and District Health Office. The purpose of the study was explained to the school principal, other concerned authorities and school children. The questionnaire concerning the prevalence study was filled during sample collection. Ethical consideration was addressed by treating subject that was positive for *S. mansoni* infection using standard drugs. The written consent was also obtained from the parents of the study subjects and those who were found positive for *S. mansoni* were treated with praziquantel at a single dose(40 mg/kg body weight), (WHO, 2002).

4. RESULTS AND DISCUSSION

4.1. Socio-demographic Characteristics of the Study Participants

The sex and age group of the study participants were given in Table 2. A total of 403 children were participated in this study. Among these, 207 (51.4%) were females and 196 (48.6%) were males. The mean age was 12 years and the age was range from 5 to 18 years.

Most of their parental educational status showed 322 (79.9%) educated and 81(20.1%) were uneducated. Many of the students, 298 (74%) used stream/ lake water for drinking. Only 105 (26%) of the students obtained tap water (Table 2). Majority of the students, 264 (66%) had no access to toilet and would defecate on open field and the remaining 139 (34%) had toilet or defecation site in their indoor house.

The study was consistant with previous report that schistosomiasis was associated with age, latrines and educational level. Most infected children were in age group 10-12 years whose are vulnerable and susceptible to infection because of their poor hygiene and playing habits in the water (Worku *et al*., 2014,). The result of this study showed similar socio-demographic characteristics but contrast in age group.

Of the children, those regularly practiced hand washing after defecation accounts 75.7 % while those not washing their hands after defecation were 24.3 %. These students had a habit of recreating in swimming on Lake Tana/ stream. Thus, children with a habit of swimming were 311(77.7%). The frequency of swimming on Lake Tana/ stream, which were swimming always were 144 (35.7%) and those sometimes swim were 259 (64.3%). More than 86% of the children had body contact with the stream while crossing it and Lake Tana.

Out of 403 children, 54.1% claimed use of stream water or Lake Tana for laundering and the rest 45.9% were not. Majority of the school children (62.5 %) were bath in Lake Tana or streams while the remaining participants consume tap water (37.5%). The result also indicated children those wore shoe regularly were 34.5 % while 65.5 % were bare foot.

The present study of *S. mansoni* prevalence compared to other studies made previously concerning school children in the age groups had similar exposure to the infection as they might have similar water-contact habit. This age-wise similarity in *S. mansoni* infection is consistent with previous findings from established endemic areas in the country (Essa *et al*., 2013). Inhabitants of the area largely depend on water exposed to contamination. Majority of households in the community have toilet but their habit to use toilet was poor and hence open air defecation was observed to be a common practice. Moreover, the low level of education observed in the community and absence of knowledge about schistosomiasis mentioned as a reason for the high prevalence of *S. mansoni* infection (Alebie *et al*., 2014).

Table . Socio-demographic characteristics of the study participants in Bahir Dar City Administration at Zegie Peninsula, North-West Ethiopia from Nov-June, 2018

Risk factors	Category	Number	Percentage
Sex	Male	196	48.6%
	Female	207	51.4%
Parental education	Educated	322	79.9%
	Uneducated	81	20.1%
Water source for drinking	Tap	105	26.1%
	Stream/lake	298	73.9%
Laundering in stream/lake	No	185	45.9%
	Yes	218	54.1%
Bathing situation	Stream (lake)	252	62.5%
	Home	151	37.5%
Swimming habit at any time on lake Tana/	No	92	22.8%
Stream	Yes	311	77.2%
Frequency of swimming on Lake Tana/	Sometimes	259	64.3%
Stream	Always	144	35.7%
Contact of lake while crossing stream/lake	Yes	348	86.4%
	No	55	13.6%
Frequency of crossing stream /lake	Yes	227	56.3%
	No	176	43.7%
Defecation site	Indoor latrine	264	65.5%
	Open field	139	34.5%
Washing hands after defecation	Yes	305	75.7%
	No	98	24.3%
Regular shoe wearing habit	Yes	144	35.7%
	No	259	64.3%

4.2. Prevalence of *Schistosoma mansoni* Infection among School Children

The prevalence of *S. mansoni* infection by age and sex of the three primary schools children were summarized and presented in Table 3. A total of 403 students were participated in this study.The result of the study showed that the prevalence of *S. mansoni* infection in both sexes of school children in age group 5-9, 10-14 and 15-18 years old were 60.6%, 46.1% and 56.3%, respectively. The prevalence of *S. mansoni* infection in males and females school children was 62.7% and 38.1%, respectively. The overall prevalence of *S.mansoni* infection was 50.1% (Table 3).This finding also indicated that children with age group 5-9 were highly affected by *S.mansoni* infection followed by 15-18 and 10-14. This is due to high contact with water body than other age groups. Similar results were reported by (Tadesse *et al*., 2010 and Scot *et al*., 2003).

There was no statistical significant difference in prevalence of *S. mansoni* infection among different age groups in male study participants ($\chi 2 = 1.618$, $p = 0.250$) (Table 3). Similarly, there was no statistical significant difference among different age groups in female school children ($\chi 2 = 0.846$ $p = 0.453$). The prevalence of *S. mansoni* infection determined by Formol-ether concentration methods in this study was 50.1%. This result was comparable to the prevalence of 54.3% obtained among school children in Adarkay District (Jemaneh, 1997), but lower than the finding of Birrie *et al*., (1994) by Kato-Katz which was 66%. The difference could be explained by variation in sampling and also lower prevalence of *S. mansoni* was obtained when compared to data of Zegie 69.7% (Erko and Tedla, 1993). Another study conducted on 1,246 children of 10-12 years old in 32 primary schools in Kenya near Lake Victoria has revealed that the mean prevalence of *S. mansoni* infection was 16.3% with range of 0-80%; and multi parasitism analysis revealed that 63% of the students were infected with one or more helminthes species. *S. mansoni* infection was predominantly light (1-99 EPG) in 67.7% of the infected; with 27. 4% considered moderate (100-399 EPG) and 9.8% considered heavy infection (≥400 EPG). The prevalence increased with each year of age, which is consistent with typical age prevalence curves that peak in early adolescence (Handzel *et al.*, 2003).

The result obtained did not agreed with some findings. For instance, finding from Ravana State demonstrated that the prevalence of *S. mansoni to* be in the age group of 5-9 (2.2%), 10-14 (32.5%), 15-19 (17.1%), 20-29 (13.5%) and ≥ 30 (7.5%) (Pedro *et al.,* 1996). Other report from Brazil also indicated that the peak prevalence in age group 10-14 was dominant (Marcia *et al.,* 1997). According to the study conducted in Bahir Dar town, the peak prevalence of *S. mansoni* in school population and non-school population of both sexes occurred in the age group of 10-14 years (Birhanu *et al*., 1991). Furthermore, it was found that the highest prevalence of *S.mansoni* was seen between the ages of 10-14 years old (Tadesse and Tsehaye, 2010).

The overall prevalence of *S.mansoni* infection observed in the present study was in agreement with previous parasitological study conducted in Gonder (Mengstu, 2010). The prevalence (81.3%) of *S. mansoni* infection observed among Demba Girara Primary School Children of Damot Woide District, Wolaita Zone(Terefe *et al.,* 2011) is in line with the prevalence (82.8%). Other parts of Ethiopia, for insitance Tikur Wuha area, Southern Ethiopia (Mitiku *et al*., 2010), Waja, Northern Ethiopia (Dejenie *et al.,* 2009) and Mekelle City, Northern Ethiopia (Assefa *et al*., 2013).

Table . Prevalence of *Schistosoma mansoni* infection and it's associated with age and sex among the examined school children in Bahir Dar City Administration at Zegie Peninsula, Northern Ethiopia from Nov- June, 2018

Age group	Male		Female		Both sex		$\chi 2$	p-value
	No. exam	No. +ve (%)	No. exam	No. +ve (%)	No. exam	No. +ve(%)		
5-9	55	33 (60%)	32	20 (62.5%)	87	53(60.9%)	2.126	0.080
10-14	128	82(64.1%)	156	49(31.4%)	284	131(46%)	0.80	0.042
15-18	13	8(61.5%)	19	10(52.6%)	32	18(56.3%)	0.260	0.024
Total	196	123(62.8%)	207	79(38.2)	403	202(50.1)		
X^2		1.618		0.846		0.034		
p-v		0.250		0.453		0.843		

M=Male, F=female, T=Total, No. exam=No. examined, No. +ve = No of positive, p-v = p-value

4.3. Intensity of *Schistosama mansoni* Infection

Intensity of *S. mansoni* infection resulted from this study was classified as light, moderate and heavy infection with 34.5%, 12.4% and 3.5% , respectively (Table 4).

The result of this study indicated that the intensity of light, moderate and heavy EPG of *S. mansoni* infection among school children in age group 5-9 were 33.3%, 20.7% and 6.9%, respectively. While the age group 10-14 were light (34.5%), moderate (9.2%) and heavy (2.5%). And also the EPG of age group 15-18 were light (37.5%), moderate (18.8%) and heavy (3.1%). The intensity infection showed that the largest number of infected children (34.5%) had light intensity. The findings are similar to those reported in Ethiopia (Essa *et al.*, 2013, Alebie *et al*., 2014)

The overall prevalence ranged from 3.5% to 34.5% in the study area. Among those whose stools were examined by formol-ether concentration method, prevalence (6.9%) and intensity

(≥400 EPG) were highest in the 5 to 9 years age group followed by (3.1%) prevalence and (≥400 EPG) intensity in the 14 to 18 years of age group and prevalence (2.5%) and intensity (≥ 400 EPG) in age group 10-14.

The severity of the disease in an individual is related to the intensity of infection measured in eggs per gram of stool (EPG). The severity of the disease decrease as the age group increase (Table 3).The finding reported in Zimbabwe 123.58 EPG intensity of *S. mansoni* was observed in a large sugar irrigation estate (Moyo and Taonameso, 2005). Moreover, Marcia *et al.* (1997) also reported 117.8 EPG of *S. mansoni* infection in rural areas of Brazil. The intensity of *S. mansoni* infection in this study was in agreement with the report made from Wondo Genet (Berhanu *et al*., 2002) with 184 EPG. Individuals, who were living in different areas or countries, are not equally infected by *S. mansoni*. The reason could be due to difference of individuals contact to water bodies, socio-economic status of the population, different sanitation practice and different immunity status of the individuals (Girum, 2005).

As indicated in Table 4, the mean±SD intensity of *S. mansoni* infection in the egg count per gram of faeces for males and female's school children were 190.7±1.359 and 265.8±1.847 EPG, respectively. The heaviest infected intensity of *S. mansoni* was observed in the age group of 5-9year was 6.9% (Table 4). This intensity variation might be due to the fact that individuals among the age groups were not equally infected and age group 15-18 years had good knowledge towards different disease. This finding agreed with a study conducted in Bahir Dar City (in residents of Kebele 8, 9 and 10, and Sertse Dengel school-children and Dil Chibo school-children) (Berhanu *et al*., 1991).

Table . Intensity of *Schistosoma mansoni* infection (EPG) among school children by age and sex in Bahir Dar City Administration, at Zegie Peninsula from Nov-June, 2018

Age (year)	No. Examined	Class of intensity No (%)			Male		Female	
		Light 1-99EPG	Moderate 100-399EPG	Heavy >400EPG	Range	Mean ± SD	Range	Mean ± SD
5-9	87	29(33.3%)	18(20.7%)	6(6.9%)	250-400	325±1.3116	260-400	322.5±1.958
10-14	284	98(34.5%)	26(9.2%)	7(2.5%)	100-300	200±1.3994	270-375	300.± 1.870
15-18	32	12(37.5%)	6(18.8%)	1(3.1%)	1-93	47±1.3675	100-250	175±1.718
Total	403	139(34.5%)	50(12.4%)	14(3.5%)	1-400	190.7±1.3593	100-400	165.8±1.8487

4.4. Association of Major Risk Factors among School Children with *Schistosoma mansoni* Infection

The present study assessed the possible association of *S.mansoni* infection with major risk factors among school children. Among the major risk factors explored in the present study were swimming, water source for drinking, contact of lake while crossing stream/lake and regular shoe wearing habit, showed statistically significant association with *S.mansoni* infection identified in the study area (Table 5).

As shown in (Table 5) regression multivariate analysis was done to assess the association between prevalence of schistosomiasis and the selected risk factors. Subsequently, the following variables were found to be associated with prevalence of *S. mansoni* infection using logistic regression analysis: (a) swimming (OR = 37.503, CI =4.187-33.823, $\chi 2$ = 2.106 and P-value = 0.001) (b) Water source for drinking (OR =1.154, CI=13.892-16.037, $\chi 2$ = 105.98 and P-value = 0.000) (c) Contact of lake while crossing stream/lake (OR= 0.007, CI=0.000-

0.110, $\chi 2$= 50.836= p=0.000) (d) regular shoe wearing habits (OR = 0.030, CI=0.004-0.218, $\chi 2$= 18.738 and p= 0.001). As shown in Table 5 significant association (OR = 0.030, CI = 0.004-0.213, $\chi 2$= 18.732 and P = 0.001) between swimming and contacting with *S. mansoni* infection association was observed.

Those individuals who were swimming, were more than three times risk of having schistosomiasis as compared to those who did not swimming. This was due to the fact that during swimming, the whole body would be exposed to cercariae-infected water. Therefore, the chance of individuals infected by cercariae was high. This was comparable to the finding in Ravena (Oswaldo *et al*., 1993) and Sao Paulo (Pedro *et al.,* 1996) and in addition to this, different studies have shown the importance of *S. mansoni* as water borne parasite. In one study conducted in Brazil, prevalence of *S. mansoni* infection was 80.5% and 19.5% in swimming and non-swimming humans, respectively (Cristiano *et al*., 2004). The findings showed that schistosomiasis was significantly associated with practices of swimming/bathing in open water these results are similar to those found in Current status of *S. mansoni* infections and associated risk factors among students in Gorgora town, Northwest Ethiopia, (Essa *et al*., 2013)

Children who drink water from unprotected source such as lake, river, and stream were more likely happened to acquire the *S.mansoni* and association risk factors were (73.9%), than compared with those who drink protected sources of water acquired *S.mansoni* infections (26.1%). This pattern of infection has been confirmed in various studies in the world over (Narain *et al*., 2000). Other children who had drinking water from lake or stream were found to harbor a greater prevalence of infection than those who had access to tap water. In the present study, the variation may arise from contamination of water with animals and human waste that flood into unprotected water sources (Narain *et al*., 2000).

Significant association was found between contact of lake while crossing stream/lake with *S.mansoni* infection (OR= 0.007, CI=0.000-0.110, x^2 = 50.836= p=0.000). Students which had body contact while crossing the stream/lake were more likely to acquire *S. mansoni*

infection. The present study of *S. mansoni* infection associated with crossing lake/stream showed similar result with this finding (Vercruysse *et al.,* 2001;CDC, 2009).

There were significant relation between regular shoe wearing habits and association risk factor with *S. mansoni* infection. The result of the study showed that (OR = 0.030, CI=0.004-0.218, $\chi 2$= 18.738 and p= 0.001). Children who had not wearing shoe frequently were more likely to acquire *S. mansoni* infections (64.3%). Report of WHO in 2007 stated teenager walking in bare foot is most likely affected by *S. mansoni* infection than children wearing shoes (WHO, 2007). Hence the result was consistence with this study.

Table . Association of Major Risk Factors among School Children with *Schistosoma mansoni* Infection in Bahir Dar City Administration at Zegie District from Nov- June, 2018

Variables	Response	*S. mansoni* Yes	No	χ^2	P-value	OR	95% C.I. for OR Lower	Upper
Sex	Male	94	102	0.715	0.467	1.564	0.469	5.203
	Female	108	99					
Age	5-9	0	87	130.041	0.996			
	10-14	170	114		0.998	1.722	5.425	9.342
	15-18	32	0		0.998			
Water source for drinking	Tap	8	99	105.985	.000	1.154	13.892	16.037
	Stream	194	102					
laundering in stream/lake	No	85	100	2.388	.999	1.030	0.0632	1.065
	Yes	117	101					
Bathing situation	Stream	151	101	25.819	.999	1.887	12.001	15.331
	Home	51	100					
Swimming habit at any time on Lake Tana/ stream	No	40	52	2.106	.001	1.503	4.187	33.823
	Yes	162	149					
Contact of lake while crossing stream/lake	Yes	199	149	50.836	.000	.007	.000	0.110
	No	3	52					
Freq of crossing stream /lake	Yes	126	101	6.024	1.000	4.3763	0.000	4.380
	No	76	100					
Defecation site	Indoor latrine	163	101	41.328	.997	1.271	0.000	10.98
	Open field	39	100					
Regular shoe wearing habit	Yes	93	51	18.738	.001	.030	.004	.218

5. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1. Summary

Schistosomiasis, also known as bilharziasis (snail fever), is among the oldest known infections of man. Human schistosomiasis is a water-born parasitic disease caused by five Schistosoma species, each with its own unique epidemiology and geographic range. The objective of the present study was to determine the prevalence, intensity and associated risk factors of *S. mansoni* infection among primary school children of Zagie Peninsula, Bahir Dar City Administration, North West Ethiopia, 2018, who had given stool for laboratory examination from November to June at Zegie Peninsula. A cross- sectional survey study was conducted involving 403 participants were age ranged from 5 to 18.

A total of 403 fresh stool samples of school children were selected from three different age groups, 5-9 years, and 10-14 years and 15-18 years and, the selection was based up on stratified random sampling technique from the three primary schools. Stool samples were collected and examined using standardized parasitological techniques by using direct wet mount and formol-ether concentration method on the fresh collected faeces. Stool samples were taken for microscopic examinations were proceeds in three primary schools of Bahir Dar City Administration at Zegie peninsula. After examining 403 stool samples, the overall prevalence of *S. mansoni* infections among school children was 50.1%.

Socio-demographic characteristics of study participants were associated with risk factors like contact with lake while crossing stream/lake, water source for drinking, frequency of swimming; regular shoe wearing habits were significantly associated with the prevalence of human *S.mansoni* infection. The other socio-demographic like characteristics sex, age and parental/guardians education level were not statistical associated with the prevalence of *S. mansoni* infections in the present study.

5.2. Conclusions

The present study showed that *S. mansoni* was highly prevalent among primary school children in Bahir Dar City Administration at Zegie Peninsula, Northern Ethiopia, 2018. In general, the finding of the present study showed that intestinal Schistosoma parasitic infection was highly prevalent and important health problem of Zegie Peninsula among primary school children.

Contact with contaminated fresh water is the major risk factor of infection. Many other environmental factors influence the distribution, prevalence, intensity of infection, morbidity and mortality of Schistosomiasis. It can be concluded also that, for *S. mansoni* infection transmitted through risk factors such as crossing stream/lake, water source for drinking, frequency of swimming, regular shoe wearing habits are risk factors that increased the prevalence of *S. mansoni*.

Most intestinal *S. mansoni* infections are threatened at public health. The most versatile drug Praziquantel, which are effective in a single oral dose against all schistosomes species (and some other trematodes and cestodes). But Praziquantel and oxamniquine, are effective only against *S. mansoni*.

A source of infection was responsible for schistosoma transmission in the study area and it needs to take immediate measure to eradicate the problem. Therefore, early detection and treatment of this worm was important to improve the health condition of the children.

5.3. Recommendations

Based on the findings of the present study and current literature knowledge of *S. mansoni* and associated risk factors of intestinal parasitic infections, the investigator suggest that health planners and decision makers need to give serious consideration for control of this neglected disease through:

- health education program directed to school children in particular and to the community at general, as it plays a significant role in changing the communities' behavior.
- mass chemotherapy directed against the *S. mansoni* parasite to reduce the worm burden.
- encouraging the community in the Peninsula to protect and keep from polluting the water of Lake Tana and the streams.
- furthermore, in-depth studies should be made on socio-economic factors like, latrine usage, and family income to better evaluate the epidemiology of *S. mansoni* in the area.
- improving school based water sanitation and hygiene programs at the school level and out of school at a community level.

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7. APPENDICES

Appendix . Questionnaire

College of the Natural and Computational Sciences, School of Biological Sciences and Biotechnology

HARAMAYA UNIVERSITY

Thanks for participation to fill the questionnaire

I am a post graduate student from the Faculty of Education School of Biological Sciences and Biotechnology, Haramaya University. I am requesting your child and others to participate in this study which would require his /her response to an interview on some related issues and collection of stool. The information that he/she provide during the interview and the results of the laboratory investigation would be kept confidential.

Dear respondents, the main purpose of this study is to find out the impact of prevalence, intensity and associated risk factor of *S. mansoni* infection among primary school children of zegie peninsula, in Bahir Dar city administration school children it is also very important to create awareness on its prevalence and controlling measure among all concerned bodies. So, this questionnaire helps together information about the status of these infections among the students Bahir Dar City Administration. The result of this study will be submitted to Haramaya University, school of biological science bio technology. Therefore, I kindly request you to give your genuine response for each question. Last, but not least, I would like to thank for your cooperation.

FOR SCHISTOSOMIASIS AND ASSOCIATED RISK FACTORS OF SCHOOL SURVEY

Name of the school _____ Code _____Grade & section_____

1. Age_____ Sex _____ parental/guardians educational status 1.Educated 2. Uneducated

2. From where do you fetch water for drinking? 1. Tap 2. Lake Tana /Stream

3. Is latrine available? 1. Yes 2. No

4. If say No, where do you defecate and dispose faeces?

1. Near the streams/ Lake Tana 2) Open field

5. Do you wash your hands after defecation? 1) Yes 2) No

6. Do you swim in streams during rainy seaso? 1) Yes 2) No

7. How often do you swim in the Lake Tana or stream? 1) Always 2) Sometimes

8. Do you make contact with the stream /Lake Tana while you cross it? 1) Yes 2) No

9. Do you wear shoes? 1) Yes 2) No

10. Do you wash clothes in the Lake Tana? 1) Yes 2) No

11. Where do you bath? 1) Stream or Lake Tana 2) Home Public bathroom

Name of the interviewer _____

Signature_____ Date _____

Checked by investigator _____ signature_____

CONSENT FORM (ENGLISH VERSION)

Participations as volunteer in research under taking.

CONSENT FORM (AMHARIC TRANSLATION)

ለተማሪዎ መረጃ መሰብሰቢያ የተዘጋጁ ጥያቄዎች

ሐሮማያ ዩንቨርሲቲ

ለድህረ- ምረቃ ማሙያ ፁሁፍ የተዘጋጁ ጥያቄዎች

የት/ቤቱ ስም----------

በመጀመሪያለትብብራቹህእያመሰገንኩ፤ይህንንጥያቄበቀናነትናበታማኝነትእንድትሞልልኝበትህት ናእየጠየቅኩየጥያቄውንመልስከታችከጥያቄውጋርበተሰጠውሣጥንየ”ምልክትበማድረግምላሹንእን ድታስቀምጡልኝስጠይቅከምስጋናጋርመሆኑንለመግለፅእወዳለሁ፡፡

1. ተማሪው የሚስጥር ቁጥር	1. ዎታ	2. እድሜ
2. የትምህርት ሁኔታ (የቤተሰቡ)	1. ፊደል የቆጠረ	2.ፊደልያልቆጠረ
3. ለመጠጥ የምትጠቀሙት ውሀ	1. ቧንቧ	2.ይቅሐ/ምንጭ
4. በአብዛኛ ውልብሳቹህን የምታጥቡበት ውሀ	1. ቧንቧ	2.ሀይቅ/ ምንጭ
5. በአብዛኛውገላቹህንየምትታጠቡበትውሀ	1. ቧንቧ	2. ሀይቅ/ወንዝ
6. ጣናየመዋኘትናውሀየመቅዳትልምዳቹህ	1. ሁል ጊዜ	2. አልፎ አለፎ
7. ሽንትቤት የምትጠቀሙት	1.በጉድጓድ/ በተሰራቤት	2. ሜዳላይ
8. ከተፀዳዳቹህ በኃላእጅ የመታጠብባህል	1. የተለመደ	2. ያልተለመደ
9.ሁልጊዜስትጫወቱምይሁንስትሰሩጫማተለብሳላቹህ	1. አዎ	2. አልፎአለፎ

Appendix . Assessment Form for School Environment

1. Name of School _____ Date _____

3. Source of water in school 1) Yes 2) No

4. Type of water source _____

5. Availability of latrines in school 1) yes 2) No

Appendix . Laboratory Procedures

Formol ether concentration technique

i. With an applicator stick, add 1.0 to 1.5g faeces to 10ml formalin in a centrifuge tube, stir, and bring into suspension. Strain suspension through surgical gauze directly into a small beaker and transfer to conical flask.

ii. Add more 10% formalin to the suspension in the tube to bring the total volume to 10 ml. Add 3.0 ml of ether to the suspension in the tube and mix well by putting a rubber stopper in the tube and shake vigorously for 10 seconds.

iii. Place the tube with the stopper removed in centrifuge; balance the tubes and centrifuge at 3000 rpm for 1 minute.

iv. Gently loosen the plug of debris with an applicator stick by a spiral movement and pour off the top 3 layers ether; a plug of fatty debris and a layer of formalin, in a single movement.

v. Return the tube to its upright position and allow the fluid from the side of the tube to drain to the bottom. Tap the bottom of the tube to re-suspend and mix the sediment.

vi. Transfer the sediment to the slide, and cover with cover glass.

vii. Observed under light microscope at10X and 40X magnifications for the presence of ova of the parasites.

Appendix . Probability Values for Chi-Square

Df	0.95	0.90	0.70	0.50	0.30	0.20	0.10	0.05	0.01
1	.004	.016	.15	.46	1.07	1.64	2.71	3.84	6.64
2	.10	.21	.71	1.39	2.41	3.22	4.61	5.99	9.21
3	.35	.58	1.42	2.37	3.67	4.64	6.25	7.82	11.35
4	.71	1.06	2.20	3.36	4.88	5.99	7.78	9.49	13.28
5	1.15	1.61	3.00	4.35	6.06	7.29	9.24	11.07	15.09
6	1.64	2.20	3.83	5.35	7.23	8.56	10.65	12.59	16.81
7	2.17	2.83	4.67	6.35	8.38	9.80	12.02	14.07	18.48
8	2.73	3.49	5.53	7.34	9.52	11.03	13.36	15.51	20.09
9	3.33	4.17	6.39	8.34	10.66	12.24	14.68	16.92	21.67
10	3.94	4.87	7.27	9.34	11.78	13.44	15.99	18.31	23.21

Acceptable ⟵ ⟶ Unacceptable

Appendix . Participants and their laboratory technician