



**ADDIS ABABA UNIVERSITY  
SCHOOL OF GRADUATE STUDIES**

**CURRENT STATUS OF *SCHISTOSOMA MANSONI* AND  
SOIL-TRANSMITTED HELMINTHIASIS IN PRIMARY SCHOOL  
CHILDREN OF ADWA TOWN, NORTHERN ETHIOPIA**

**A THESIS SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES OF  
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**ADDIS ABABA UNIVERSITY  
SCHOOL OF GRADUATE STUDIES**

**Current status of *Schistosoma mansoni* and soil-transmitted helminthiasis in  
primary school children of Adwa town, Northern Ethiopia**

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## **ACRONYMS**

AAU: Addis Ababa University

WHO: World Health Organization

STH: Soil -Transmitted Helminth

EPG: Egg per gram of faeces

SRS: Simple random sampling

GM: Geometric mean

EC: Ethiopian calendar

## **ABSTRACT**

Epidemiological study on public health problem of *Schistosoma mansoni* and soil-transmitted helminthes was carried out between October and November 2007, in 9 primary schools of Adwa town to determine the prevalence, intensity and associated risk factors for *S. mansoni* and soil-transmitted helminthes (STH). Fecal samples of 386 subjects aged 7-18 years, were examined using Kato-Katz and formol-ether concentration methods. A questionnaire was used to obtain socio-demographic information and associated risk factors for *S. mansoni* and STH infections. Data was analyzed using the SPSS statistical software. Both Kato-Katz and formol-ether concentration methods done on the 386 stool specimen revealed that 263(69%) had one or more intestinal parasites. *S. mansoni* infection was the most prevalent (63%), while the prevalence of soil-transmitted helminthiasis was found to be low. The prevalence of *A. lumbricoides* and hookworm infections were (6.4%) and (1%), respectively, whereas no infection of *T. trichiura* was found. Other parasites identified in this study were *S. stercoralis* (0.3%), *H. nana* (8.1%) and cysts of *E. histolytica /dispar* (1.8%). *S. mansoni* and *A. lumbricoides* were found in all age groups; but with no significant difference among the age groups. Intensity of *S. mansoni* and *A. lumbricoides* infection was generally low, except for 5.1% who have high intensity of *S. mansoni* infection. Double infection was found in 4% of the children. An association was not found between socio-demographic variables and STH infection. However, multiple regressions revealed that male gender ( $p<0.05$ , OR=1.72), swimming habit in rainy season ( $p<0.05$ , OR=2.12), and water contact while crossing the stream ( $p<0.05$ , OR=1.85) were significantly associated with *S. mansoni* infection. The high prevalence of *S. mansoni* infection among school children of Adwa town signifies the need for timely control measures in the study area.

Keywords: *S. mansoni*, soil-transmitted helminth, prevalence, intensity, risk factors and Adwa town

## 1. INTRODUCTION

Schistosomiasis and soil-transmitted helminthiasis are chronic and insidious diseases producing long term effect on man (Stephenson *et al.*, 2000). They are caused by parasitic worms belonging to the group helminths. They are one of the most common parasitic infections in the world (Okpala *et al.*, 2004; Montresor *et al.*, 2002). Approximately 300 million people with heavy helminth infection suffer from severe morbidity that results in more than 150,000 deaths annually (Montresor *et al.*, 2002). The infection rate is higher in children (WHO, 2004).

The high prevalence rate of intestinal parasite is attributed largely to low socio-economic status, poor sanitation, inadequate medical care, absence of safe drinking water supplies, climatic condition and lack of knowledge (Tedla, 1986; WHO, 2004; Montresor *et al.*, 1998). The consequence of infection in children may interfere with growth and development and may limit their school achievement. The health effects include anaemia, stunted growth, lower work capacity and increased susceptibility to other infections (Koroma *et al.*, 1996).

Schistosomiasis, also known as bilharzias, is among the six major tropical disease targeted for control while it comes second to malaria as a cause of morbidity in developing countries (Handzel *et al.*, 2003). There are five major species of schistosomes that are able to infect humans. These are *S. mansoni*, *S. japonicum*, *S. intercalatum*, *S. mekongi* and *S. haematobium* (Okpala *et al.*, 2004). The most common STHs are *Ascaris lumbricoides*, *Trichuris trichiura* and the two hookworms (De Silva *et al.*, 2003). Their life cycle follow general pattern, the adult parasite stage inhabit the gastrointestinal tract (*A. lumbricoides* and hookworm in small intestine; *Trichuris trichiura* in colon). They reproduce sexually and produce eggs which are passed in faeces and deposited in external environment (Brooker *et al.*, 2006).

Chronic STH infections resulting from *Ascaris*, *Trichuris* and hookworm can affect physical and mental development in children (WHO, 2002). Hookworms have been recognized as important cause of intestinal blood loss leading to iron deficiency anemia. Because of their underlining poor iron status, children are one of the most susceptible to developing hookworm anemia (Hotez *et al.*, 2004).

The life cycle of *S. 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 worms of *S. 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 (George & Mohb, 2000) which result in abdominal pain and blood in faeces. Other eggs are carried away and are finally trapped in portal system of the liver and may cause hepatosplenomegaly. In a later stage these lesions may result in periportal fibrosis of the liver (George & Mohb, 2000). When the eggs in faeces come in contact with water, the eggs hatch and become ciliated larvae called miracidium.

The miracidium infect the snail intermediate host and produce cercariae. The cercariae which is the infective stage penetrates the skin when human comes in contact with water containing cercariae. The skin penetration produces an allergic dermatitis at site of entry with prior sensitization and a pruritic papular rash occurs (Xiaonong *et al.*, 2002). The cercariae develop to schistosomula. The schistosomula migrates in tissues, blood vessels, the lungs and finally to liver where they develop to adult schistosome. Thus, the transmission of *S. mansoni* is associated with contamination of freshwater with human faeces containing schistosome eggs, presence of snail hosts, *Biomphalaria* species (Okpala *et al.*, 2004) and human contact activities.

Different diagnostic methods that have been developed for determinations of *S. mansoni* infection include clinical symptoms, immunodiagnosis, ultrasonography, parasitological diagnosis. All of these have limitation either in terms of cost, rapidity, simplicity or

applicability for large scale survey. The direct faecal smear lacks sensitivity in the detection of schistosome eggs unless the individual is heavily infected. While formol–ether concentration can detect light infection, it is difficult to apply in field situation and is costly. Similarly, serological method is expensive and not applicable for large scale epidemiological survey. Currently the Kato- Katz thick smear method is considered as a gold standard for diagnosis, especially when repeated specimen are analyzed. This is due to its direct applicability in the field, and owing to the fact that it provides quantitative results enabling diagnosis of STHs (Montresor *et al.*, 1998). Nevertheless, Kato- Katz thick smears also have limitation because collection of specimen is tedious especially in areas with low intensity of infection as repeated examination are needed to obtain reliable data (WHO, 1998).

Different strategies have been used to control schistosomiasis and soil-transmitted helminthiasis. It includes anthelmintic drug treatment, sanitation and health education (WHO, 1998). Periodic deworming (anthelmintic drug treatment) stands out as the most cost effective means to reduce morbidity of schistosomiasis and STH infection. The recommended drug to control STH infection are albendazole (single dose 400mg) and mebendazole (single dose 500mg) (WHO, 2002) and praziquantel (single dose 40mg/kg) for schistosomes (Colley *et al.*, 2001). Other control measures for schistosomiasis include control of the intermediate host snail.

### **1.1. Statement of the problem**

Water-based development schemes being initiated in several areas and population mobility for the settlement and job opportunities (Woldemichael & Kebede, 1996; Erko *et al.*, 1997) may have an impact on the epidemiology of *S. mansoni* in Ethiopia. Several epidemiological studies were conducted in Adwa in the 1960s and 1970s (Lemma *et al.*, 1975). The latest study conducted in the area was in the early 1990s (Birrie *et al.*, 1994). Nevertheless, there has been no current epidemiological information on schistosomiasis and STHs in the area. Therefore, there is a need to generate current epidemiological data on the magnitude of *S.*

*mansoni* and soil-transmitted helminth infections to enable decision on the control of these neglected but poverty promoting diseases.

There are several reasons for conducting the survey in this age group, children consistently have highest prevalence and transmission of schistosomiasis and soil transmitted helminths (except hookworm); treatment via schools is feasible (Guyatt, 2003) and cost effective.

Health strategy for attainment of effective parasitic disease control programs demand knowledge of magnitude of the disease and their changes in course of time as related to ecological, cultural, behaviour and other factors. Hence, the present study provides epidemiological information on prevalence and intensity of infections as well as on associated risk factors among school children of Adwa town, Northern Ethiopia. The information obtained from this study is believed to serve as a baseline data for the future intervention.

## **1.2. Significance of the study**

The study provides current epidemiological information on *S. mansoni* and soil-transmitted helminth infections of human among primary school children of Adwa town. The study enables decision makers to institute appropriate intervention program in the town. In addition, the data obtained is useful for further research study.

## 2. LITERATURE REVIEW

*Schistosoma mansoni* and soil-transmitted helminthiasis are the most widely distributed parasitic infections, especially in areas of poverty in developing world. Recent global prevalence estimate show that *S. mansoni* infects 67 million, *A. lumbricoides* 1.221 billion, *T. trichiura* 795 million and hookworm 740 million people globally (De Silva *et al.*, 2003).

In 75 randomly selected households examined for *S. mansoni* and STH in rural community of rural Côte d'Ivoire, the respective prevalence of infection for *S. mansoni*, hookworm, *T. trichiura* and *A. lumbricoides* was found to be 39.8%, 45%, 6% and 2%, respectively, with difference in prevalence of infection only for hookworm (53.8% for males and 36.3% for females) (Raso *et al.*, 2004). In the study conducted in primary schools in Malaŵi, the prevalence of *S. mansoni*, hookworm, ascariasis, trichuriasis was found to be 0.4%, 1.3%, 0.5% and 0%, respectively. The intensity of infection was also low for this study (Bowie *et al.*, 2004). In another study conducted in south eastern Nigeria, the prevalence of *A. lumbricoides* infection was 10.8% followed by hookworm 4.3%, *T. trichiura* 1.2% and *S. stercoralis* 0.6%, with more males infected than females (Chigozie *et al.*, 2007).

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 multiparasitism analysis revealed that 63% of the students were infected with one or more geohelminth. *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 ( $\geq 400$  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).

In Ethiopia, a number of surveys carried out on *Schistosoma mansoni* and soil transmitted helminthiasis have shown that the helminthic infections are a major public health concern. One of the main reasons why people seek medical attention in Ethiopia is intestinal parasitoses (Shibru, 1989).

Most areas affected by *S. mansoni* in Ethiopia are rural farming villages at intermediate altitudes depending on rain-fed agriculture that are located near the many perennial streams (Woldemichael and Kebede, 1996). Dependence of more than 90% of rural house holds on these and other potential infective surface water in absence of safe water supplies and sanitary facilities puts the great majority of the population at risk of infection. The absence of health services providing affordable antischistosomal drug, lack of awareness of schistosomiasis in the population and population movements to endemic areas are additional risk factors (Berhane *et al.*, 2005).

Schistosomiasis has a focal distribution in Ethiopia (Kloos *et al.*, 1978). Temperature appears to be the major factor that affects distribution of schistosomiasis species in Ethiopia. It is mainly found at altitudes ranging mainly from about 1000 to 2200m and the disease is particularly prevalent in the northern and northwestern administrative regions of the country (Kloos *et al.*, 1978; Birrie *et al.*, 1998).

Several studies made on schistosomiasis in Ethiopia shows that relationship exist between prevalence of schistosomiasis and sex, (Polderman, 1974). Prevalence rates are generally higher in males than females (Birrie *et al.* 1994; Assefa *et al.* 1998; Tadesse, 2005). Moreover, Results of epidemiological studies in different parts of Ethiopia shows the

characteristic clustering of schistosomiasis cases, including heavy excretors of ova, among school children (Birrie *et al.*, 1994; Woldemichael and Kebede, 1996; Jemaneh, 2000).

Specific occupation influences the prevalence and intensity of schistosomiasis. Occupational groups having intensive contact with water bodies including farmer, daily laborers, tala (local beer), and servant, have generally higher rates of infection than housewives, office clerks, artisans, and technicians (Polderman, 1974).

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 *et al.*, 1997).

The Prevalence rate of 93% among felasha immigrants in Israel has been the highest ever reported in Ethiopia. Among the common intestinal parasite *S. mansoni* has been recorded from all regions and about 19 million people are assumed to live at risk of infection (Assefa *et al.*, 1998). A country-wide survey conducted by Tedla (1986) reported that over 70% of the population harboured at least one parasitic helminth, 2 to 6% harboured 3 or 4 parasitic helminths and about 0.1% harboured six parasitic helminths, the overall prevalence of ascariasis, trichuriasis and hookworm infection being 57.1%, 36.1% and 9.8%, respectively.

In surveys conducted in twelve elementary schools in the Dembia plains, Northwest Ethiopia, infection due to *A. lumbricoides* was registered in all school among children and was the most prevalent (41.3%) followed by *S. mansoni* (35.8%), the hookworm (22.8%) and *T. trichiura* infection (16.5%). Infection was found in all age and appears to increase with age in schistosomiasis and ascariasis. The intensity of infection was generally higher for *A. lumbricoides* and *S. mansoni* (Jemaneh, 1998).

In the epidemiological study of intestinal helminthes infection in Lake Zway Islands in central Ethiopia 56.7% were found to harbour one or more kinds of intestinal helminthes. In this study higher prevalence of *T. trichiura* (46.2%), low prevalence *A. lumbricoides* (4.1%) and almost total absence of hookworm (<1%) was found (Tefamichael and Teklemariam, 1983).

In recent epidemiological study conducted in Wondo Genet area, South Ethiopia, Erko & Medhin (2003) reported the prevalence of *A. lumbricoides* and *T. trichiura* infections among school children to be 83.4% and 86.4% respectively, and the respective intensity of infection to be 7,343 EPG and 461 EPG.

According to Ye-ebiyo (1992), the overall prevalence of *S. mansoni* infection in Tigray region schoolchildren ranged from 5-59% and that of STHs was about 22%. On the other hand, another survey conducted for *S. mansoni* in the region between 1992-93 showed an over- all prevalence of 18.4% (Woldemichael & Kebede, 1996). Another survey of *S. mansoni* and STHs was conducted in 1998. Of 2,078 stool samples in villages near microdams in Tigray 7.2%, 2.3%, 2.4% and 8.9% were found to be positive for *S. mansoni*, *A. lumbricoides*, *T. trichiura* and Hookworm respectively (Alemayehu *et al.*, 1998).

The epidemiological study of Adwa, Northern Ethiopia Buck *et al.*, 1965 reported the over all prevalence of *S. mansoni* 61% and that of STH infection 71%, 3.7%, 34.9% for *A. lumbricoides*, hookworm and *T. trichiura* respectively.

An epidemiological study done on *S. mansoni* in Tigray and north Wello was conducted in 1992 in six schools accessible by roads. The overall prevalence ranged from 1% in Maychew to 61.8% in Adwa. Among those whose stools were examined by Kato method in Adwa town; prevalence (68%) and intensity (597EPG) were highest in the 10 to 14 years age group followed by (64%) prevalence and (591EPG) intensity in the 15 to 19 years of age respectively (Birrie *et al.*, 1994). Considering diverse geographic nature of the Tigray region

it is highly likely that variation in the magnitude of these intestinal helminth infections occurs.

Helminths control strategies require adequate awareness of the epidemiology on large scale and the changes in time (Jemaneh, 1998). Thus, this study addresses the prevalence of *S. mansoni* and soil-transmitted helminth parasites with respect to prevalence, intensity and associated risk factors among primary school children of Adwa town, Tigray region, Northern Ethiopia.

### **3. OBJECTIVES OF THE STUDY**

#### **General Objectives**

- To determine the current status of Schistosomiasis and soil-transmitted helminthiasis among primary school children of Adwa town, Northern Ethiopia.

#### **Specific Objectives**

- To determine the current prevalence of *S. mansoni* and soil-transmitted helminth infections in school children of Adwa town
- To determine intensity of *S. mansoni* and soil-transmitted helminth infection

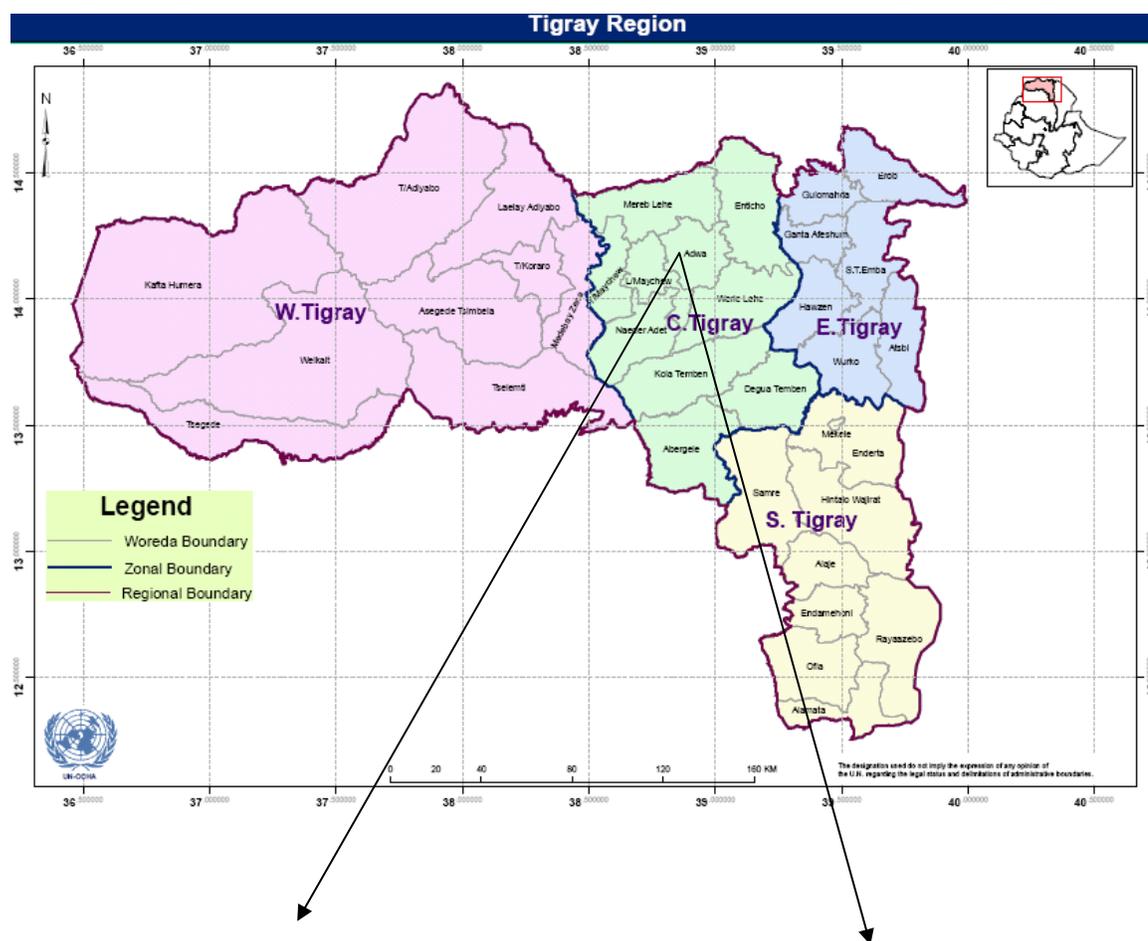
- To compare intensity and prevalence of *S. mansoni* and soil-transmitted helminth infection
- To assess associated risk factors of *S. mansoni* and soil-transmitted helminth infection

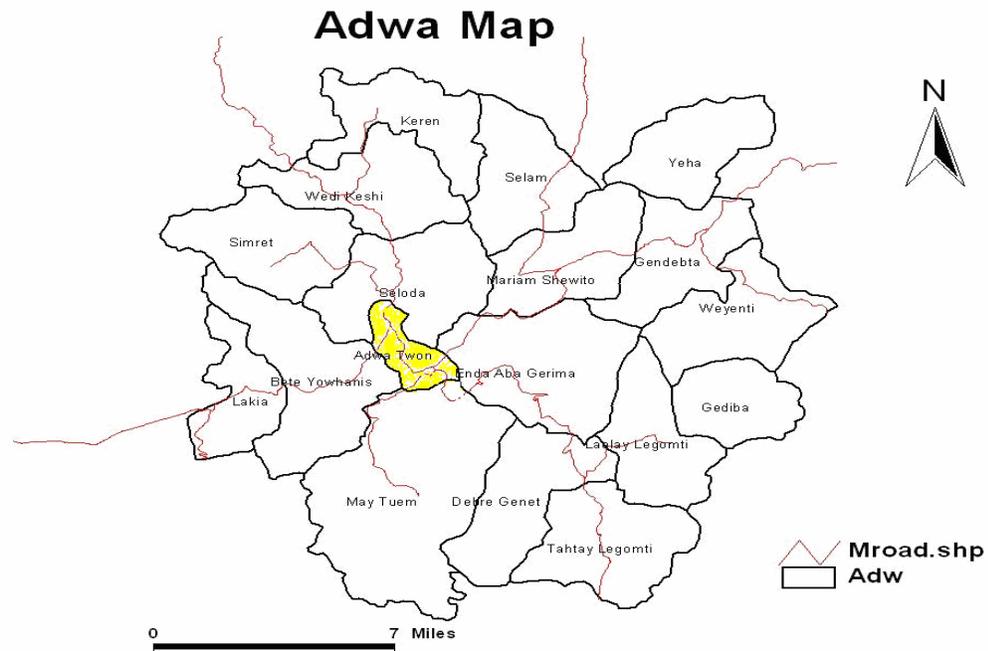
## **4. MATERIALS AND METHODS**

### **4.1. Study area and population**

The study was carried out during October and November 2007 in the town of Adwa, mountainous area located in northern Ethiopia. It is located in Northern part of Ethiopia at a distance of 1006 km away from Addis Ababa (Birrie *et al.*, 1998), at an altitude range of 1800-1900 meters above sea level. The annual rainfall is between 500mm and 600mm, reaching its peak from July to August. The temperature is warm and ranges from 27°C to 28°C. (Data obtained from Adwa district Meteorology department). The area is traversed by streams and rivers which constitute major source of *S. mansoni* infection and it is known as endemic area for intestinal schistosomiasis (Buck *et al.*, 1965). The population have a habit of swimming in rainy season as the rivers decrease their volume in dry season.

Adwa Woreda covers a total area of 646.78 sq.km (Figure 1) and Adwa town had a population of approximately 46,645 inhabitants in 2006 of whom 22,737 were males and 23,908 were females (CSA, 2007). The study population included children attending grade one to eight at nine primary schools.





**Figure1.** Map of Adwa town, Tigray Region.

Source: Top, Tigray Region ([www.ocha-eth.org/Maps/downloadables/TIGRAY.pdf](http://www.ocha-eth.org/Maps/downloadables/TIGRAY.pdf)).  
 Bottom, Adwa Town (Tigray finance and economic development bureau).

#### 4.2. Study design

A cross sectional study was conducted in Adwa town to study the prevalence of *S. mansoni* and soil-transmitted helminth infection.

#### 4.3. Sample size and sampling technique

Sample size was determined based on the previous prevalence (66%) from a study done in Tigray (Birrie *et al.*, 1994). The minimum sample size required at analysis stage was calculated using the 95% confidence interval with 5% margin error. Additional 10% was allowed for non response. The statistical formula applied for determining the sample size was:

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

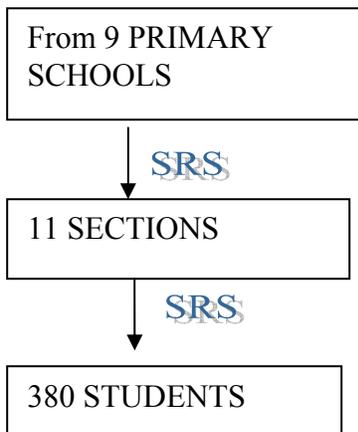
Where,  $N$  = the minimum sample size required

$Z = 1.96$  at 95% confidence interval

$d^2 =$  is margin of sampling error tolerated (5% marginal error was used)

$P =$  an estimate of the prevalence rate for the population

Based on the above formula 380 sample size was determined formerly; however, because of excess material the data collectors included six additional students increasing the sample size to 386. Sampling with probability proportional to size was used to select study subjects using the master list of each school (Montresor *et al.*, 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.



#### 4.4. Study variable

The independent variables were: age, sex, religion, availability of latrine, shoe wearing habit, water source for (drinking, cooking, washing cloths, bathing), habit of swimming, number of water contact and cleanliness of finger nail. The dependent variables were: prevalence and intensity of schistosomiasis mansoni and soil-transmitted helminthiasis.

#### 4.5. Data collection

##### Questionnaire

A questionnaire was developed to obtain information such as age, sex, source of water for drinking and other purposes, defecation practices etc. The questionnaire was prepared in English, and translated into Tigrigna (Appendix IV). Four local 12<sup>th</sup> grade students were trained by the investigator on how to interview the students and to fill the questionnaire. The questionnaire was completed before specimen collection and at the time of conversation, interviewers also inspected whether the fingernails of the students were trimmed or not. At the end of their interview observation was made on the availability of latrine and water in each school.

A total of 386 schoolchildren enrolled in grades 1 to 8 from nine primary schools were interviewed. The schools were May Guagua (50 students), Adi maheleka (46 students), Adwa (51 students), May tsadik (63 students), Tsion (63 students), Adi Abeto (46 students), Soloda (39 students), Haleka Teweldemedhine (23 students) and Assefa Mamo (5 students).

### **Parasitological techniques**

Following the questionnaire, the children were supplied with plastic sheet, applicator stick, and soft paper; instructed to bring proper stool sample. A single stool specimen was collected from each student. A portion of the stool sample (about 1-2gm) was collected in labeled screw capped vials pre-filled with 10% formalin. In addition, a portion of the specimen was processed using 41.7mg Kato-Katz template (WHO, 1991), examining two slides per stool sample.

After clearing the slides for 30-45min they were examined using the light microscope by one of the three experienced laboratory technicians for the presence of hookworm ova, and second reading was done for the presence of ova of *S. mansoni*, *A. lumbricoides*, and *T. trichiura* a day after, in Adwa clinic laboratory. Twenty percent of the total slides were re-read after one month by a second experienced laboratory technician in Tigray Regional Health Bureau. The preserved fecal specimens were transported to the laboratory where they were processed using formol ether concentration technique and screened by the experienced technicians under light microscope in two weeks of collection.

#### **4.6. Quality control**

Before the commencement of the survey a day was spent evaluating the consistency of egg counting among laboratory technicians with that of the principal investigator. Each day during the survey the principal investigator read 10% of the slides of each laboratory technicians. Reagents were checked by known positive and negative samples from the clinic before stool sample preparation and examination. 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. For quality control purpose 20% of the total slides were randomly selected and read by a second experienced laboratory technician in Tigray Regional Health Bureau. The use of two different techniques Kato Katz and formol- ether concentration for diagnosis of the parasite also ensures quality control.

#### **4.7. Data analysis**

Data entry was performed in EpiInfo Version 5.0 statistical package. Then it was exported to SPSS 11.0 for windows for statistical analysis. For quantitative assessment, the eggs per gram of stool (EPG) was obtained by multiplying the number of eggs by 24 (Kato slides delivering 41.7 mg of stool plug). The intensity of infection was expressed as geometric mean. Egg count results were reported as light, medium and heavy. Accordingly, an egg count of 1–99, 100–399 and  $\geq 400$  EPG was considered light, moderate and heavy infection for *S. mansoni*, and 1–4,999, 5000–49,999 and  $\geq 50,000$  EPG as light, moderate and heavy infection for *A. lumbricoides* (WHO, 1987). P-value less than 0.05 was considered as statistically significant. Associations were investigated by fitting logistic regression model for *S. mansoni* and STH. Risk factors were calculated with 95% confidence interval. Odds ratio was used to determine the strength of association between the independent variables and the dependent variable.

#### **4.8. Ethical consideration**

Prior to the commencement of the study, the project obtained ethical clearance from the ethical clearance committee of the Department of Microbiology, Immunology and Parasitology (DMIP), and Faculty Research and Publications Committee (FRPC). Permission was also obtained from Tigray Regional Health Bureau, local education authority of the schools to conduct the study. Prior to stool collection, the objective of the study and procedure of sample collection were explained to school teachers and students. 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). Children who were found positive for STHs were also treated with albendazole (400mg). *H. nana* infection was also treated with praziquantel, in single oral dose of 40 mg/kg body weight in collaboration with local nurse.

#### **4.9. Dissemination of findings**

The findings of this study will be disseminated to Department of Microbiology, Immunology and Parasitology, Addis Ababa University, Tigray region Health Bureau, Adwa Town Health Center Administration. The findings will be also disseminated to different organizations that will have a contribution to improve the status *S. mansoni* in the town. Findings will be published in a scientific journal.

## **5. RESULT**

### **5.1. Questionnaire result**

Out of the total 386 school children Assefa Mamo students were excluded from analysis as they are only five students. Among the selected students, 167 (43.8%) were males and 214 (56.2%) were females. The mean age was 11.73 years and the age range was 7 to 18 years.

The minimum duration of stay was one year and majority of them were born and have lived in the area. Regarding religion, Orthodox Christian took the highest percentage [348 (91.3%)]. Most of the students 357(93.7%) used tap water as source of water for drinking and cooking. Only 6.3% of the students obtained water for this purpose from stream (Table 1), fourteen (58.3%) of them making two trips per day.

Most of the students 280(73.5%) had toilet in their house. The remaining 101 (26.5%) had no access to toilet and would defecate in open field. Regarding schools it was observed that one of the primary schools, Haleka Teweldemedhine, had no latrines but all the schools had tap water. Ninety percent of the children regularly practiced hand washing after defecation. About 75.6% of the children had trimmed finger nails.

During rainy season, 287 students (75.3%) swam in streams. 133 (46.3%), and 154 (53.7%) swam frequently and sometimes respectively. More than four-fifth (82.4%) of the children (n=314) had body contact with the stream while crossing it.

Out of the 381 children interviewed, 24.7% claimed use of stream water for washing cloths in Assem stream (8.5%), Guagua stream (22.3%) and other streams (69.1%). Majority of the students (94%) bath in households water pipe, while the remaining 23 (6%) of the total children bath their body in streams. All the children wore shoes regularly, (19.7%) wore protected shoes while (80.3%) wore sandal type.

**Table 1.** Proportion for risk factors of intestinal parasites of the study population of Adwa town, Northern Ethiopia 2007

Variables	Frequency	
	N	%
Age Group: <b>5 to 9</b>	<b>47</b>	<b>12.3</b>
<b>10 to 14</b>	<b>307</b>	<b>80.6</b>
<b>15 to 19</b>	<b>27</b>	<b>7.1</b>
Sex : <b>Male</b>	<b>167</b>	<b>43.8</b>
<b>Female</b>	<b>214</b>	<b>56.2</b>
Religion : <b>Muslim</b>	<b>33</b>	<b>8.7</b>
<b>Christian</b>	<b>348</b>	<b>91.3</b>
Water source for drinking & cooking: <b>Tap</b>	<b>357</b>	<b>93.7</b>
<b>Stream(A,G,O)</b>	<b>24 (0,1,23)</b>	<b>6.3(0,4.2,95.8)</b>
Laundering in streams: <b>Yes (A,G,O)</b>	<b>94(8,21,65)</b>	<b>24.7(8.5,22.3,69.1)</b>

	<b>287</b>	<b>75.3</b>
Bathing: <b>Home</b>	<b>358</b>	<b>94</b>
<b>Stream (A,G,O)</b>	<b>23 (3,4,16)</b>	<b>6(13,17.4,69.6)</b>
Swimming habit in rainy season: <b>Yes(A,G,O)</b>	<b>287(19,96,172)</b>	<b>75.3(6.6,33.5,59.9)</b>
<b>No</b>	<b>94</b>	<b>24.7</b>
Freq of swimming: <b>Always</b>	<b>133</b>	<b>46.3</b>
<b>Sometimes</b>	<b>154</b>	<b>53.7</b>
Contact of river while crossing stream : <b>Yes</b>	<b>314</b>	<b>82.4</b>
<b>No</b>	<b>67</b>	<b>17.6</b>
Freq of crossing stream: <b>Always</b>	<b>72</b>	<b>22.9</b>
<b>Sometimes</b>	<b>242</b>	<b>77.1</b>
Defecation site: <b>Indoor latrine</b>	<b>280</b>	<b>73.5</b>
<b>open field</b>	<b>101</b>	<b>26.5</b>
Washing hands after defecation: <b>Yes</b>	<b>343</b>	<b>90</b>
<b>No</b>	<b>38</b>	<b>10</b>
Shoe wearing habit: <b>Protected</b>	<b>75</b>	<b>19.7</b>
<b>Unprotected</b>	<b>306</b>	<b>80.3</b>
Finger nails trimmed: <b>Yes</b>	<b>288</b>	<b>75.6</b>
<b>No</b>	<b>93</b>	<b>24.4</b>

A= Assem stream; G= Guagua stream; O= other streams

## 5.2. Prevalence and intensities of *S. mansoni* and *A. lumbricoides* infection

Results of Kato-Katz and formol-ether concentration methods were obtained for 386 school children. The stool samples of six students were not processed by Kato-Katz technique as they provided loose stool but were processed by formol-ether concentration technique. Pooling the results of the two diagnostic approaches increased the prevalence for both *S. mansoni* and STH infection. Table 2 displays the overall prevalence of sex related difference of each parasite investigated.

**Table 2.** Prevalence of intestinal parasites based on Kato-Katz and formol-ether concentrations among Adwa town school children, Northern Ethiopia 2007

<i>Parasite species</i>	<b>No. positive (%)</b>				
	<i>Kato-Katz smear</i>	<i>Formol-ether concentration</i>	<i>Combined results</i>		
			<b>Male (n=167)</b>	<b>Female (n=214)</b>	<b>Both sex (n=381)</b>
<i>S. mansoni</i>	220 (58.7)	234 (60.6)	118 (70.7)	122 (57.0)	240 (63.0)
<i>A. lumbricoides</i>	24 (6.4)	23 (6.0)	12 (7.3)	12 (5.7)	24(6.4)
<i>Hookworm sp.</i>	0 (0.0)	4 (1.0)	1 (0.6)	3 (1.4)	4 (1.0)
<i>H. nana</i>	10 (2.7)	25 (6.6)	14 (8.4)	17 (7.9)	31 (8.1)
<i>S. stercoralis</i>	0 (0.0)	1 (0.3)	0 (0.0)	1 (0.5)	1 (0.3)
<i>E. histolytica / dispar</i> cyst	0 (0.0)	7 (1.8)	5 (2.9)	2 (0.9)	7 (1.8)

Of the total 381 children examined, about 263 (69%) were found positive for various intestinal parasites (after pooling the results of the two diagnostic approaches). The dominant parasite was *S. mansoni* with prevalence of 63%. Males were more infected with *S. mansoni* than females, 70.7% versus 57% ( $p < 0.05$ ). The number of school children with detectable soil-transmitted helminth infection was low. Twenty-four (6.4%) children had *A. lumbricoides* and four children (1.0%) had hookworm with no significant sex difference. There was no single case of *T. trichiura* infection. Other parasites encountered in this study were *S. stercoralis* 0.3%, *H. nana* 8.1% and cyst of *E. histolytica / dispar* (1.8%).

As shown in Table 3, *S. mansoni* infection was encountered in all schools. The highest prevalence of *S. mansoni* infection was reported for Tsion 43(70.5%) while the lowest 10(20%) was reported for Adwa. On the other hand, infection due to *A. lumbricoides* was found in six of the eight schools but much lower than *S. mansoni* infection, with prevalence ranging from (1.6%) in Tsion to (14.0%) in May Guagua. The intensity of *S. mansoni* infection ranged from 57.3 EPG in Soloda to 141.6 EPG in Adi Abeto. Likewise the intensity of *A. lumbricoides* infection ranged from 22.3 EPG in Soloda to 1051.6 EPG in Haleka Teweldemedhine. The intensity of hookworm infection was not analyzed since the diagnostic technique is not absolutely reliable for quantification of hookworm eggs.

**Table 3.** Prevalence and intensities of *S. mansoni* and ascariasis based on Kato-Katz in 8 elementary schools of Adwa town, Northern Ethiopia 2007

School	No. examined			Positive for			
	Male	Female	Total Examined	<i>S. mansoni</i> No. (%)	EPG	<i>A. lumbricoides</i> No. (%)	EPG
May Guagua	28	22	50	33 (66)	108.2	7 (14)	27
Adi Maheleka	22	24	46	31 (68.9)	110.8	2 (4.4)	38
Adwa	26	25	51	10 (20)	134.4	0 (0)	0
May Tsadik	26	37	63	36 (57.1)	71	8 (12.7)	91.6
Tsion	23	40	63	43 (70.5)	109.8	1 (1.6)	600
Adi Abeto	18	28	46	26 (56.5)	141.6	0 (0)	0
Soloda	13	26	39	27 (69.2)	57.3	4 (10.3)	22.3
HalekaTewelde medhine	11	12	23	14 (66.7)	73.8	2 (9.5)	1051.6
<i>Total</i>	165	210	375	220 (58.7)	95.8	24 (6.4)	62.4

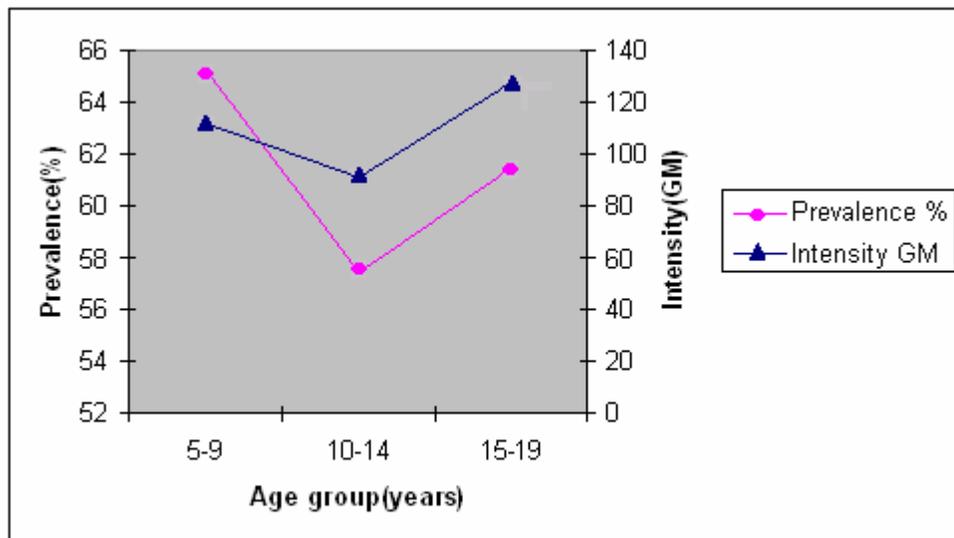
Analysis of age specific prevalence of infection of *S. mansoni* and *A. lumbricoides* (Table4) showed the presence of infection in all age groups with no marked difference in prevalence of infection of *S. mansoni* ( $p > 0.05$ ), while *A. lumbricoides* appears to be more aggregated in the 5-9 year age group.

**Table 4.** Prevalence of *S. mansoni* and *A. lumbricoides* based on Kato-Katz among different age groups of the residents of Adwa town, Northern Ethiopia 2007

Parasite Species	No.(%) of infected children by age group (years) & sex								
	5-9 (n=46)			10-14 (n=303)			15-19 (n=26)		
	M	F	T	M	F	T	M	F	T
Sm	20 (76.9)	10 (50)	30 (65.2)	85 (67.5)	89 (50.3)	174 (57.4)	7 (53.8)	9 (69.2)	16 (61.5)
Al	4 (15.4)	1 (5)	5 (10.9)	8 (6.3)	10 (5.6)	18 (5.9)	0 (0.0)	1 (7.7)	1 (3.8)

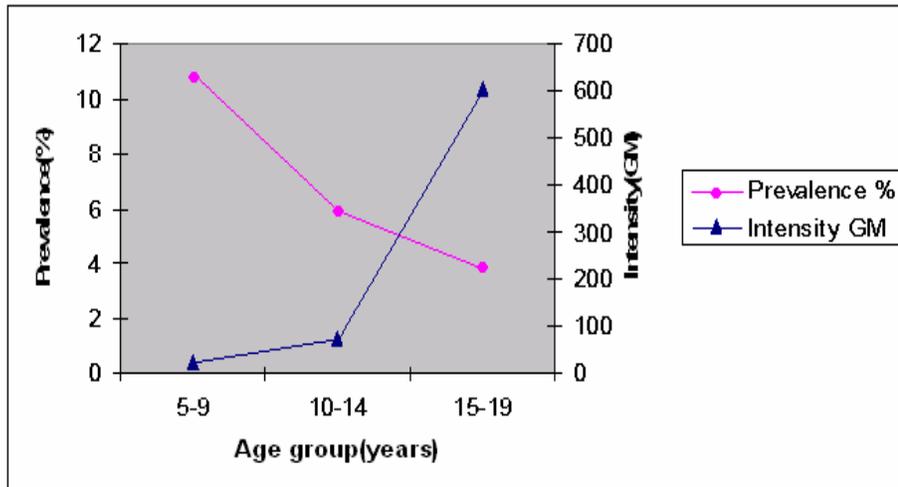
\* M=Male; F=Female; T=Total; Sm= *S. mansoni*; Al= *A. lumbricoides*

Prevalence and intensities of *S. mansoni* is presented in Figures 2. The prevalence of infection is high (>50%) in all age groups, while the peak intensity of *S. mansoni* infection was observed in the age group of 15-19 (127.7 EPG) followed by 5-9 age group (111.5 EPG).



**Figure 2.** Prevalence and intensity (GM) of *S. mansoni* infection by age groups of Adwa town school children, Northern Ethiopia, 2007

The prevalence of *A. lumbricoides* infection appears to decrease with increasing age, where as there is no such trend in intensity of infection. The peak intensity of *A. lumbricoides* infection was observed in age group 15-19 (600EPG) with a decrease in 10-14 age group (71.3 EPG) and with a further decrease seen in 5-9 age group (24.6EPG).



**Figure 3.** Prevalence and intensity (GM) of *A. lumbricoides* infection by age groups of Adwa town school children, Northern Ethiopia, 2007

Categorization of intensity of infection for *S. mansoni* and *A. lumbricoides* among different age groups is shown in Table 5. The mean number of eggs per gram of faeces indicated that the intensity of infection was generally low for the two helminths following the thresholds proposed by WHO (1987). For individuals with *S. mansoni* infection the prevalence of light, moderate & heavy infections were 32%, 21.1% and 5.1%, respectively. For *A. lumbricoides* the proportion with light infection was 6.3%. There was no moderate or heavy infection. The highest egg count for *S. mansoni* and for *A. lumbricoides* were 1464 egg/gram and 2040 egg/gram, respectively.

**Table 5.** Categorization of intensity (GM) of *S. mansoni* & *A. lumbricoides* infection by age among Adwa town school children, Northern Ethiopia, 2007

Age(year)	No examined	<i>S. mansoni</i>			<i>A. lumbricoides</i>		
		Negative	light	Moderate	Heavy	Negative	Light
		0	1-99 EPG	100-399 EPG	≥400 EPG	0	1-4999 EPG
	No	No (%)	No (%)	No (%)	No (%)	No (%)	No (%)
5-9	46	16(34.8)	17(37)	9(19.6)	4(8.7)	41(89.1)	5(10.9)
10-14	303	129(42.6)	96(31.7)	64(21.1)	14(4.6)	285(98.1)	18(5.9)
15-19	26	10(38.5)	7(26.9)	8(30.8)	1(3.8)	25(96.2)	1(3.8)
Total	375	155(41.3)	120(32)	81(21.1)	19(5.1)	351(93.6)	24(6.4)

Table 6 shows the number of students with either single or multiple infections. A total of 118 (31%) children were free of *S. mansoni* and major STH infection and 199 (53.1%) had a monoinfection with *S. mansoni*, while 8 (2.1%) and 4 (1.0%) were infected with *A. lumbricoides* and hookworm respectively. The double infection was encountered in 15 (4%) specimens and they were combination of *S. mansoni* and *A. lumbricoides*. The prevalence of mono infection and co infection among males and females were similar.

**Table 6.** Double and single infections with *S. mansoni*, *A. lumbricoides* and hookworms of Adwa town elementary school children Northern Ethiopia, 2007

Multiplicity of infection	Male N (%)	Female N (%)	Both sexes N (%)
Sm, Al	9 (2.4%)	6 (1.6%)	15 (4%)
Sm	97(25.8%)	102(27.2%)	199(53.1%)
Al	2(0.5%)	6(1.6%)	8(2.1%)
Hw	1(0.6%)	3(1.4%)	4(1.0%)

Sm= *S. mansoni*; Al= *A. lumbricoides*; Hw=Hookworm; % = of the total sample

### 5.3. Risk factors associated with *S. mansoni* infection

Among the potential risk factors explored regarding the prevalence of *S. mansoni* infection of Adwa town, statistical significant association was found between *S. mansoni* infection and sex, swimming in rainy season, and water contact while crossing the stream. On the other hand, no significant association was found with age group, religion, duration of stay, washing cloths in streams, bathing, source of water for (cooking, drinking and bathing), frequency of swimming in rainy season and frequency of contact while crossing the stream (Table 7).

Multiple logistic regression was performed for variables that were significantly associated with *S. mansoni* from univariate analysis. After adjustment for Males, swimming habit in rainy season and contact of river while crossing stream remained significantly associated with infection of *S. mansoni* (Table7). Males were 1.72 times (95% CI: 1.1, 2.6) more likely to get infection with *S. mansoni* than females. Children with swimming habit in rainy season were 2.13 times (95% CI: 1.27, 3.5) more likely to acquire *S. mansoni* infection. Students which have body contact while crossing the stream were 1.85 times (95% CI: 1.1, 3.2) more likely to acquire *S. mansoni* infection. However, comparing risk factors regarding *A. lumbricoides* and hookworm infection were not found to be statistically significant.

**Table7.** Risk factors and *S. mansoni* infection among Adwa town school children, Northern Ethiopia, 2007

Risk factors		Number (%)		OR,95%CI (Crude)	OR,95%CI (Adjusted)
		Sm Negative	Sm Positive		
Age Group	5 to 9 (n=46)	16(34.8)	30(65.2)	0.89 (0.34, 2.35)	0.89 (0.31, 2.54)
	10 to 14 (n=303)	129(42.6)	174(57.4)	0.84 (0.37, 1.91)	0.77 (0.33, 1.83)
	15 to 19 (n=26)	10(38.5)	16(61.5)	1.00	1.00
Sex	Male (n=165)	53(32.1)	112(67.9)	1.99(1.31, 3.05) *	<b>1.72(1.12,2.67) *</b>
	Female (n=210)	102(48.6)	108(51.4)	1.00	1.00
Swimming habit in rainy season	Yes (n=283)	101(35.7)	182(64.3)	2.56(1.58, 4.14) *	<b>2.12(1.27,3.54) *</b>
	No (n=92)	54(58.7)	38(41.3)	1.00	1.00
Contact of river while crossing stream	Yes (n=308)	117(38)	191(62)	2.14(1.25, 3.65) *	<b>1.85(1.10,3.23)*</b>
	No (n=67)	38(56.7)	29(43.3)	1.00	1.00

\* Statistically significant at  $p < 0.05$ ; OR =odds ratio; CI =confidence interval;  
Sm= *S. mansoni*

## 6. DISCUSSION

Epidemiological study on the intestinal parasitic infection in a given locality is a prerequisite for planning and evaluating intervention programs. In line with this the present study attempted to assess the prevalence of intestinal schistosomiasis and major soil-transmitted helminthiasis in school children in Adwa.

The result of the present study has added further evidence on the endemicity of intestinal schistosomiasis in the area. The town of Adwa is long known to be endemic for intestinal schistosomiasis Buck *et al.*, (1965). Lemma *et al.*, (1975) using merthiolate-idoine-Formalin (MIF) ether concentration technique reported reduction of *S. mansoni* prevalence from 64% in 1969 to 33% in 1974 among school children, as a result of snail control by Endod application. Birrie *et al.* (1994) reported a prevalence of 62% by concentration technique.

In this study the prevalence of *S. mansoni* infection by formol-ether concentration was 60.6%. This prevalence was comparable to previous study conducted by (Birrie *et al.* 1994). The fact that the prevalence of *S. mansoni* infection has not changed in Adwa has shown that transmission is stable and control measures were inadequate. The reason for persistence of transmission could be due to favorability of the environmental for the parasite inspite of the possible ecological changes brought about by the recurrent drought. The persistence of transmission of Adwa is evidenced by the recovery of infected snail (Birrie *et al.* 1994). Also human behavioral factors influence the transmission processes.

The prevalence of *S. mansoni* infection by Kato in this study was 58.70%. This is comparable to the prevalence rate of 54.3% obtained among school children in Adarkay district (Jemaneh, 1997), but lower than the finding of Birrie *et al.* (1994) by Kato (66%). The difference could be explained by variation in sampling.

The result of the present study has shown relatively higher prevalence rates compared to earlier surveys conducted in school aged children in other parts of Ethiopia. Including Dembia plains 35.8% (Jemaneh, 1998), Wondo-Genet Zuria 30.2% (Roma & Worku, 1997), Gorgora 29% (Dagneu, 1999), Babile 4.3% (Tadesse, 2005), Lake Langano 21.2 %

(Legesse & Erko, 2004), South Wello 24.9 % (Assefa *et al.*, 1998) and Chilga district 19.4%, Gonder 16.4% (Jemaneh, 2001, 2000). But lower prevalence of *S. mansoni* was obtained when compared to data of Zeghie 69.7% (Erko & Tedla, 1993). These variable results in prevalence may be due to a reflection of the local endemicity and geographic condition.

The prevalence of *A. lumbricoides* was low in the study subjects with prevalence of 6.4%. This rate was found to be considerably lower than those reported in Wondo-Genet (83.4%) (Erko & Medhin, 2003); Gonder (28.9%) (Jemaneh, 2000); and similar other studies carried out among school children elsewhere (Jemaneh, 2001; 1998). Although the prevalence of *A. lumbricoides* was low, it was comparable with study conducted in Lake Langano 6.2% (Legesse & Erko, 2004); Babile 4.3% (Tadesse, 2005).

The overall prevalence of STHs is lower than expected. The survey conducted in Adwa (Buck *et al.*, 1965) finds higher prevalence of STHs; that is, 71%, 3.7%, 34.9% for *A. lumbricoides*, hookworm and *T. trichiura* respectively. The difference might have been followed by mass treatment programme conducted twice a year since 1997 E.C.; or by improvements in general standards of living of the people. However further studies had to be conducted before reaching at such conclusion. Another explanation for the low prevalence of hookworm infection could be a combination of high temperature and long dry season which causes high mortality in the soil stage of hookworm (Tedla and Jemaneh, 1985). The absence of *T. trichiura* in this study may be due to low humidity and absence of shade. Although *A. lumbricoides* and *T. trichiura* have the same mode of infection and are more or less coexistent, it is suggested that *A. lumbricoides* eggs are more resistant to extreme temperatures than *T. trichiura* eggs (Bundy & Cooper, 1989).

In the present study, prevalence rate ranging from 20%-70.5% for *S. mansoni*; and 1.6%-14.0% for *A. lumbricoides* was found in more than half of the schools. Children attending May guagua, Adi Maheleka, Adwa, Tsion and Adi Abeto showing higher mean EPG (GM) indicate that *S. mansoni* infection is very common among school children in the town. The

difference between schools in the present study is not easy to explain as in-depth study in geographical area and socio economic status is needed.

With respect to age specific prevalence of *S. mansoni* infection in the present study, all age groups show no marked difference as has been demonstrated in Adarkay district (Jemaneh, 1997). All age group (5 to 19 years) also show comparable high prevalence of *S. mansoni* infection. This might be due to similar exposure risk to *S. mansoni* infection among these age groups. The fact that more than 50% of *A. lumbricoides* are found below 15 years might be explained by high level of soil contact activities and lower personal hygiene in this age group. The faecal egg count obtained by the Kato Katz technique was used to assess the intensity of infection in this study. Although this technique is susceptible to sampling error due to significant day to day and intra specimen variations in faecal egg count of *S. mansoni* (Engels *et al.*, 1997; Booth *et al.*, 2003; Crolle *et al.*, 1982), it is still well acknowledged as a method of assessing gut worm load (WHO, 1999).

In this study, the overall prevalence and intensity of *S. mansoni* are not directly related. Using the same method, study of *S. mansoni* intensity of infection has been carried out in school children of Adwa (Birrie *et al.*, 1994). The reported EPG (577) for comparable prevalence rate was much higher than the present study. This was probably due to sampling variation on one hand and difference in frequency of exposure to infected water body on the other hand (At the moment houses generally have piped water). The low intensity relative to prevalence corroborates the finding by Barakat *et al.* (2000), who suggested the community was at high risk of contracting the infection but adequate exposure, necessary for high intensity of infection. A study conducted on ascariasis in south east Lake Langano (Legesse & Erko, 2004) has indicated low intensity of infection in subjects who have similar egg count for *A. lumbricoides*. In agreement with this report the present study show low egg count suggesting low intensity of infection (62.4 EPG).

Age specific intensity curve of *S. mansoni* infection was more or less equally distributed among all age groups; a rise in intensity of infection among the 5 to 9 and 15 to 19 age

group might be due to small number examined in these age group. In accordance with epidemiological expectation (Bundy, 1995) the present result show that peak prevalence of *A. lumbricoides* infection in 5-9 year age group; whereas peak intensity of *A. lumbricoides* infection occurred in 15-19 year age group which is older than previously reported (Naish *et al.*, 2004; Alemayehu *et al.* 1998) for unclear reasons.

Analysis of the class of intensities of infection for *S. mansoni* and *A. lumbricoides* showed the infection to be light and moderate for *S. mansoni* and light for *A. lumbricoides*. The majority of the sampled children were negative for *A. lumbricoides* and few egg passers for *S. mansoni* infection. This is consistent with the findings of Palmer & Bundy (1995). They established the fact that the infection is over dispersed, that is, often minority of the population will produce (excrete) large amounts of eggs while majority have light infection, excreting very few eggs.

In the present study the co-infection by *S. mansoni* with *A. lumbricoides* was encountered 4% of the total examined population. This is comparable to co-infections (4.4%) reported by Erko & Medhin (2003). But they were very much lower than that reported by Jemaneh (1998) in Dembia plains school children (20.3%).

The identification of risk factors for the infection by *S. mansoni* and STH also contribute to a better understanding of transmission on a process. The socio-economic factors (Table 1) in this study demonstrate that 73.5% of the school children had access to latrine. This result agrees with the finding of Tadesse (2005). Most of the students (90.2%) had the habit of washing hands after defecation, 75% of the school children had trimmed finger nails. The above and other factors, might have contributed to the low prevalence of STH among Adwa schoolchildren.

The incidence of *S. mansoni* infection among males was found to be higher than that of females and the association was statistically significant ( $p < 0.05$ ). Logistic regression analysis also proved sex as a significant risk factor for the infection of *S. mansoni* in Bivariate and multivariate analysis. This sex associated difference has also been observed in

other studies (Lo CT *et al.*, 1989; Assefa *et al.*, 1998; Ayele & Tesfayohannes, 1982; Handzel *et al.*, 2003). This could be explained by the fact that males stay most of the time outdoors, playing, swimming in rivers compared to females who seldom participate in such activities.

Of the water related activities considered, only swimming habit in rainy season and contact of water while crossing the rivers were identified as being important risk factors in prevalence of *S. mansoni* infection. These variables also sustain their significance after adjusting for other variables in multivariate analysis.

## **7. STRENGTHS AND LIMITATIONS OF THE STUDY**

### **Strengths:**

- The study included all primary school in the town to show the actual prevalence of *S. mansoni* and STH infection.
- The study focused on one of the most vulnerable groups of the population.
- The non-response rate was almost none.

### **Limitations:**

- Malacological survey not included due to budget constraints.
- In the questionnaire some important factors like history of travel, family income were not mentioned.

## 8. CONCLUSIONS AND RECOMMENDATIONS

The present study showed that *S. mansoni* was highly prevalent among school children of Adwa town. The prevalence was associated with factors such as sex, swimming habit in rainy season and water contact while crossing the stream, which contributes to the high prevalence of the disease. Moreover, the high *S. mansoni* infection rate observed in this study indicate that the school children could become a source of infection and therefore are responsible for parasite transmission in the study area and calls for immediate measures. It is, therefore, suggested that health planners and decision makers need to give serious consideration for control of this neglected disease through:

- Mass chemotherapy directed against the *S. mansoni* parasite to reduce the worm burden.
- Health education program directed to school children in particular, and to communities in general, as it plays a significant role in changing human behaviour.
- Encouraging people in the town to plant and apply Endod for snail control near the streams.

Furthermore, in-depth studies should be made on socioeconomic factors like, history of travel, latrine usage, and family income to better evaluate the epidemiology of STH in the area.

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## **9. APPENDIX**

### **Appendix I. Questionnaire**

Department of Microbiology, Immunology and Parasitology

Addis Ababa University Medical Faculty

FOR SCHISTOSOMIASIS AND STH SCHOOL SURVEY

1. Participant identification

1.1 Name of the school \_\_\_\_\_

1.2. Code \_\_\_\_\_

1.3 Name \_\_\_\_\_

1.4 Grade section \_\_\_\_\_

1.5 Age \_\_\_\_\_

1.6 Sex 1. Male  2. Female

1.7 Religion \_\_\_\_\_

1.8 Duration of stay \_\_\_\_\_

2. From where do you fetch water for drinking and cooking ?

2.1 Private tab Yes  No

2.2 Public tab Yes  No

2.3 Rain water Yes  No

2.4 Stream Yes  No

3. If you bring your water from stream, where do you fetch it?

1. Assem stream  2. Guagua stream  3. Other specify \_\_\_\_\_

4. How many trips do you make to collect water per day? \_\_\_\_\_

Once  twice  More than three times

5. Is latrine available? Yes  No

5.1 If yes is it? Private  Common

5.2 If No where do you defecate and dispose faeces?

Near the streams

Open field

Using pits and dispose to the streams

6. Do you wash your hands after defecation? Yes  No

7. Do you swim in streams during rainy season?

Yes  No

7.1 If yes where do you swim?

Assem  Guagua  Other specify \_\_\_\_\_

8. How often do you swim in the stream?

Always

Occasionally

Sometimes

9. Do you make contact with the river while you cross it?

Yes  No

9.1 If yes how often?

Always  Occasionally  Some times

10. Do you wear shoes? Yes  No

11. Do you wash clothes in the rivers? Yes  No

11.1 If yes where

Assem  Guagua  Other, specify \_\_\_\_\_

12. Where do you bath?

Stream  Home  Public bathroom

12.1 If the answer is stream which stream?

Assem  Gauga  Other specify \_\_\_\_\_

12.2 If the answer is home, where do you obtain the water?

Stream  Pipe  Other specify \_\_\_\_\_

12.2.1 If the answer is stream which stream

Assem  Guagua  Other, specify \_\_\_\_\_

13. Are finger nails of the student trimmed?

Yes  No

Name of the interviewer \_\_\_\_\_

Signature \_\_\_\_\_ Date \_\_\_\_\_

Checked by investigator \_\_\_\_\_ signature \_\_\_\_\_

### Laboratory Data

1. Results of stool examination

*Schistosoma mansoni* eggs/ slide \_\_\_\_\_ eggs/gram \_\_\_\_\_

*Ascaris lumbricoides* eggs/slide \_\_\_\_\_ eggs/gram \_\_\_\_\_

*Trichuris trichiura* eggs/slide \_\_\_\_\_ eggs/gram \_\_\_\_\_

Hookworm eggs/slide \_\_\_\_\_ eggs/gram \_\_\_\_\_

Others \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_

## Appendix II. ASSESSMENT OF SCHOOL ENVIRONMENT FORM

1. Name of School \_\_\_\_\_

2. Date \_\_\_\_\_

3. Source of water in school yes  No

4. Type of water source \_\_\_\_\_

5. Availability of latrines in school yes  No

### Appendix III. LABORATORY PROCEDURE

#### **Kato - thick technique Procedure**

1. Place a small amount of fecal material on a newspaper or scrap paper and press the small screen on top so that some of the faeces are sieved through the screen & accumulate on top.
2. Scrap the flat-sided spatula across the upper surface of the screen to collect the sieved faeces.
3. Place template with hole on the center of a microscope slides and add faeces from the spatula so that the hole is completely filled. Remove excess faeces from the edge of the hole.
4. Remove the template carefully so that faeces will be left on the slide
5. Cover the fecal material with the pre soaked cellophane strip.
6. Invert the slides & firmly press the fecal samples against the cellophane strip on another slide or on a smooth hard surface.
7. Carefully remove the slide by gently sliding to avoid separating the cellophane strip. Place the slide on the bench with the cellophane upwards. Water evaporates while glycerol clears the faeces
8. Keep the slides for 30-45min at room temperature to speed up clearing & examination.
9. Examine the smear and count the number of eggs.

### **Formol ether concentration technique procedure**

1. 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.
2. 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.
3. Place the tube with the stopper removed in centrifuge; balance the tubes and centrifuge at 3000 rpm for 1 minute.
4. 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.
5. 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.
6. Transfer the sediment to the slide, and cover with cover glass.
7. Observed under light microscope at 10X and 40X magnifications for the presence of ova of the parasites.

## Appendix IV. CONSENT FORM (ENGLISH VERSION)

### **For participation as volunteer in research undertaking.**

I am a post graduate student from the Faculty of Medicine, Addis Ababa University. I am here to study the current status of *S. mansoni* and STHs infection. 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.

The laboratory findings would be used to initiate appropriate treatment for the said infections of your child. The study findings would also be used to design and implement control strategies in the study area in the future. In the end of the study, a report would be compiled and presented to the Faculty. The reports will not bear any information relating to your child personality. You have also the right to decline to cooperate in the study. If you have understood the explanation well enough, I am requesting you to your signature as illustrated below.

I, the, undersigned have been informed about the study objectives. I have also been informed that all the information within the questionnaire is to be kept confidential and that I have the right to decline from or to cooperate in the study. Therefore, with full understanding of the study objective I agree to give the informed consent voluntarily to the researcher to identify the parasites from my child's stool specimen and requesting for his /her appropriate treatment.

Name parent (guardian) \_\_\_\_\_ Signature \_\_\_\_\_ Date \_\_\_\_\_

CONSENT FORM (TIGRIGNA TRANSLATION)

ናይ ስምምዕነት ቅጥዒ (ብትግርኛ)

ምሽጥር ቁፅሪ \_\_\_\_\_

ሙሉእ ሽም ተሳታፊይ \_\_\_\_\_

ናይ ወለዲ ወይ መዕበዪ ሽም \_\_\_\_\_

ዝምድና \_\_\_\_\_

እነ ኣብ ፋካሊቲ ሕክምና ዩኒቨርሲቲ ኣዲስ አበባ ናይ ድህረ ምረቓ ተምሃሪት እንትኾን ዝመፃኹሉ ዕላማ ፅንዓት ንምክያድ'ዩ። ናይቲ ፅንዓት ዓላማ ናይ ብልሃርዚያን ካልኣት ኣመድ ወለድ ናይ መዓናጡ ኣሳኹን ዝተጠቐሙ ተምሃሮ በዝሒ ብሚኢታዊ ንምፍላጥ እዩ። ኣብዚ ፅንዓት ቃለ መጠየቕን (ንኣብነት ሽም፣ ዕድመ፣ ቅድሚ ወርሒ መድሐኒት ምውሳድን ዘይምውሳድን ዝኣመሰሉ) ናይ ፍታን ምርምራን ንተሳታፊ ክግበረሉ እዩ። ናይቲ ፍታን ውፅኢት ተራኢዩ በቲ ናይ ከባቢ ባዓል ሙያ ጥዕና ኣድላዪ መድሐኒት ክወሀቦ እዩ ። ብተወሳኺ ኣፈሻዊ ናይ ተምህሮ ውፅኢት ተራኢዩ ኣብዚ ከባቢ ቀፃሊ ናይ ምክልኻል ትልሚ ንምሕንፃፅ ክጠቅም እዩ ።

ኣብቲ ቃለ መጠይቕ ውላድኩም ዝህቡ/ትህቡ ኣበሬታ ሚሽጥራውነቱ ዝተሓለወዩ። ዝተወሰደ ሐበሬታን፣ ፍታንን ንምርመር ጥራይ ክውዕል እዩ። ናቶም ይኹን ናይ ውላዶም ሽምን መንነትን ንዋላ ኣደ ኣይግለፅን እዩ። ስለዚ ኣብዚ ምርምር ውላዶም ኣብቲ ቃለ መጠይቕን ናይ ፍታንን መርኣያ (ናሙና) ንምሃብ ንክተሓበበረና (ንክትተሓበበሩና) ፍቓደኛ እእንተኮይንኩም ኣብዚ ታታሕቲ ተገሊፁ ዘሎ ፊርማኹም ክተንቡሩልና ብትሕትና ይሓትት።

እነ ኣብ ታሕቲ ሽመይ ዝተጠቐሰ ኣብ ላዕሊ ተጠቀሱ ዘሎ ዓለማ ተረዲኦ ውላደይ ኣብዚ ፅንዓት ንክሳተፍ ፍቓደኛ ምዃነይ ክገልፅ ይፈቱ።

ሽም ወላዲ ( መዕበዪ)-----

ፊርማ-----

ዕለት-----

DECLARATION

I the undersigned, declare that this is my original work and has never been presented for a degree in any other university and that all the source material used for the thesis have been duly acknowledged.

**M.Sc candidate:**

**Lemlem Legesse W/Gabriel**

Signature

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Date and palace of submission

\_\_\_\_\_

DMIP, Faculty of Medicine, Addis Ababa University

This thesis has been submitted for examination with my approval as a university advisor

**Advisor:**

**Prof. Asrat Hailu**

Signature

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Date and place of submission

\_\_\_\_\_

Addis Ababa, Ethiopia

**Advisor:**

**Ato Berhanu Erko (A. Prof.)**

Signature

\_\_\_\_\_

Date and Place of Submission

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Addis Ababa, Ethiopia