Intestinal Helminthes Infections and Re-Infections with Special Emphasis on *Schistosomiasis* Mansoni in Waja, North Ethiopia

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ABSTRACT

To determine the status of infection and re-infection caused by *Schistosoma mansoni* in a small town of Waja, northern Ethiopia, stool samples were collected from primary school children in two rounds (in mid June and mid September 2004) and were examined using the Kato thick smear method. In addition, water bodies that might serve as biotopes for the intermediate host snails were located and searched using scoops. During the first survey, the prevalence of *S. mansoni* among the 224 children (119 male and 105 females) sampled was 27.1%. *S. mansoni* prevalence increased from 27.1% to 36.4% ($P< 0.05$), during the 2nd survey, three months following the treatment of the positive cases. Similarly, an increase in the prevalence of *T. trichiura* was observed (from 16 to 30.7%), whereas that of *Ascaris lumbricoides* decreased during the second survey (from 50 to 42.8%) ($P<0.003$). *S. mansoni* prevalence was higher in males than in females during both surveys (35.3% vs 18.1% 1st survey; and 51% vs 32.6% in the 2nd survey ($P < 0.05$). The profile of infection with *S. mansoni* in the various age groups showed a peak infection rate in the age group 15-19 years (41.2%) followed by the age group 10-14 (24%) and the least affected were the 5-9 age groups (18.5%) ($P<0.002$). The risk of decreasing schistosomiasis mansoni is discussed and the possible prevention and control measures are suggested.

Key words: *Schistosoma mansoni*, Infection, Re-infection, Intensity

1. INTRODUCTION

In many developing countries, one of the most prevalent and most important helminthes is the blood flukes, schistosomes (Razendaal, 1997). Dorit, et al. (1991) reported that schistosomiasis is considered to be in par with malaria and hookworm infections that cause serious illnesses in humans. In agreement with this, Ruppert and Barnes (1994) pointed out that schistosomiasis can be an important disabling human disease, which may also result in death. Schistosomiasis is one of the most important human parasitic diseases in terms of socioeconomic 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 (Rozendaal, 1997).

Reports of WHO showed that 74 tropical countries are endemic for Schistosomiasis and 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 (Rozendaal, 1997). Schistosomiasis is responsible for 50,000 deaths annually (Dupre et al., 1999). In Ethiopia, the optimum range for distribution of *S. mansoni* has been reported as 1500 to 2000masl (Lo et al., 1988). In Tigray, various studies have been conducted on the prevalence, distribution and infection foci of *Schistosoma mansoni* infection (Alemayehu et al., 1998; Birrie, 1994; Woldemichael and Kebede, 1996), but none of them studied re-infection of *S. mansoni* infections.

In a recent study, 87% infection was recorded for Tumuga (Tadesse and Beyene, 2009), which is 1450mas and only five kilometers far from Waja. This might be attributed to the higher water contact of the children in Timuga. Waja-Wuha, which is a nearby water body has high density of cercaria-infected snail intermediate host. This is considered a cause for the situation

The preventive measure to be taken depends on our understanding of the extent of the problem in the different regions of the country. Hence, a survey of *Schistosoma mansoni* infection and re-infection in Waja, Northern Ethiopia was carried out. This study intends to assess the prevalence of intestinal schistosomiasis so as to recommend the effective means of control in Waja. Thus, the objectives of this research is a) to examine the present epidemiological profile of *Schistosoma mansoni* and identify new endemic foci, b) to have basic information on infection and re-infection of *Schistosoma mansoni* in Waja and c) to identify water bodies with the intermediate hosts *Biomphalaria pfeifferi.*

2. MATERIALS AND METHODS

2.1. Description of the Study Area

The study was conducted in a small town, Waja, located in southern Tigray, near the border between Tigray region and the Amhara Regional State. Waja is found between latitude 12^0 and 15^0 N, 38^0 10′ and 40^0E longitude. Lying at an average altitude of 1450 masl, the town has about 5000 inhabitants; most of them are engaged in subsistent agriculture. It has one primary school and a health centre.

2.2. Study Design

The study involved two longitudinal surveys in a randomly selected sample of children aged 6-14 years from the only Primary school in the town. The primary school children were selected to represent the community they live in as prevalence of infection in school-aged children, which can be used as an index for assessing community prevalence (Guyatt et al., 1999). The first survey was conducted in mid July, 2004 and all children who were found positive for any intestinal parasites were treated. Three months later (mid September 2004), we re-visited the school and re-examined the same children that could be traced. In other words, those who were negative and the positives (after being treated) were used as a cohort for the re-infection study (second survey).

At the beginning of the study, the objectives were explained to the school principal, other concerned authorities and students. Students who volunteered to participate and fulfil the following inclusion criteria were listed as prospective donors of faecal sample:

- Live in the town, never had gone away far from Waja;
- Never had treatment for any intestinal helminth infections during the last 3 months;
- Students attending classes at the time of sample collection.

From the list containing the names of prospective donors, a total of 224 students were selected using random start to identify the sample population (only during the first sampling).

2.3. Sample Collection and Processing

After the lists of donors were drawn up, students were supplied with plastic sheet to bring about 5 gm of faeces. In the first survey (N= 224) and in the re-infection study, only 194 students stool samples (31 students were absent from school during the second sampling collection) were processed by Kato thick smear technique (Peters et al., 1980). The prepared slides were transported to Mekelle University for microscopic examination, for further cross checking and quality control. Positive samples were rated as eggs per gram of stool in order to determine the intensity of infection.

In this infection and re-infection study, prevalence was estimated from the proportion of infection as compared with the total population examined. Intensity of infection was estimated from the number of eggs per gram of faeces (epg). Egg count for the different parasites was used as recommended by WHO (Razendaal, 1997) for the purpose of classification of intensity of infection in the community into light, moderate and heavy infections. Cut off value for classification of intensity of infection by Montresor et al. (1999) was used. Accordingly for *S. mansoni* infection is: Light = 1-99epg, Moderate = 100-399epg, Heavy = >400 epg.

To determine the occurrence and distribution of the snail intermediate hosts, live snails and shells were collected by scooping from Waja Wuha (the big river on the northern side of Waja town) in order to establish whether or not local transmission occurs. *Biomphalaria pfeifferi*, the main intermediate vector for *S. mansoni were* placed in a transparent vial and placed in a sunny area to observe the shading of motile cercaria of *S. mansoni*.

All positive cases for any type of intestinal parasite were treated with appropriate antihelminthic drugs. Those with *S. mansoni* were treated at each subsequent sampling with Praziquantel 40 mg/kg body weight, single dose.

Data were entered into a computer and analyzed using SPSS version 11.1. The chi-square test of significance was applied. Significance was determined on a 5% significance level (p-values < 0.05).

3. RESULTS

A total of 224 (119 male and 105 female) students were examined in the first screening for intestinal helminthes. Of these, 194 (86.6% - 103 males, 92 females) were traced and examined during the second survey, which was conducted three months later. At base line (first round), over 65% of the schoolchildren were infected with one or more intestinal helminthes. This has increased to 72.2%, three months following the treatment of positive cases ($P < 0.03$) (Table 1). In other words, fecal examination after three months of the initial treatment indicated that 72.2% of the study population remained infected or became re-infected by this time (there is evidence from recent study of efficacy of Praziquantel in treating *S. mansoni* infected individuals by Tadesse et al. unpublished data).

Just over 27% of the school children were found infected with *S. mansoni* during the first round (baseline) of the study. The prevalence of *S. mansoni* infection showed a significant increase during the second survey (from 27.1% to 36.4% ($p < 0.05$) (Fig. 1). We did not do water contact studies of the school children. Nevertheless, the data showed that re-infection rates were not improved following single treatment and natural re-exposure.

Table 1. Proportion of the students who were positive for one or more intestinal helminth parasite species in both infection and re-infection sampling in Waja, 2004.

Sampling period	Female		Male		Total	
	Examined	Positive No (%)	Examine	Positive No (%)	Examine	Positive No (%)
June 2004 sampling	105	69 (38.8)	119	78 (34.82)	224	147 (65.62)
Sept. 2004 sampling (After initial treatment)	92	60 (30.9)	103	80 (41.2)	194	140 (72.16)

Similarly, an increase in the prevalence of *Trichuris trichiura* infection was observed (from 16% to 30.7%). At baseline, the prevalence of *A. lumbricoides* was 50%, but it decreased to 42.8% in the re-infection study ($p < 0.003$) (Fig. 1).

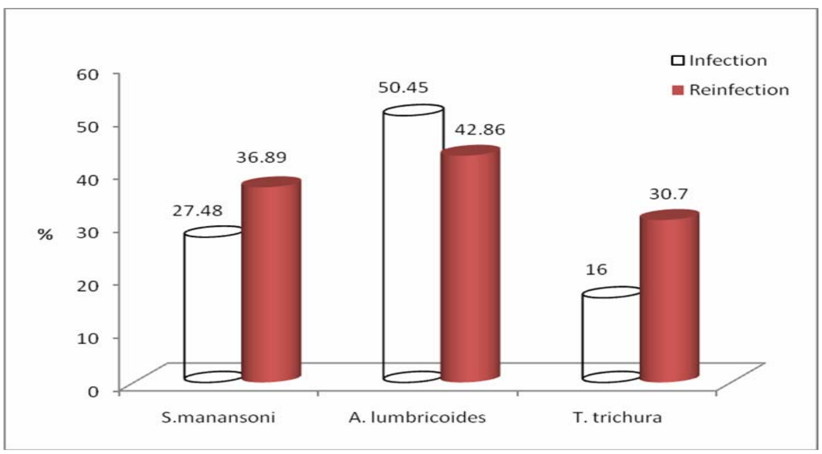

Figure 1. Infection and re-infection of S. *mansoni, A. lumbricoides* and *T. trichiura.*

Both at baseline (35.3% males &18.1% females) and during the second survey (51% males and 32.6% females), *S. mansoni* prevalence was significantly higher in males than in females ($P<0.05$) (Fig. 2). Nevertheless, there was no significant difference in prevalence of the other intestinal parasites between the sexes, both during the first and second surveys.

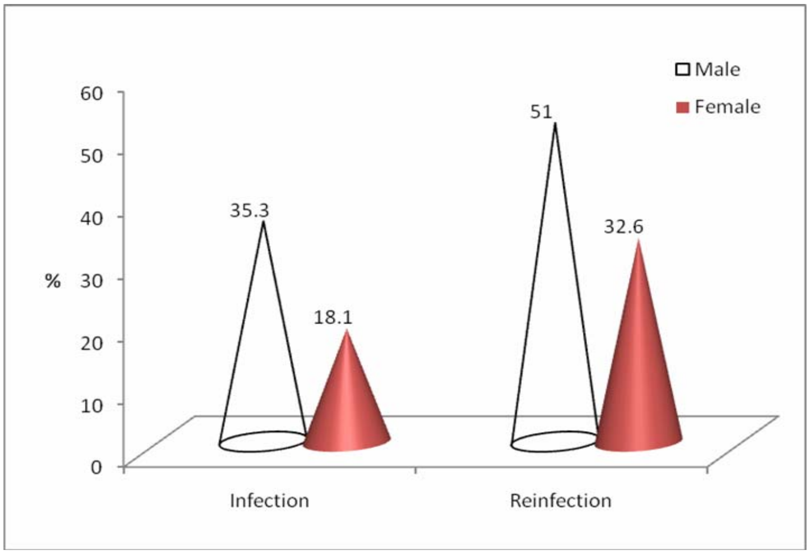

Figure 2. *S. mansoni* infection and re-infection in Waja school children with respect to sex.

The number of students examined with respect to the age group was 27 in the age group 5-9, 146 in the age group 10-14 and 51 in the age group 15-19 years for the first sampling. For the re-infection, the number of students examined was 24, 126 and 44, respectively.

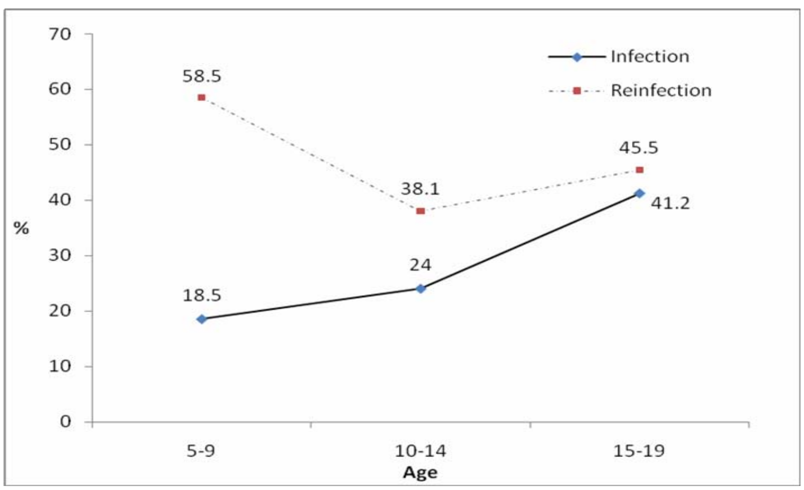

Figure 3. *S. mansoni* infection and re-infection in Waja school children with respect to age.

At baseline, the prevalence of *S. mansoni* infection prevalence was highest in the age group 15-19 (41.2%) (P< 0.002) followed by the age group 10-14 (24%), and in 5-9 years

(18.5%) (Fig.3). During the follow up survey, however, the peak was observed in the age group 5-9 (58.5%) followed by the 15-19 (45.5%) and the least infection rate was in the age group 10-14 (38.1%) (P<0.08).

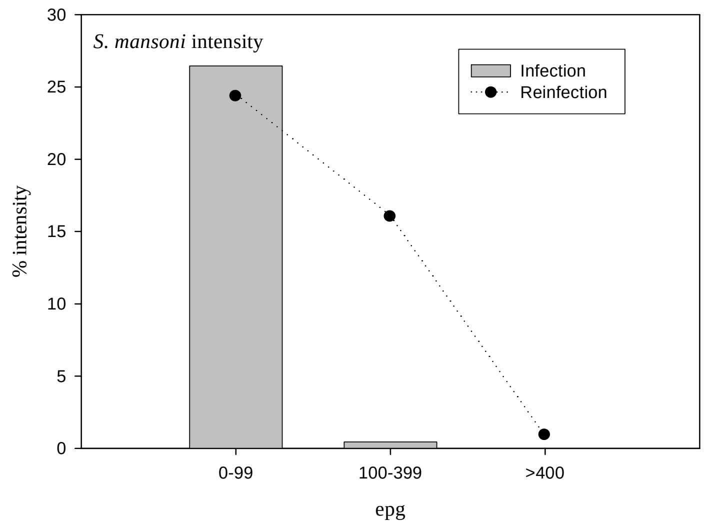

Figure 4. Intensity of *S. mansoni* infection in epg (eggs per gram of faeces).

The intensity of *S. mansoni* infection was compared at baseline and after 3 months following the treatment of positive cases. As indicated in Fig. 4, higher intensity was observed during the second survey. It can be clearly seen that both moderate and heavy intensity of infection was observed during the second sampling survey (P<0.02). Besides, higher intensity of *S. mansoni* infection was observed in males than in females at both surveys (P<0.005) (Fig. 5).

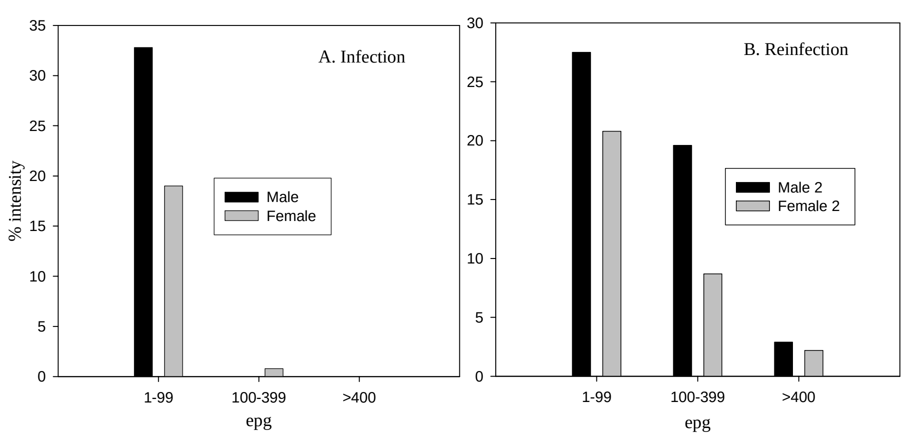

Figure 5. Intensity of *S. mansoni* infection among sexes in epg (eggs per gram of feces). Key: Light infection = 1-99 epg, Moderate infection = 100-399epg and Heavy infection = >399epg, Abbreviations: A = *S. mansoni* infection intensity, B = *S. mansoni* re-infection intensity.

The intensity of *S. mansoni* infection with respect to age revealed that the peak for light infection was in the age group 15-19 (P < 0.03) (Fig. 6) whereas in the re-infection survey, there was significant difference among the age groups (P > 0.05).

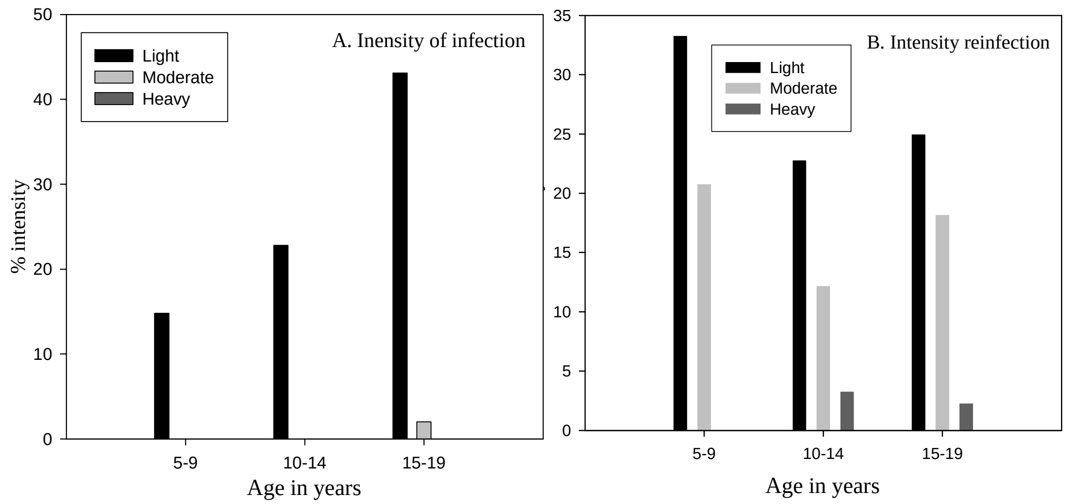

Figure 6. Intensity of *S. mansoni* infection with age in both infection and re infection

Key: Light infection = 1-99epg, Moderate infection = 100-399epg and Heavy infection = >399epg, Abbreviations: A = *S. mansoni* infection intensity, B = *S. mansoni* re-infection intensity

4. DISCUSSION

Intestinal helminthic infection is one of the major health problems in Ethiopia. The knowledge of the prevalence and distribution of intestinal helminth infection has been gradually increasing. Various studies have been conducted on all intestinal parasites spp. or specifically on *Schistosoma mansoni* infection in Ethiopia. In Tigray, a variety of surveys have been done (Tadesse and Beyene, 2009; Mc-Connel and Armstrong, 1976; Birrie et al., 1993; Woldemichael and Kebede, 1996; Alemayehu et al., 1998; Kiloos et al., 1978).

However, prevalence studies in relation to infection and re-invention is limited or none. The present study aimed at determining the infection and re-infection of *S. mansoni* in Waja. Overall prevalence of intestinal helminth parasite infections was 65.62% and 72.16% in both infection and re-infection respectively. The prevalence of *S. mansoni* was also consistent, that is, 27% and 34% in infection and re-infection study respectively. The results show that in spite of the decrease in the prevalence of *Schistosoma mansoni* after treatment, increase in rate during re-infection was observed. This high rate of infection after treatment could be attributed to the fact that the re-infection sampling was done immediately after the rainy and hot season, which might have some impact in facilitating the rate of prevalence of re-infection (Birrie et al., 1998). Besides, soon after the first sample collection, schools were closed and students didn't go to school rather they were engaged in farm and related activities that might increase the chance to have contact with water bodies. On the other hand, water and vegetation nearby water bodies increase during the rainy season, and flood (flashing the water bodies) decrease with the decrease of rain beginning mid of August. The relatively high temperature, humid environment and presence of water may lead to an increase in the intermediate host population, which on the other hand increases the production of cercaria (the infective stage of the *S. mansoni*).

This might indicate that more effort is needed than only treating infected individuals to achieve a continuous drop in prevalence, incidence, and re-infection rates.

In *S. mansoni* infection, more males were infected than females in both infection and re-infection studies. Similar findings were reported by different investigators (Birrie et al., 1994; Woldemichael and Kebede, 1996; Lemma, 1969). But in the recent finding in Tumuga (Tadesse and Beyene, 2009) sex related difference in infection was not consistent.

The limitation of the present work is the limited age range of the study population, because the target population was primary school children with the age range of 5-19 years. Even then, significant age related differences could be discerned. The peak of *S. mansoni* infection was seen in the age group 15-19 and then followed by the age group 5-9 and least infection was in the age group10-14. Similar pattern of age related difference was also observed in both infection and re-infection studies. Other reports in contrary to this, indicate that the peak of infection in the age group 10-14 and the least peak in the age group 5-9 (which is usually associated with low water contact of this age group) were in different parts of the country (Erko, 1988; Birrie et al., 1997) and from the same region (Tadesse and Beyene, 2002; Alemayehu et al., 1998).

Analysis of the intensity of infection in the age groups showed the peak of light infections to be in the age group 15-19. The intensity decreased in the age group 5-9 and the least affected were 10-14 years old children. This is in contrary to the reported finding in Tumuga (Tadesse and Beyene, 2009) and Bahir Dar that showed the peak of all light, moderate and heavy intensity of infection in the age group 10-14 (Erko et al., 1991). On the other hand, it was the 5-9 age group, which was harboring the highest *S. mansoni* infection. Though this result is contrary to different reports (Tadesse and Beyene, 2009; Erko et al. 1991), this observation might be correct due to the fact that they will have the highest contact with water if children once start contacts with infected water. Besides, Abel et al. (1991) reviewed an evidence suggesting that for individuals having frequent contacts with water infested with the cercaria of *Schistosoma mansoni*, both infection intensities and re-infection after treatment depend, in large part, on their intrinsic susceptibility/resistance to infection, suggesting a role of genetic factors. These are age groups which have the responsibility to look after cattle which gives ample time for water contact, increasing the likelihood of infection. Due to the high susceptibility and high contact with infected water, all children including age groups 5-9 year are considered to be equally susceptible to infections of *S. mansoni*.

In *A. lumbricoides* infection, younger children had higher infection rates than the older ones. This indicated that younger children were more exposed to infections, which could be transmitted due to the contamination of the environment, especially the soil where the children usually played in the open fields and ate food without washing hands. Thus, as age increases, susceptibility to intestinal nematode infection decreases possibly due to improved personal hygiene as reported by Alemayehu et al. (1998).

In general, the result showed that children are much more rapidly re-infected than adults as reported in other studies also (Tadesse and Beyene, 2009; Erko et al., 1991). In addition, from this study it can be concluded that single time mass treatment may not be effective means of controlling *Schistosomiasis mansoni* in an endemic area due to very frequent re-infection and different risk factors that expose to infections.

This finding demonstrates that additional measures such as proper environmental sanitation and vector control are needed to control human schistosomiasis. Besides, treating infected individuals, continuous cleaning of the canals to eliminate the snail intermediate host of *S. mansoni* is recommended (Agula'i, which is found in Tigray region, with more than 100 years of traditional irrigation practice had no snail intermediate host of *S. mansoni,* could be taken as vivid evidence, Tadesse and Tsehaye in preparation). So the pattern of community canal-water interaction may have a role in many traditional, cultural and occupational factors that should be taken into consideration in any effective long-term control programme.

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