Schistosomiasis Mansoni among School Children of Different Water Source Users in Tigray, Northern Ethiopia

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ABSTRACT

The current trend of harvesting water to supplement the agricultural productivity is associated with the expansion of schistosomiasis mansoni and other intestinal parasitic infections. Considering this, the present study was started with the objective of assessing the prevalence and intensity of *S. mansoni* infection and other intestinal helminth among different water source users. A total of 622 stool samples from school children of those families, which were using lands around longstanding-irrigation, recently constructed dam-irrigation and non-irrigated land, were processed by Kato thick smear and examined microscopically. The overall prevalence rate for intestinal parasites was 26.53%, where as for *S. mansoni* infection it was only 5.95%. A total of eight species of helminth parasites were identified; the highest being *Ascaris lumbricoides* (10.45%) followed by *Enterobius vermicularis* (8.52%). The prevalence and intensity of *S. mansoni* infection showed the highest rate in the longstanding areas (13.73%), followed by the recently started irrigated areas from recently constructed dams (6.18%) and the least in areas where the school children stay in un-irrigated area (0.61%) (χ^2 = 21.99, P = 0.000). We recommend that due attention should be given to health impacts of such agricultural interventions. The worm burden can be reduced by proper management of the water and the canal system like clearing the lithoral zones and the water canals to reduce the establishment of the intermediate hosts.

Key words: Eggs per gram, Intensity of infection, Long standing irrigation, *Schistosoma mansoni, Schistosomiasis mansoni*.

1. INTRODUCTION

In developing countries such as Ethiopia, infections due to intestinal parasites especially in children are still a public health problem (WHO, 1981). *Ascaris lumbricoides, Trichuris trichiura,* hookworms and *Schistosoma mansoni* (Rozendaal, 1997; WHO, 2002) are among the common causes of gastrointestinal discomforts.

Parasites are often encountered through unhygienic habits. Thus, regularly assessing the rate of parasitic infections in a given area could be a good indicator of the status of hygiene. All parasitic infections again flourish in nutritionally compromised or immune deficient patients, such as HIV/ AIDS patients.

To reduce the dependency on rain-fed agriculture, the Ethiopian government is constructing small, medium, and large dams/reservoirs for irrigation development. More than 70 small reservoirs are constructed in Tigray during the last two decades with a primary purpose of supplementing the irrigation (De Wit, 2003; Tsehaye et al., 2007; Tadesse et al., 2008). On the other hand, the introduction of irrigation-based agricultural scheme has been associated with an increase in the prevalence of *S. mansoni* (Lo et al., 1988; Birrie et al., 1998; Kloos et al., 1998)

Intestinal schistosomiasis is reported to be widely endemic in Tigray. Investigations, including the recent ones, reported that *Schistosoma mansoni* has covered quite many localities in the region with different prevalence rates: Maichew (1%), Hiwane (4.2%), Waja (34.2%), Bele'at (38.3%) Adwa (66%), and Tumuga (87%) (Birrie et al., 1994; Woldemicheal and Kebede, 1996; Alemayehu et al., 1998; Tadesse and Tsehaye, 2008; Tadesse and Beyene, 2009; Tadesse et al., 2009).

In this study, areas with long standing irrigation practices (more than 100 years of irrigation practices in Agulae), less than 30 years (e.g. Genfel river diversion in the mid 1980s; Wukro, 47 Kms North of Mekele), recently constructed dams and sites without irrigated lands are compared for the prevalence and intensity of intestinal helminth with special emphasis on *S. mansoni* infection. The finding of this study could be used to update the baseline data for mapping the distribution of schistosomiasis foci and future reference for designing and evaluating schistosomiasis control strategies.

2. MATERIALS AND METHODS

2.1 Study area

The study was conducted in Tigray, northern Ethiopia (Fig. 1). The study sites are located within 100 km radius toward north and south from Mekelle town, the capital of Tigray Regional State. Eight Primary Schools, namely, *Megabit Selassa, Fana, Nekual Imni, Agulae, Mereb Mieti, Kokhi Azan, Hagere Selam* and *Gra Shitu* were choosen for the study. Primary school children were used to index the assessment of community prevalence (Guyatt et al., 1999).

2.2 Study Design

A total of 622 school children (303 females and 319 males) were selected from the 8 representative schools (Table 1). The subjects were chosen randomly from their grade categories. Data collection was undertaken from April 2006 to March 2007. Specimens were collected on-the-spot. Students who were not able to pass stool during sample collection were advised not to bring their friends stool, but to report that they could not do it. Those who reported not able to pass were substituted by other students. The 622 samples were processed by Kato thick smear (Peters *et al*., 1980) in the field with in 1 hour of their collection and samples were transported to the laboratory at Mekelle University for microscopic examination. For each stool sample, only single slide was prepared by well trained expertise. All positive cases were treated after the identification of the parasite. Those study participants known to have *S. mansoni* infection were treated with Praziquantel 40 mg/kg body weight, single dose, while for other helminthic infections such as *A. lumbricoides, T. trichiura* and hookworm; 100mg BID Mebendazole were given for three days.

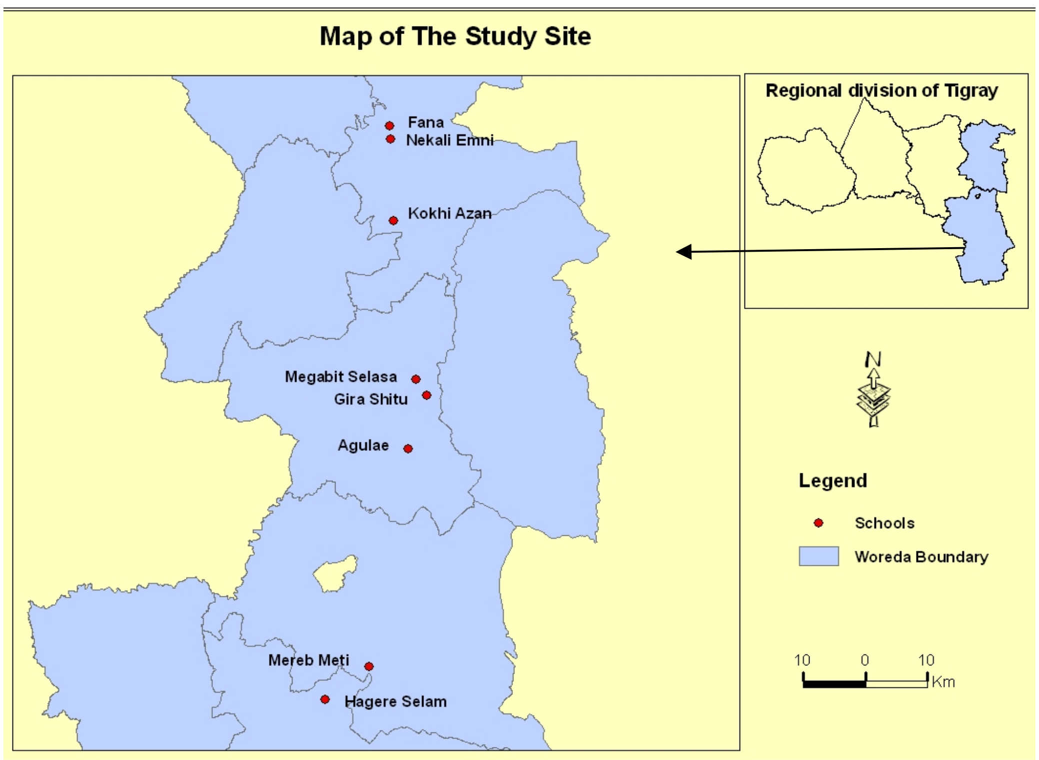

Figure 1. Map of study area, filled circles represent the location of the 8 primary schools.

Intensity of infection was estimated from the number of eggs per gram of faeces (epg). Based on egg counts, the intensity of different helminthic infections among children was categorized into light, moderate, and heavy using standard cut-off values (Montresor et al., 1999). Intensity of *S. mansoni* was classified into light (1-99 epg), moderate (100-399 epg) and heavy infections (> 400 epg). Similarly, the classification for *A. lumbricoides* was considered as light infection (1-

4999 epg), moderate (5000-49999 epg) and heavy (>50,000epg). Moreover, intensity of *T. trichiura* was classified as light (1-999 epg), moderate (1000-9999 epg) and heavy infections (> 10,000 epg). Finally, the classification of hookworm intensity was considered as light (1-1999 epg), moderate (2000-3999 epg) and heavy infections (>4,000epg). In the results, only intensity of *S. mansoni* was presented because the intensity in all others was light infection.

Table 1. List of study schools, number of students examined, altitude and name of nearby water bodies.

Schools	***# of students examined***	***Altitude***	***Nearby***	
			Dam	***LS irrigation***
Megabit Selasa	50	1985		Wukro diversion
Nekal Imni	51	2564	Enda Gebriel	
Merb Meti	50	2227	Hizaeti Wedicheber	
Fana	75	2682	Bokoro	
Agulae	51	2010		Agulae river
Kokhi Azan	131	2360	Tsinkanet	
Hagere Selam	84	2188	Gereb Mihiz	
Gira shitu	130	2025	Korir	

Snail samples were collected from water bodies using forceps to check the presence of appropriate snail intermediate host in the study area. *Biomphalaria pfefferi* were collected and squashed between two slides for checking the presence of cercariae of *S. mansoni*. The cercariae were identified morphologically by checking their bifurcated tail.

2.3 Data analysis

Data were entered into a computer and SPSS software (version 12) was used for Chi square test. The levels of significance of variables were evaluated at 95%.

3. RESULT AND DISCUSSION

In the present study eight different species of parasites were identified from the school children (Table 2). Relatively the highest prevalence of infection was due to *Ascaris lumbricoides* (10.45%) followed by *Enterobius vermicularis* (8.52%). The prevalence of infection for one or more of intestinal helminthic parasite was 26. 53% (ranging from 6.87 - 47.1%), while infection due to *S. mansoni* was 5.95% (ranging from 0 to 27.45%) (Fig. 2). The least intestinal helminth parasitic infection was recorded in Kokhi Azan Primary School (2600 masl) and the highest (68%) was in Mereb Mieti with an altitude of 2227 masl.

Generally, the prevalence of intestinal helminth parasitic infection recorded in this study was very low as compared to previous studies (Birrie et al., 1994; Woldemichael & Kebede, 1996; Alemayehu et al., 1998, Erko et al., 1991; Birrie et al., 1997, Tadesse & Beyene, 2009; Tadesse et al., 2009). This may be due to difference in location, awareness of the children, modification towards parasitic infection and the low prevalence of vectors.

In the study area, the prevalence of intestinal helminthic parasites specifically *S. mansoni* infection among different schools was highly significant (χ^2 = 90.78, P = 0.000 and χ^2 = 187.5, P = 0.000, respectively). This variation in infection might be associated with location of the school, altitude, behavior of children towards water body and presence of vector, etc.

The prevalence of infection due to one or more intestinal helminthic parasite showed significant variation among sexes (21.78% in females and 31.03% in males) (χ^2 = 6.825, P < 0.009) (Fig. 3). Similarly, the prevalence of *S. mansoni* was significantly higher in males than in females (χ^2 = 6.825, P < 0.009). This finding was similar with the results of previous studies (see Lemma, 1969; Birrie *et al*., 1994; Woldemichael and Kebede, 1996). Higher prevalent rates among males than females have been reported from different parts of Ethiopia (Leykun, 1977, Birrie et al., 1998). This variation in infection is associated mainly to division of work in different communities and ethnic groups. Prevalence rate for *S. haematobium* among the Afar in the Awash Valley, for example, was reported to be twice as high among women as in men; because women collect aquatic plants in infected swamps on the Awash flood plain (Kloos et al., 1978).

Table 2. Different species of helminthic parasites found in the study population and their percentage prevalence.

Species	***Number +ve***	***% prevalence***
A. lumbricoides	65	10.45
E. vermicularis	53	8.52
S. mansoni	37	5.95
Taenia sp	36	5.79
T. trichiura	3	0.48
Hookworm	2	0.32
Strongyloides stercoralis	2	0.32
H. nana	2	0.32

The prevalence of infection with respect to age in both general intestinal helminth parasites and *S. mansoni* infection did not show significant variation (χ^2 =1.87, P < 0.396 and χ^2 =2.56, P <

0.258, respectively) (Fig. 4). In contrary to our findings, other research reports indicated significant difference in infection among different age groups (Erko et *al.*, 1991; Birrie *et al.*, 1997; Alemayehu *et al.*, 1998; Tadesse and Beyene, 2008). Fig. 4, age specific prevalence of *S. mansoni* infection; the highest being the age group 10-14 years, which is similar to the above findings.

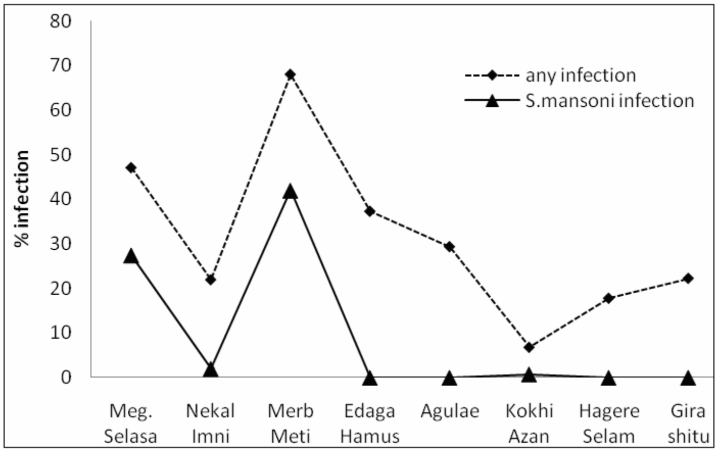

Figure 2. Comparison of infection due to *S. mansoni* and other helminth infection in the school children.

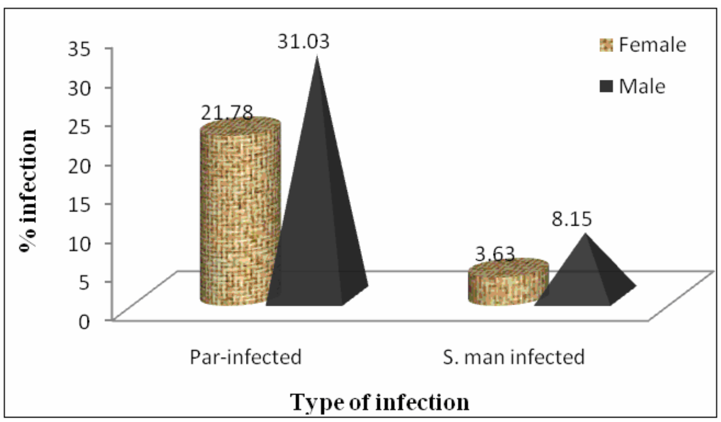

Figure 3. Prevalence of *S. mansoni* and other helminth infections among sex.

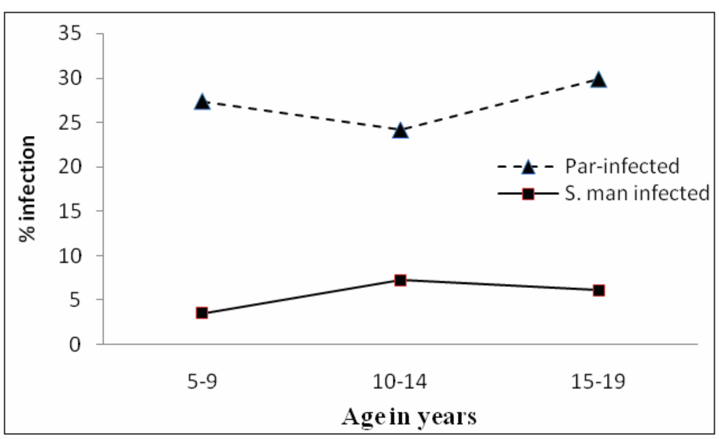

Figure 4. Percentage of infection among different age groups.

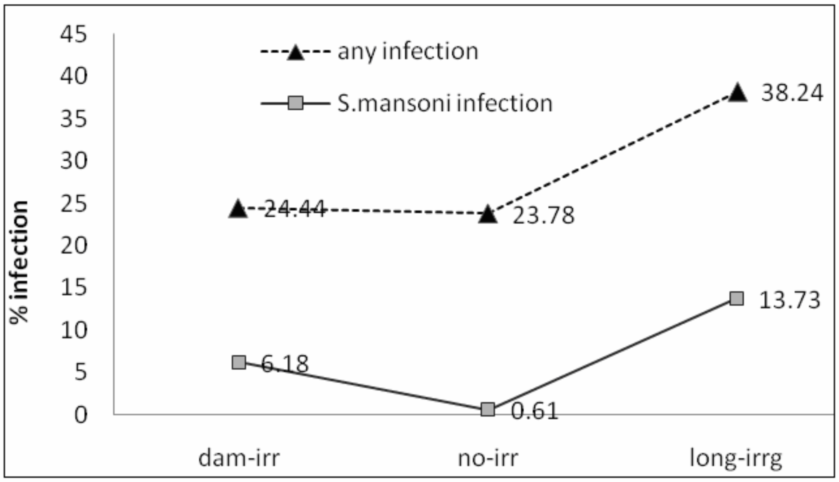

Figure 5. Comparison of infections due to *S. mansoni* and other intestinal helminth infections in school children of different water source users.

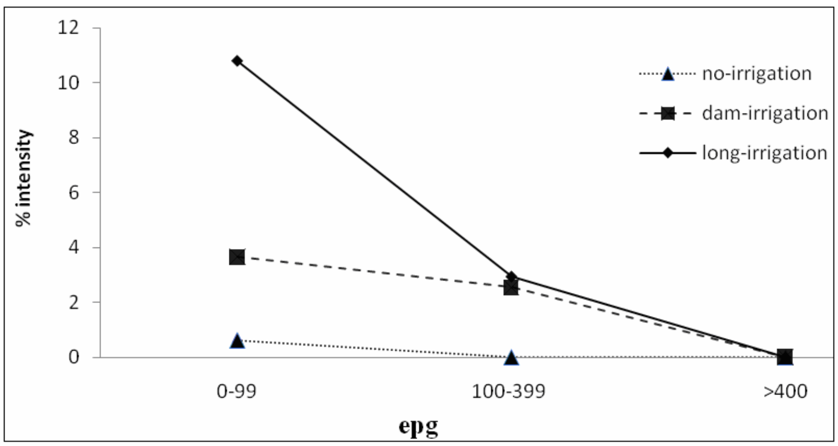

Figure 6. Intensity of *S. mansoni* infection among school children in different irrigation schemes.

The prevalence for one or more parasitic infection and specifically to *S. mansoni* infection with respect to water source user is presented in Fig. 5. The prevalence of *S. mansoni* showed the highest infection rate in the longstanding irrigated areas (13.73%), followed by the recently introduced irrigation schemes from recently constructed dams (6.18%) and the least in areas where the school children stay in un-irrigated area (0.61%). The distribution of intestinal parasitic infections in association to water source still showed significant variation (χ^2 = 8.605, P < 0.014) with highly significant variation in *S. mansoni* infection (χ^2 = 19.42, P = 0.000). Similar results were reported from Tigray by Alemayehu et al. (1998), Tadesse and Tsehaye (2008) and Tadesse and Beyene (2009). In agreement with this, longitudinal studies in other parts of Ethiopia had also indicated an increase in the prevalence of schistosome infection with the age of the irrigation scheme (Tedla et al., 1986; Abebe et al., 1995; Birrie et al., 1995). Reports from Egypt had also shown an increase in prevalence from 0.05% to 60% within less than five years following the introduction of an irrigation scheme into a region (Farid, 1971).

The prevalence of *S. mansoni* infection is associated with prevalence of the snail intermediate hosts (Markell, 1971) (see Table 3). Lemma (1969), Kloos et al. (1978) and Kloos (1985) also observed that the continuing large-scale agricultural use contributes to the spread of schistosomiasis. On the other hand, the fact that the major human intestinal helminth parasites such as hookworm, *Ascaris* and *Trichuris* larvae and ova require humid environments indicates that water source could still be a factor for transmission of intestinal parasites (Kloos et al., 1981). The findings of *S. mansoni* were also cross checked by comparing the distribution of the snail intermediate host, *Biomphalarai pfeifferi* (Table 3).

Table 3. Results of malacological survey.

No.	***Water body searched for*** *Biomphalriai pfeifferi*	***Snails***	***Cercaria infected snails***
1	Endagebriel dam	Absent	Absent
2	Bokoro dam	Absent	Absent
3	Hizaeti-Wedicheber dam	Present (++)	Present (+)
3	Lailay- Wukro dam	Absent	Absent
4	Wukro river and irrigation canals	Present (++)	Present (+)
5	Agula'e river and irrigation canals*	Absent	Absent
6	Mai Wuhug	Present (+)	Absent
7	Korir dam	Absent	Absent
8	Gereb Mihiz dam	Present (+)	Absent
9	Tsinkanet dam	Absent	Absent

- *= All weeds and grasses in the canals were removed, + indicates presence but very high quantity, ++ indicates the presence in high quantity.*

In the present study, only light and moderate intensity of *S. mansoni* infections were recorded, with no heavy infection (χ^2 = 21.99, P = 0.000) (Fig. 6). The highest light intensity of *S. mansoni* infection was in the longstanding irrigated sites followed by the recently introduced irrigation practices. In areas where there is no irrigated land (sites with rain fed agriculture), the prevalence and intensity of *S. mansoni* infection was very low, which is similar to previous studies (Alemayehu et al., 1998; Tadesse and Tsehaye, 2008; Tadesse and Beyene, 2009). In general, our findings demonstrate the impact of water- based development in creating favorable condition for intestinal helminth parasitic infections especially for *S. mansoni*.

The interesting finding of this study is the absence of *S. mansoni* infection in Agulae an area with irrigation history of more than 100 years. Furthermore, it is reported that *S. mansoni* has high prevalence (27.45%) in Megabit Selasa Primary School (Wukro), which is only 10 km away from Agulae and with similar environmental conditions.

4. CONCLUSION

It can be concluded that the increased prevalence rate of *S. mansoni* infection with the increased introduction of irrigation schemes will be of great public health concern unless appropriate control measures are designed. Lessens can be learned from Augulae, a longstanding irrigation area for more than 100 years and no *Biomphalarai pfeifferi* in the canals. Thus, removing the intermediate host by periodic clearing of the irrigation canals might have resulted getting rid of schistosomiasis. To reduce the overall parasitic infections, proper management of the water and the canal system is recommended. The provision of safe water supply and latrines can also contribute to deter schistosomiasis transmission in endemic areas by reducing the human-water contact, as significant reduction in the prevalence and intensity of infections by *S. mansoni* which has already been reported from elsewhere by water supply provision alone (Jordan *et al*., 1980).

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