

Schistosomiasis mansoni and soil-transmitted helminthiasis in Bushulo village, southern Ethiopia

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Abstract

Background: *Schistosomiasis mansoni* and soil-transmitted helminthiasis (STHs) are considerable medical and public health problems in Ethiopia. However, information is limited on the epidemiology of these infections in different localities even though it is needed to plan effective prevention and control measures.

Objective: This study was designed to determine the prevalence of *Schistosoma mansoni* and soil-transmitted helminth infections in school children and residents in Bushulo village near Lake Awassa (Hawassa), southern Ethiopia.

Methods: Cross-sectional epidemiological and parasitological studies were conducted on *schistosomiasis mansoni* and STHs in Bushulo village in May and June 2007. A total of 419 participants (353 school children and 66 other residents) were included in the study. The principal investigator interviewed the study subjects about demographic status using structured questionnaires. Moreover, experienced nurse took history and conducted physical examination to assess symptoms and signs related to chronic *S. mansoni* infection. A single stool sample was collected from each participant and processed using the Kato-Katz technique. Experienced laboratory technician read all slides at Bushulo Health Center.

Results: The overall infection rates of *schistosomiasis mansoni*, trichuriasis, ascariasis and hookworm infection were 73.7%, 41.5%, 37.2% and 28.4%, respectively. Other parasitic infections observed were caused by *Hymenolepis nana* (1.7%), *Taenia* species (1.4%), and *Enterobius vermicularis* (1.4%). Children in the age range 10-14 years and those attending at St. Paul's School had higher rates of *T. trichiura* and *S. mansoni*, respectively. Intensity of infection was higher for *A. lumbricoides* in the age range 5-9 years. The overall prevalence of any STHs was 67.3%. The rates of single, dual, triple and quadruple infections were 29.6%, 32%, 20.3% and 7.4%, respectively.

Conclusion: The high prevalence and intensity of *schistosomiasis mansoni* and soil-transmitted helminthiasis makes periodic deworming programme urgent to reduce morbidity and transmission of helminthiasis in the area. Provisions of sanitary facilities and clean water supply as well as health education are also critically needed to sustain the impact of chemotherapy. [*Ethiop. J. Health Dev.* 2011;25(1):46-50]

Introduction

Schistosomiasis and soil-transmitted helminthiasis are widely distributed and are among the major medical and public health problems in many parts of the world. According to the World Health Organization (WHO), about 1.45 billion people globally are infected with *Ascaris lumbricoides*, 1.3 billion with hookworm and 1.05 billion with *Trichuris trichiura* (1). Schistosomiasis is also common in many parts of the world and about 200 million people are infected globally (2).

Intestinal helminthiasis is intimately related to poverty and most infections are entrenched particularly in tropical regions where the biophysical environment and cultural practices favor transmission (3). For instance, of the global burden of schistosomiasis, an estimated 85% is found in sub-Saharan Africa (2). Infection with helminths is responsible for many deaths and morbidities. Among tropical parasitic diseases, the yearly estimated deaths of 200,000 are making schistosomiasis second only to malaria as a cause of mortality (2). Apart from morbidity

and mortality, intestinal helminthiasis is associated with poor physical growth and development, as well as with retarded intellectual and cognitive development in children (4, 5).

In Ethiopia, numerous epidemiological surveys of intestinal helminths were conducted and varying infection rates were reported from different regions and communities (6-9). However, most of past studies overlooked estimating intensity of infections, which would have been crucial for epidemiological and clinical evaluations. Unsafe and inadequate provision of water, unhygienic living conditions and unsanitary waste management allow intestinal parasites and other communicable diseases to flourish in various localities (10). *S. mansoni* has been recorded from all regions and is rapidly spreading with water resource development and population movements (11). *S. mansoni* is transmitted by *Biomphalaria pfeifferi* in most endemic foci in Ethiopia and by *B. sudanica* in only three foci (12).

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Schistosomiasis mansoni and soil-transmitted helminthiasis are among the major health problems around Lake Awassa (Hawassa) in southern Ethiopia. However, little is known regarding the epidemiology of these infections around Lake Awassa, where majority of children are involved in fishing and swimming activities. This survey was, therefore, conducted to determine the prevalence and intensity of *S. mansoni* and soil-transmitted helminthes infections in Bushulo village near Awassa Lake, to provide baseline information for future prevention and control programs.

Methods

Cross-sectional epidemiological and parasitological studies were conducted in Bushulo village in May and June 2007. Bushulo is a small rural town, found in Southern Nations and Nationalities Peoples Region and located along the shore of the Lake Awassa. It is located at 1,700 meters above sea level with temperatures ranging from 11.5 °C -33 °C (13). Social service institutions in the area include, one major health center and five schools (1 kindergarten and 4 junior secondary schools). The health center had beds and provided diagnostic and treatment services for its five catchment *kebeles* (administrative units) of Tulo, Alamura, Finchuwa, Worancha and St. Paulo's. Few standing pipes and dug wells were supplying water for residents in the village although they are inadequate to meet their demands. Thus, inhabitants largely relied on water from Lake Awassa for both domestic and laundering purposes. As to what proportion of inhabitants had and used latrines properly was not known. During this survey, however, we observed areas nearby bushes and the lake-side polluted with human faeces.

The study population consisted of school children attending grades 2-7 in three junior secondary schools (Tulo, St. Paulo's, and Finchuwa) and residents of Worancha *Kebele*. Selection of these schools and the Worancha *Kebele* was based on the presence of water contact points along the shore of the lake. The study subjects were those who had lived in the area for 3 or more years and had not taken treatment for any intestinal ailment during the month prior to the survey.

Sample size was estimated only for school children on the basis of *S. mansoni* prevalence of 33% (14), precision of 5% and 95% confidence interval. Rosters at the 3 schools were used as a sampling frame and a systematic sampling technique was employed to include school children (Tulo, St. Paulo's, and Finchuwa) as study subjects. Studying school population probably results in over-reporting of infections levels because of the higher rates in younger age groups. Hence, all members above 5 years of age from 20 randomly selected households in Worancha *Kebele* were also included for comparative purposes. It has to be said that, constraint of resources impeded including a justified number of residents. In total, 419 individuals (353 children and 66 residents) participated in this study.

The principal investigator interviewed the study subjects about their demographic status using structured questionnaires. Moreover, an experienced nurse took history and carried out physical examination to assess symptoms and signs related to chronic *S. mansoni* infection. Only symptoms present within 2 weeks of examination and signs present at the date of investigation were included in the analyses. A single stool sample was collected from each participant, and two slides per sample were prepared using the Kato-Katz technique at respective schools and the *Kebele* (3). On the same day of stool collection, slides were transferred to Bushulo Health Center and read once by an experienced laboratory technician. Averages of egg count on pair of slides per sample were taken and conversions into eggs per gram (epg) of stool were done by a factor of 24. Intensity of infection for each parasite was estimated using epg and categorized as light, moderate and heavy infection according to the WHO criteria specified as follows: *S. mansoni* [Light (1-99 epg), moderate (100-399 epg), heavy (≥ 400 epg)]; *T. trichiura* [Light (1-999 epg), moderate (1000-9999 epg), heavy ($\geq 10,000$ epg)]; *A. lumbricoides* [Light (1-4999 epg), Moderate (5,000-49,999 epg), Heavy ($\geq 50,000$ epg)] (1).

The study was approved by the Ethical clearance Committee of the Faculty of Medicine, Addis Ababa University. Participation was fully voluntary and study subjects or their parents gave informed oral consent. Participants found to be positive for any intestinal parasite were treated with anti-parasitic drugs as recommended by WHO (1).

The data were analyzed using SPSS Version-13 software and results were summarized using means and percentages. Pearson Chi-square test and One-Way Anova were used to evaluate differences in proportions and means, respectively. A p-value <0.05 was considered to be significant.

Results

A total of 419 individuals participated in this study 353 of whom were children attending the 3 study schools (Tulo, St. Paulo's and Finchuwa) and 66 were residents of Worancha *Kebele*. Most of the participants (92.4%) were under 20 years of age (the mean being 13.2 years) and the male to female ratio was 1 : 0.8.

Microscopic examination of stool samples showed that 323 (91.5%) of the school children and 51 (77.3%) of the residents were positive for at least 1 parasite. Seven helminth parasite species were identified and the most prevalent were *S. mansoni* (73.7%), followed by *T. trichiura* (41.5%), *A. lumbricoides* (37.2%) and hookworm species (28.4%) (Table 1). The prevalence of any STHs was 67.3%. Rare parasites observed were *Hymenolepis nana* (1.7%), *Taenia* species (1.4%), and *Enterobius vermicularis* (1.4%), although *Teania* infections were characteristically underreported in stool tests.

S. mansoni was significantly associated with the study sites ($p = 0.002$), and the highest infection rates manifested in children attending St. Paul's School (84.3%). Though differences were non-significant, rates of infection were higher among children in the age group 10-19 years (77.6%) and in males (76.6%). Moreover, *T. trichiura* was significantly associated with age ($p = 0.02$), and the highest infection rates were observed in children 10-14 years old (46.5%) (Table 1).

The intensity of infection was determined for *A. lumbricoides*, *T. trichiura* and *S. mansoni*. Although high intensities of *S. mansoni* infection were observed among the participants, associations of age, gender and study site with an arithmetic mean epg were not significant. However, intensities of *A. lumbricoides* infection were significantly influenced by age ($p = 0.03$), with the highest mean epg observed in children 5-9 years old (13,236 epg) (Table 2).

Table 1: Prevalence of schistosomiasis mansoni and soil-transmitted helminthiasis by age, gender and study sites at Bushulo village, southern Ethiopia, 2007

Characteristics	Total No. examined	<i>S. mansoni</i> no. (%)	<i>T. trichiura</i> No. (%)	<i>A. lumbricoides</i> No. (%)	Hookworm No. (%)
Age (years)					
5-9	115	78 (67.8)	50 (43.5)	43 (37.4)	35 (30.4)
10-14	200	156 (78.0)	93 (46.5)	84 (42.0)	53 (26.5)
15-19	72	55 (76.4)	19 (26.4)	20 (27.8)	22 (30.6)
20+	32	20 (62.5)	12 (37.5)	9 (28.1)	9 (28.1)
Total	419	309 (73.7)	174 (41.5)	156 (37.2)	119 (28.4)
p-value		0.10	0.02	0.12	0.86
Gender					
Male	218	167 (76.6)	95 (43.6)	89 (40.8)	70 (32.1)
Female	201	142 (70.6)	79 (39.3)	67 (33.3)	49 (24.4)
p-value		0.20	0.42	0.33	0.10
Study sites					
Tulo	148	108 (73.0)	70 (47.3)	62 (41.9)	51 (34.5)
St. Paulo's	121	102 (84.3)	40 (33.1)	40 (33.1)	32 (26.4)
Finchwua	84	60 (71.4)	37 (44.0)	34 (40.5)	18 (21.4)
Worancha	66	39 (59.1)	27 (40.9)	20 (30.3)	18 (27.3)
p-value		0.002	0.12	0.26	0.17

Table 2: Arithmetic mean eggs per gram (epg) of stool for *S. mansoni*, *A. lumbricoides*, and *T. trichiura* infections by age and gender in Bushulo village, southern Ethiopia, 2007.

Characteristics	<i>S. mansoni</i> Mean epg	<i>T. trichiura</i> Mean epg	<i>A. lumbricoides</i> Mean epg
Age (years)			
5-9	434.1	74.9	13236.0
10-14	534.8	126.2	3022.9
15-19	597.3	57.0	536.7
20+	246.0	229.9	3995.8
p-value	0.17	0.31	0.03
Gender			
Male	643.3	90.7	8021.1
Female	336.4	127.9	2420.2
p-value	0.19	0.20	0.22

As presented in Table 3, the majority of the study subjects harboring *A. lumbricoides* or *T. trichiura* had light infections. Heavy infections were common among subjects with *S. mansoni* infections (42.5%); no case of heavy infection with *T. trichiura* was observed.

Participants were infected with 1-4 parasites. Multiple infections (polyparasitism) were seen in 250 (59.7%) of all 419 examined individuals and in 66.8% of those with any infection (374 individuals). Most parasites occurred as double infections (32%) (Table 4). *S. mansoni* most

frequently combined with *T. trichiura* and *A. lumbricoides* occurred in 85 individuals (20.3%) as a triple infection. Moreover, these three parasites combined with hookworm species in 31 individuals (7.4%) as quadruple infection. The prevalence of mixed infection was not affected by age, gender or study sites.

Table 5 summarizes the prevalence of signs and symptoms among the participants stratified by *S. mansoni* infections. The most frequently reported symptoms in the study subjects were recurrent abdominal

discomfort (46.7%) and diarrhea (29.1 %). A history of diarrhea was significantly higher among participants with *S. mansoni* compared to those without this infection ($p = 0.01$).

Table 3: Prevalence and intensity of *S. mansoni*, *A. lumbricoides*, and *T. trichiura* infections among persons with respective parasite infected in Bushulo village, southern Ethiopia, 2007

Parasite	Frequency	Percent
<i>S. mansoni</i>		
Light (1-99 epg)	76	24.6
Moderate (100-399 epg)	103	33.3
Heavy (≥ 400 epg)	130	42.1
<i>T. trichiura</i>		
Light (1-999 epg)	163	93.7
Moderate (1000-9999 epg)	11	6.3
Heavy ($\geq 10,000$ epg)	0	0
<i>A. lumbricoides</i>		
Light (1-4999 epg)	110	70.5
Moderate (5,000-49,999 epg)	38	24.3
Heavy ($\geq 50,000$ epg)	8	5.1

Table 4: Prevalence of single and multiple infections by sex in Bushulo village, southern Ethiopia, 2007.

Infection status	Number (%) of individuals		
	Males	Females	Total
No parasites	19 (8.7)	26 (12.9)	45 (10.7)
Single infection	61 (28.0)	63 (31.3)	124 (29.6)
Double infections	66 (30.3)	68 (33.8)	134 (32.0)
Triple infections	50 (22.9)	35 (17.4)	85 (20.3)
Quadruple infections	22 (10.1)	9 (4.5)	31 (7.4)

Table 5: Prevalence of signs and symptoms stratified by *S. mansoni* infection status in Bushulo village, southern Ethiopia, 2007

Signs and symptoms	Positive for <i>S. mansoni</i> (N = 309) No. (%)	Negative for <i>S. mansoni</i> (N = 110) No. (%)	Total No. (%)	p-value
Enlarged liver	10 (3.2)	2 (1.8)	12 (2.9)	0.70
Enlarged spleen	15 (4.9)	3 (2.7)	18 (4.3)	0.52
Blood in stool	22 (7.1)	4 (3.6)	26 (6.2)	0.19
Abdominal pain	151 (48.9)	45 (40.9)	196 (46.7)	0.15
Diarrhea	80 (25.9)	42 (38.2)	122 (29.1)	0.01

Discussion

We determined the prevalence and intensity of infection with *S. mansoni* and soil-transmitted helminths among school children and residents of Bushulo village along the shore of Lake Awassa. The overall prevalence of helminth infection in this study was 89.3 % and infection rates were very high in children in all 3 schools and in residents of Worancha Kebele. The present study showed infection rates comparable with those previously reported from other communities in the Rift Valley in southern Ethiopia (14-16).

In Ethiopia, altitude between 1,200 to 2,000 meters is optimal for *S. mansoni* transmission and the majority of endemic areas are located in this altitudinal range (11). High infection rates of *S. mansoni* above 50% were reported in the hyperendemic areas of northwestern (Gorgora, Zerima, and Dek) (6), northeastern (Kemise and Bati towns) (7) and northern Ethiopia (Adawa) (8). However, previous studies on populations living in the same high-risk altitudinal zone in the southern part of the country reported moderate prevalence rates of *S. mansoni* infection (14, 15, 17, 18). The high prevalence and intensity of *S. mansoni* and other parasites in the present study may be attributable to unhygienic conditions,

inadequate provision of water and unsanitary waste management that, in turn, forcing residents to resort to the usage of the lake water. The magnitude of the problem emphasizes the need to take immediate intervention measures. Combined mass chemotherapy and focal snail control using primary health care systems reduced *S. mansoni* infection significantly in western Ethiopia (19). Similar interventions may have an effect on the prevalence and intensity of infections in the study area.

The high prevalence and mean intensity of *S. mansoni* infection, regardless of the age and gender of participants, highlights the negative impact it might have to promote further transmission as well as getting enormous clinical significance in various segments of the population. Likewise, high intensity of infection was reported from northern Ethiopia (8). In contrast to the present study, however, lower intensities were reported by others (6, 17). *S. mansoni* infection was significantly influenced by study sites, with the highest rate observed in children attending St. Paul's School. This may be due to the nearness of the children's dwelling close to the lake, which enhances exposure to infected water although this was not systematically studied.

The prevalence of ascariasis and hookworm infection was also in accordance with the rates reported for the 1,000 to 2,000 m zone in Ethiopia (10). Similar prevalence of *A. lumbricoides* and *T. trichiura* is possibly due to their shared ecology and life cycle. The higher intensity of ascariasis among children 5-9 years old may be because they indiscriminately play on faecally contaminated grounds and have a common habit of placing soiled fingers in the mouth.

Multiple infections are common in Ethiopia (15, 16). In this study, 1 to 4 species of parasites per individual were observed and of those with any infection most individuals harbored more than 1 parasite. This may be because of the higher prevalence of each parasites and/or their similar mode of transmission which favors multiple infections.

In conclusion, the high prevalence and intensity of *schistosomiasis mansoni* and soil-transmitted helminthiasis observed in the study area call for a periodic deworming programme to reduce transmission, worm burden and morbidity. Deworming should be supplemented with improved sanitation and access to clean water, appropriate health education and environmental measures to have a lasting impact on transmission.

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