ORIGINAL ARTICLE

STATUS OF *SCHISTOSOMA MANSONI* PREVALENCE AND INTENSITY OF INFECTION IN GEOGRAPHICALLY APART ENDEMIC LOCALITIES OF ETHIOPIA: A COMPARISON

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ABSTRACT

BACKGROUND: Schistosomiasis is one of the chronic and neglected tropical diseases affecting rural communities. Heavy infections contribute to anemia and can retard children's growth, physical activity and cognitive function. This study was conducted in order to determine the prevalence, intensity and variation of Schistosoma mansoni infection among human subjects in geographically apart localities. The prevalence and intensity of Schistosoma mansoni infection was assessed in three geographically apart endemic areas of Ethiopia from May to August 2010 through cross-sectional approach.
METHODS: A total of 1073 individuals (528 males and 545 females) were found eligible for the study. Their age ranged from 5-60 years with mean age of 11 years in Wondo Genet, 22 years in Kemissie and 24 years in Sille-Elgo. Small plastic sheets were distributed to the study participants and sizable stool specimens were collected and examined using Kato-Katz method (41.7mg template).
RESULT: The prevalence of Schistosoma mansoni infection among the study participants in Kemissie, Wondo Genet and Sille-Elgo was 89.6%, 59.9%, and 31.6%, respectively. The highest geometric mean of egg per gram of stool for Kemissie, Wondo Genet and Sille-Elgo was, 5208 and 346, 8472 and 252, 3960 and 91, respectively.
CONCLUSION: It was observed that there was comparable variation in the prevalence and intensity of infection among the study localities. Moreover, it is indicated that S. mansoni is still an ongoing public health problem which requires integrated intervention activities in the country.
KEYWORDS: Schistosoma mansoni; intensity of infection; geographic variation; Ethiopia

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INTRODUCTION

Schistosomiasis is a chronic, parasitic disease caused by blood flukes (trematode worms) of the genus *Schistosoma*. At least 230 million people require treatment every year. Transmission of schistosomiasis has been documented in 77 countries. However, those at the highest risk of infection are in 52 countries (1). Schistosomiasis ranks second to malaria among the parasitic diseases with regard to the number of people infected and those at risk. Typically, schistosomiasis is a disease that affects rural communities, particularly those dependent upon irrigation to support their agricultural activities (2). In Ethiopia, intestinal schistosomiasis and soil-transmitted helminthic infections represent a major public health concern (3). Different authors at different times and endemic localities had reported a high prevalence of *Schistosoma mansoni* with variation in intensity of infection (4, 5, 6). Rainfall and temperature are important driving factors of malaria and schistosomiasis transmission.

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Rainfall is largely responsible for creating the conditions that allow sufficient surface water accumulations in ponds which will provide abundant snail breeding sites and facilitate transmission of schistosomiasis (7).

MATERIALS AND METHODS

Study areas and duration: A cross sectional *S. mansoni* prevalence and intensity of infection study was conducted in Wondo Genet, Kemissie and Sille-Elgo in 2010. Wondo Genet is found in western Arsi in Oromiya Regional State. It is about 261Km south of Addis Ababa, located at 07°05'35"N, 038°36'66"E at an altitude of 1,682 meters above sea level with average annual rainfall of 1244mm and annual temperature of 17-19°C.Kemissie is found in Oromiya Nationality Administrative Zone of the Amhara Regional State. The study site is situated within the Borkena River basin, approximately 305 km northeast of Addis Ababa at 10°43'30"N, 039°04'20"E at an altitude of 1,450 meters above sea level with average annual temperature of 19.36°C and 950mm rainfall. Sille-Elgo is found in Gofa Zone in the Southern Nations and Nationalities Regional State. It is about 525Km away southwest of Addis Ababa located at about 05°28'39"N, 037°26'02"E at an altitude of 1,188 meters above sea level, with annual rainfall of 900mm and 29°C annual average temperature**.**

Sample size determination: The sample size was estimated for each study site using Daniel's formula [$n=Z^2 P (1-P)/d^2$], where n is the sample size, Z is statistics for level of confidence, P is expected prevalence or proportion, and d is precision. Thus, based on previous prevalence of *S. mansoni* infections, i.e., 55% for Wondo Genet (8) 66% for Kemissie and 65% Sille-Elgo(9), sample size of 380, 345 and 350 were drawn for Wondo Genet, Kemissie and Sille-Elgo, respectively. The inclusion criterion to participate in the study was 5–60 years of age for both sexes.

Diagnosis: Small plastic sheets were distributed to voluntary study participants and sizable stool specimens were collected and examined using Kato-Katz thick smear method using 41.7mg template (10). Infection status was determined by the presence or absence of *Schistosoma mansoni* eggs, and level of intensity was determined by egg count per gram (EPG) of the stool. Classes of intensity were determined as light (1 -99), moderate (100-399 eggs), and heavy (≥400 eggs). The EPG was determined by multiplying the number of eggs counted by a factor of 24 according to WHO guideline (11).The laboratory examination was carried out both by experienced laboratory technicians and the principal investigator.

Data analysis: Data for both prevalence and intensity of infection was analyzed using Microsoft Excel 2007and SPSS version 16. Chi square test, odds ratio and ANOVA were used to describe statistical parameters. Data was presented in the form of tables and figures.

Ethical considerations: The study was ethically approved by the Institutional Research and Ethics Committee of the Department of Biology, Addis Ababa University, and by the National Research and Review Committee. Informed consent was obtained from all adult study subjects. For school age children younger than 18, verbal consent was obtained from their parents or through health extension workers and school principals. In addition, the children also gave their assent. All study participants found positive for *S. mansoni* and other helminthes were treated with Praziquantel at a dose of 40mg/Kg body weight and Albendazole (400mg), respectively.

RESULTS

The prevalence of *Schistosoma mansoni* infection among the study participants in Kemissie, Wondo Genet and Sille-Elgo was 89.6, 59.9, and 31.6%, respectively (Table1).

In this study, *Ascaris lumbricoides* and *Trichuris trichiura* were also observed as major helminthic parasites (Table 1). Among the study participants examined in Wondo Genet, 65.5% of the males and 55% of the females were found positive for *S. mansoni*. The minimum and maximum egg per gram of feces count was 24 and 8472, respectively, with a geometric mean of 252. In Kemissie, 91% of males and 83.3% of females were found positive for *S. mansoni*. The minimum and maximum eggs per gram of feces were 24 and 5208, respectively, with a geometric mean of 346. In Sille-Elgo the proportion of *S. mansoni* positive males and females was 32.8% and 30.2%, respectively. The minimum and maximum egg per gram of feces was 24 and 3960, respectively, with a geometric mean of 91 EPG.

Table 1: Distribution of major helminth infection among Wondo Gent, Kemissie and Sille-Elgo study subjects with respect to sex, 2010

Study Area	Examined			*S. mansoni*			*A. lumbricoides*			*T.trichia*			All three		
	Male	Female	Total	Male (%)	Female (%)	Total (%)	Male (%)	Female (%)	Total (%)	Male (%)	Female (%)	Total (%)	Male (%)	Female (%)	Total (%)
Wondo Genet	177	207	384	116(65.5)	114(55)	230(59.9)	64(36.1)	90(43.4)	154(40)	45(25.4)	59(28.5)	104(27)	40(22.5)	42(20.2)	82(21)
Kemissie	156	189	345	142(97.2)	167(88.3)	309(89.9)	25(16)	25(13.2)	50(14)	6(3.8)	9(4.7)	13(3.7)	4(2.5)	4(2.1)	8(2)
Sille-Elgo	195	149	344	64(32.8)	45(30.2)	109(31.6)	8(4.1)	12(8)	20(5.8)	9(4.6)	24(16.1)	33(9.5)	0(0)	2(1.3)	2(0.5)
Total	528	545	1073	322(60.9)	326(59.8)	748(69.7)	97(18.3)	127(23.3)	227(21.1)	60(11.3)	92(16.8)	104(9.6)	44(8.3)	48(8.8)	92(8.5)

In order to determine the significance of sex and age on infection rate and intensity level, comparison of means and regression analysis were carried out. The highest proportion of *S. mansoni* heavy intensity of infection with respect to age was observed among the 5-14 years age groups of Wondo Genet followed by Kemissie and Sille-Elgo (Table2).

Table 2: Frequency of *S. mansoni* intensity of infection by age groups among Wondo Gent, Kemissie and Sille-Elgo study subjects, 2010

	Wondo Gent			Kemissie			Sille-Elgo		
AGE	Light	Moderate	Heavy	Light	Moderate	Heavy	Light	Moderate	Heavy
5-9	39	31	50	20	23	26	10	9	5
10-14	30	30	37	11	17	37	16	7	3
15-19	0	3	0	4	10	22	10	4	0
20-24	2	1	0	5	4	10	10	1	2
25-29	2	0	1	3	10	7	8	3	0
30-34	0	1	1	6	7	5	5	2	0
35-39	0	0	0	4	10	5	4	0	0
40-44	1	0	0	11	14	5	2	0	0
45+	1	0	0	10	14	9	7	2	0
Total	75	66	89	74	109	126	72	28	10

It was also observed that heavy intensity of *S. mansoni* infection in relation to sex was higher among males (39.1%) than in females (33.8%) in Kemissie. Similarly heavy intensity of *S. mansoni* infection in Wondo Genet was higher in males (26.5%) than in females (20.2%), while in Sille-Elgo, the proportion was relatively lower among males (2.5%) than females (3.3%) (Table3). On the other hand, age has association with *S. mansoni* infection in all study areas (Table 4).

Table 3: Proportion of *S. mansoni* intensity of infection among Wondo Gent, Kemissie and Sille-Elgo study subjects by sex, 2010

	Wondo Genet			Kemissie			Sille-Elgo		
	Light	Moderate	Heavy	Light	Moderate	Heavy	Light	Moderate	Heavy
Male	18.6%	20.3%	26.5%	18.5%	33.3%	39.1%	23.5%	7.1%	2.5%
Female	20.2%	14.4%	20.2%	23.2%	31.2%	33.8%	17.4%	9.3%	3.3%
Total	19.5%	17.1%	23.1%	21.1%	32.1%	36.2%	20.9%	8.1%	2.9%

Table 4: Statistical comparison of *S. mansoni* infection rate in relation with sex and age, 2010

Study area	Sex				Age		
	χ^2	OR	95%CI	P value	χ^2	OR	95%CI P value
Wondo Genet	4.35	1.511	(1.026-2.346)	0.037	43.596		0.000
Kemissie	*	*	*	*		1.517	(1.084-2.123)
Sille-Elgo	*	*	*	*	26.904	2.889	(1.150-7.259) 0.001

*No significant Association, OR: Odds ratio, CI: Confidence interval

ANOVA indicated that there is a significant association between age and intensity of *S. mansoni* infection among Wondo Genet (F=4.970, 8DF*P*=0.000), Kemissie (OR=2.044, 95%CI, 1.299, 3.216) and Sille-Elgo (F= 3.866, 8DF, *P*=0.000), (OR=7.457, 95%CI, 1.496, 3.718) study subjects (Table 5). In Wondo Genet, sex and intensity of infection had significant association (OR=1.55, 95%CI, 1.033, 1.446) while in Kemissie and Sille-Elgo, there was no association (Table5).

Table 5: Statistical comparison of *S. mansoni* intensity of infection in relation with sex and age

Study area	Sex				Age			
	χ^2	OR	95%CI	P value	χ^2	OR	95%CI	P value
Wondo Genet	4.35	1.55	(1.033-1.446)	0.037	43.596			0.000
Kemissie	*	*	*	*		2.044	(1.299-3.216)	
Sille-Elgo	*	*	*	*		7.457	(1.496-3.718)	0.000

*No significant Association, OR: Odds ratio, CI: Confidence interval

The overall prevalence of *Schistosoma mansoni* infection in the three study areas combined was 69.7% (Table1).The proportion of infection rates among males (60.9%) and females (59.8%) was relatively similar. Hence, there was no association observed between sex and rate of infection (χ^2 =0.207, 1DF, *P*=0.649). However, age had an impact on infection rate (χ^2 =51.663, 8DF, *P*=0.000). ANOVA indicated that age has a significant influence on intensity of infection (*P*=0.000). The Odds Ratio also showed association between age and intensity of infection (OR=1.156, 95%CI, 1.009, 1.326).

DISCUSSION

In the present study, *Schistosoma mansoni* infection among the study participants of Kemissie, Wondo Genet and Sille-Elgo was prevalent at different rates. Other helminthic infections observed to be prevalent included *Ascaris lumbricoides* and *Trichuris trichiura*. Intensity of *S. mansoni* infection within the three study sites was considerably variable. There was variation in intensity of infection among the different age categories. In Kemissie, 91% of males and 88% of females were found positive for *S. mansoni*. A previous study conducted around Kemissie (Cheretee) (9) reported *S. mansoni* infection prevalence of 50.2% of which 28.3% of them had an egg per gram count of greater than 100 with a geometric mean of 24. In contrast to this previous study, the current study showed a higher prevalence (89.9%) and intensity (346 EPG) of *S. mansoni* infection. This could be an indicator for the presence of change in the dynamics of *S. mansoni* transmission.

A previous work by Berhe et al. (2007) demonstrated that in Sille-Elgo, the prevalence of *S. mansoni* infection was 65.1%, with the intensity of infection being over 100 epg (mean 24 epg) in 33.8% of the positive cases. However, in the present study, the prevalence of *S. mansoni* infection was 31.6% with a maximum epg of 3960 (mean 91 epg). Although the prevalence of *S. mansoni* in Sille-Elgo decreased, the intensity of infection remains high. This could be due to over-dispersion of *S. mansoni* infection in an endemic community. An important consequence of the over-dispersed distribution in egg counts is that the majority of eggs excreted in a community come from a minority of residents (12). The

intensity of infection in Sille-Elgo was found to be associated with age. In the 5-9 years age group, the intensity of infection was 7.457 times that of 40-44 years age group. Children below 10 years of age had the highest intensity of infection compared with the adults. In a Brazilian study, the highest infection rates occurred in the age group from 10-30 years, and the highest epg were found in the age group of children up to 10 years (10). In terms of age in relation to high intensity of infection, these finding are in line with the current study.

The current study showed a high rate of *S. mansoni* infection in Wondo Genet. The prevalence of infection has sex-related patterns. Furthermore, moderate and heavy intensity of infection was more prevalent in males than in females, while the prevalence of light infection was relatively higher in females than in males. A previous study (13) to evaluate efficacy of Prazequentel among children randomly selected from Shesha Kekele Elementary School in Wondo Genet, showed a pre-treatment prevalence of 74.9% *S. mansoni* infection, relatively higher than our report, with sex related pattern. However, infection intensity showed significant association with age, but not with sex in contrast to our study where both sex and age has association with intensity of infection.

In conclusion, the study demonstrated that the prevalence of *Schistosoma mansoni* infection in the study areas was high and represents a public health problem. However, there was variation in the prevalence among the different localities, the highest being in Kemissie followed by Wondo Genet and Sille-Elgo. Similarly, intensity of infection was the highest for Kemissie followed by Wondo Genet and Sille-Elgo. We recommend a more rigorous research and control activities in the endemic areas of the country in order to minimize the health and economic burden. In general, in Africa and other parts of the tropical areas, economic developmental works such as the construction of dams mainly for irrigation and occasionally for large hydroelectric power projects has intensified community level infection by diseases related to water and created new areas of transmission(14). This is also happening in Ethiopia. A study had indicated that through mass treatment administration, a successive survey found that the prevalence of soil-transmitted helminthes and *Schistosoma mansoni* infection had been reduced significantly. Infection intensity and signs of early clinical morbidity also decreased significantly (15). Mass preventive chemotherapy with Praziquantel is important to control the diseases. However, mass chemotherapy may result in development and spread of drug resistance that requires a system to monitor its sensitivity and detection of instance of resistance (16). Thus, such preventive chemotherapy control programs integrated with snail control should be implemented in the country.

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