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Soil transmitted helminths and *Schistosoma mansoni* infections in elementary school children at Tach Armachiho district, north-west Ethiopia

Mulat Yimer [1a], Bayeh Abera [1b],Wondemagegn Mulu[1c]

College of Medicine and Health Sciences, Bahir Dar University[1]

ABSTRACT

Background*: In developing regions of the world, helminth infections particularly those caused by soil transmitted helminths (STHs) and schistosomes constitute major public health challenges. Current data indicates that an estimated 4.5 billion individuals are at risk of STHs infections and the global estimate number of cases of A. lumbricoides is 807 million, T. trichiura 604 million, Hookworm species 576 million and schistosomiasis 207 million. Therefore, the aim of this study was to determine, STHs and S. mansoni infections in elementary school children at Tach Armachiho district, north-west Ethiopia.*

Methods: *A cross- sectional study was conducted from May15 to June 10, 2013 on STHs and S. mansoni infections. For the study, a total of 422 school age children were participated at three elementary schools. Proportionate allocation was used to determine the number of students involved in each selected school. Moreover, using registration list, simple random sampling method was employed to select students from each section. The stool sample was processed using: direct and Kato-Katz methods.*

Results: *Of the 422 study participants involved in the study, 135 (31.9%) were males and 287 (68 %) were females. The overall prevalence of STHs and S. mansoni infections was 315 (74.6%) and more than half 262 (62.1%) of school age children had single infections. Most of the double infections account for S. mansoni + A. lumbricoides 24 (5.7%). However, no triple or quadruple infections were identified. Most of light infections 170 (40.3%), moderate and heavy infections were identified in S. mansoni and accounts for 90 (21.3%) and 32 (7.6%) respectively. Shoe wearing and swimming habits, water source and latrine used by the family showed statistically significant associations (P < 0.001).*

Conclusion: *Prevalence of STHs and S. mansoni was high and the disease was still a major health problem in the study areas. Therefore, there is a need for community mobilization towards provision of safe and adequate water supply, latrine construction to reduce open field defecation, and health education aimed at bringing behavioural change in the district.*

Keywords: STHs, *S. mansoni*, school age children, Tach Armachiho district, Ethiopia

INTRODUCTION

In the vast majority of developing tropical and subtropical regions of the world, helminth infections particularly those caused by soil transmitted helminths (STHs) and schistosomes constitute major public health and developmental challenges [1]. Current data indicates that an estimated 4.5 billion individuals are at risk of STH infections and the global, estimated number of cases of *A. lumbricoides* is 807 million, *T. trichiura* 604 million, Hookworm species 576 million, schistosomiasis 207 million [2].

However, the burden of these helminth infections has been consistently underestimated in the past, but there is now a general consensus that STHs infections and schistosomiasis represent an important public health problem especially for children [3]. STHs are transmitted through poor sanitation, through ingestion of faecally contaminated eggs and through skin penetration of infective larva and schistosomiasis by contact with infected freshwater streams and lakes [4]. School -aged children are typically at increased risk resulting in high prevalence and intensity of infection due to high level of exposure [5].

The adverse effects of intestinal parasites among children are diverse as well as alarming and have detrimental effects on the survival, appetite, growth and physical fitness's, school attendance and cognitive performance [6].

In Ethiopia, the prevalence and distribution of STHs and *S. mansoni* differs from place to place due to differences in geography and climate. The prevalence of hookworm spp., *A. lumbricoides* and *T. trichuiria* in children are estimated to be 16%, 37% and 30% respectively [7]. Previous researches carried out in different parts of the country have shown that prevalence of STHs and *S. mansoni* are higher in humid central highlands than in dry areas of the country [8, 9].

An increment in prevalence of STHs and schistosomiasis in Ethiopia is because of the lowest: quality of drinking water supply and latrine coverage in the world. Hence, they have been widespread in our country and are the second most predominant causes of outpatient morbidity in the country [10], and schistosomiasis is common in northern region as compared to south and south west regions of Ethiopia [11]. Hence, Tach Armachiho district is one of the districts found in the north-west parts of the country, with every third patient is infected with *S. mansoni* and every 4-6 patients with STHs [laboratory registration book]. Therefore, aim of this study was to determine, STHs and *S. mansoni* infections in elementary school children at Tach Armachiho district, north - west Ethiopia.

MATERIALS AND METHODS

Study period and area

A cross- sectional study was conducted from May15 to June 10, 2013 on soil transmitted helminths and *Schistosoma mansoni* infections in elementary school children at Tach Armachiho district, north-west Ethiopia. Tach Armachiho is one of the woredas in the Amhara Region of Ethiopia and is named after "Armachiho", a province in northwestern Ethiopia along the border with Sudan and south of the Tekezé River. It is bordered on the south by Lay Armachiho and Chilga, on the southwest by Metemma, on the west by Mirab Armachiho, on the north by the Tegeda, on the east by Dabat, and on the southeast by Wegera. The woreda has a total population of 89,115. Of whom 45,874 are men and 43,241 women and 13.8% are urban inhabitants. The majority of the inhabitants practiced Ethiopian Orthodox Christianity, with 97.8% reporting that as their religion, while 1.4% of the population said they were Muslim [12].

Sample size determination and sampling techniques

There are 6 elementary schools in the district and each school can be considered as a stratum based on geographical difference. Assuming that the sample includes 50% of schools and hence, using the simple random sampling method 3 schools were selected.

The sample size for this study was calculated by using single proportion formula at 95% confidence interval (CI) level (Z (1-ά/2) = 1.96), an expected prevalence of 50% since there was no study conducted regarding this topic in the area and 5% marginal error. Then the sample size was calculated as $n = [Z\ 1- a/2]^2\ P(1-p]/d^2$, Where: n = sample size, P = population proportion, Z 1-a/2 = CI of 95%, d = Marginal error to be tolerated. By adding 10% of non response rate, 422 students were included in our study. Then, proportionate allocation was employed to know sample size of each stratum based on the number of students enrolled in each school. Hence, the number of students participated in each school were: 150 for Sanja, 132 for Ashere and 140 for Masero, having a total of 422 students.

Finally, using registration list, simple random sampling method was employed to select students from each section using a table of random numbers and when the selected student was absent, the student before or after the indicated one was sampled for replacement.

Quality control

For quality purpose proper thin wet mount and Kato-Katz techniques was prepared using standard amount of specimen and examined within a given time. Ten percent of the slides was randomly selected and re-examined at the end by experienced laboratory technologist who was blind for the first examination result. The result of laboratory examination was recorded on well prepared format carefully and finally it was attached with the questionnaire.

Data management and analysis

After data collection process, the data was checked for completeness. Then the result of laboratory examination was recorded on well prepared format carefully and finally was attached with the questionnaire. The egg per gram stool (EPG) was used to categorize intensity of infection. The intensity of infection was classified as light (when EPG was < 200), moderate (EPG = 201-800), and heavy (EPG > 800) [13]. The frequency distribution of both dependent and independent variables were done. The dependent variables were STHs and *Schistosoma* infections in the children. Potential risk factors explored include: hand washing, shoe wearing, finger nail trimming and swimming habits, presence of latrine and its usage. The data was entered into a computer using SPSS 16 version and univariate association between each exposure and the presence of infection was assessed using the Chi-squared test and P-value less than 0.05 was taken as statistical significant.

Ethical consideration

Ethical clearance was obtained from Bahir Dar University, College of Medicine and Health Sciences and Tach Armachiho district education office. Additionally, after explaining the importance of the study briefly an informed written consent was obtained from parents of the study subjects. Anyone not willing to take part in the study had full right to do so and confidentiality of the study participants was also maintained. Finally, those students who were positive for intestinal parasites were treated accordingly by appropriate antiparasitic drugs.

RESULTS AND DISCUSSION

In this study, of the 422 study participants involved in the study, 135 (31.9%) were males and 287 (68 %) were females. Half of the school age children 214 (50.7%) were those in the age groups between 6-10, followed by 11-15, 193 (45.7%). While the least were those ≤ 5, 4 (0.9%). More number of school age children involved in this study were those in 1st cycle (grades from 1-4), 302 (71.6%) as compared to 2nd cycle (grades from 5-8), 120 (28.4%). Regards to parents' education of the students, more than 50 % of their parents hadn't had formal education 279 (66.1%). Most of the study participants were Orthodox 348 (91%) and the least were protestant 13 (3.1%) (Table 1

Table 1 Sociodemographic characteristics of school age children attending at three elementary schools infected with soil transmitted helminths and *Schistosoma mansni* at Tach Armachiho district, 2013.

	Name of school			
Characteristics	Sanja	Ashere	Masero	Total
	No (%)	No (%)	No (%)	No (%)
Sex				
Male	47 (34.8)	39 (28.9)	49 (36.3)	135 (31.9)
Female	103 (35.9)	93 (32.4)	91 (31.7)	287 (68)
Total	**150 (35.5)**	**132 (31.3)**	**140 (33.2)**	**422 (100)**
Age group in years				
≤ 5	2 (50)	2 (50)	0	4 (0.9)
6-10	78 (36.4)	70 (32.7)	66 (30.8)	214 (50.7)
11-15	66 (34.2)	58 (30)	69 (35.8)	193 (45.7)
16-20	4 (36.4)	2 (18.2)	5 (45.4)	11 (2.6)
Total	**150 (35.5)**	**132 (31.3)**	**140 (33.2)**	**422 (100)**
Students' education				
1st cycle (1-4)	110 (36.4)	92 (30.5)	100 (33.1)	302 (71.6)
2nd cycle (5-8)	40 (33.3)	40 (33.3)	40 (33.3)	120 (28.4)
Total	**150 (35.5)**	**132 (31.2)**	**140 (33.2)**	**422 (100)**
Parents' education				

No formal	102 (36.2)	92 (33)	86 (30.8)	279 (66.1)
1-4	25 (33.3)	21 (28)	29 (38.7)	75 (17.8)
5-8	6 (33.3)	5 (27.7)	7 (38.9)	18 (4.2)
9-12	8 (34.8)	7 (30.4)	8 (34.8)	23 (5.4)
Diploma & above	10 (37)	7 (25.9)	10 (37)	27 (6.4)
Total	**150 (35.5)**	**132 (31.2)**	**140 (33.2)**	**422 (100)**

Association between, some of the potential associated factors with STHs and *S. mansoni* infections in school age children showed that most of the students had hand washing habit before and after meal 299 (70.9%) and the least had hand washing habit before meal 26 (6.5%). More than half of school age children didn't trimmed their finger nails 279 (61%) as compared to trimmed ones 143 (33.9%) (Table 2).

Regarding to shoe wearing habit, most of the school age children wore their shoes sometimes 245 (58%) and the least were those who wore not at all 9 (2.1%). Moreover, those who had swimming habit of sometimes accounting for greater than 50% of the school age children 267 (63.3%). However, those who swam not at all were nil (0). Furthermore, almost all family members of school age children use the water source from rivers 310 (73.5%). While those used pipeline were nil (0). Finally, 246 (58.3%) of school age children practiced open field daefication, followed by public latrine 176 (41.7%). while those practiced private latrine were nil (0) (Table 2). Among the above associated factors, hand washing habit and finger nail trimming didn't show statistically significant association $P < 0.917$ and $P < 0.867$ respectively. Whereas shoe wearing and swimming habits, water source and latrine used by the family showed statistically significant associations $P < 0.001$ (Table 2).

Table 2 Association between potential associated factors with soil transmitted helminths and *Schistosoma mansoni* infections in school age children at three elementary schools in Tach Armachiho district, 2013.

	Name of school				
Characteristics	Sanja	Ashere	Masero	Total	P -value
	No (%)	No (%)	No (%)	No (%)	
Hand washing habit					
Before meal	9 (34.6)	10 (38.6)	7 (27)	26 (6.1)	
After meal	35 (36.1)	31 (32)	31 (32)	97 (23)	$P < 0.917$
Before &after meal	106 (35.5)	91 (30.4)	102 (34.1)	299 (70.9)	

Total	**150 (35.5)**	**132 (31.2)**	**140 (33.2)**	**422 (100)**	
Finger nail trimming					
Yes	52 (36.7)	46 (32.2)	45 (31.5)	143 (33.9)	P < 0.867
No	98 (35.1)	86 (30.8)	95 (34)	279 (66)	
Total	**150 (35.5)**	**132 (31.2)**	**140 (33.2)**	**422 (100)**	
Shoe wearing habit					
Always	62 (36.9)	69 (41.1)	37 (22)	168 (39.8)	
Sometimes	85 (34.7)	62 (25.3)	98 (40)	245 (85)	P < 0.001
Not at all	3 (33.3)	1 (11.1)	5 (55.6)	9 (21.3)	
Total	**150 (35.5)**	**132 (31.2)**	**140 (33.2)**	**422 (100)**	
Swimming habit					
Always	57 (36.8)	64 (41.3)	34 (21.9)	155 (36.7)	
Sometimes	93 (34.8)	68 (25.5)	106 (39.7)	267 (63.3)	P < 0.001
Not at all	0	0	0	0	
Total	**150 (35.5)**	**132 (31.2)**	**140 (33.2)**	**422 (100)**	
Water source					
Pipe line	0	0	0	0	
Protected spring	30 (50)	20 (33.3)	10 (16.7)	60 (14.2)	P < 0.001
Well	20 (38.5)	15 (28.8)	17 (32.7)	52 (12.3)	
River	120 (38.7)	60 (19.4)	30 (9.7)	310 (73.5)	
Total	**150 (35.5)**	**132 (31.2)**	**140 (33.2)**	**422 (100)**	
Latrine type					
Public	60 (34.1)	53 (30.1)	63 (35.8)	176 (41.7)	
Private	0	0	0	0	P < 0.001

Open field	90 (36.6)	79 (32.1)	77 (31.3)	246 (58.3)
Total	**150 (35.5)**	**132 (31.2)**	**140 (33.2)**	**422 (100)**

The overall prevalence of STHs and *S. mansoni* infections was 315 (74.6%) and more than half 262 (62.1%) of school age children had single infections. While 53 (12.6%) had double infections and no triple or quadruple infections were identified. The prevalence in each school showed that Sanja accounts 112 (74.7%), Ashere, 91 (69%) and Masero, 112 (80%). Among the parasites identified, *S. mansoni* accounts for 239 (56.6%), hookworm spp., 12 (2.8%), and *A. lumbricoides*, 5 (1.2%). Among the double infections, most of the double infections account for *S. mansoni* + *A. lumbricoides* 24 (5.7%), followed by *S. mansoni* + hookworm spp., 18 (4.3%) (Table 3).

Table 3 Prevalence of soil transmitted helminths and *Schistosoma mansoni* infections in school children attending at three elementary schools in Tach Armachiho district, 2013.

	Name of school			
Parasites identified	Sanja	Ashere	Masero	Total
	No (%)	No (%)	No (%)	No (%)
No ova or parasite	38 (35.5)	41 (38.3)	28 (26.2)	107 (25.4)
Schistosoma mansoni	84 (35)	68 (28.5)	87 (36.4)	239 (56.6)
Ascaris lumbricoides	3 (27.3)	4 (36.4)	4 (36.4)	11 (2.6)
Hook worm spp.	4 (33.3)	6 (50)	2 (16.7)	12 (2.8)
S. mansoni, T. trichuira	5 (45.5)	4 (36.4)	2 (18.2)	11 (2.6)
S. mansoni, A. lumbricoides	9 (37.5)	7 (29.2)	8 (33.3)	24 (5.7)
S. mansoni, Hook worm spp	6 (33.3)	3 (16.7)	9 (50)	18 (4.3)
Total	**150 (35.5)**	**132 (31.2)**	**140 (33.2)**	**422 (100)**

The intensity of STHs and *S. mansoni* infections showed that most of light infections categorized as *S. mansoni* 170 (40.3%), followed by hook worm spp., 30 (7.1%) and *A. lumbricoides*, 14 (3.3%). However, moderate and heavy infections were identified only in *S. mansoni* infections and accounts for 90 (21.3%) and 32 (7.6%) respectively (Table 4).

Table 4. Categorization of intensity of infection due to *S. mansoni, A. lumbricoides* and hook worm spp. in school age children at three elementary schools in Tach Armachiho district, 2013.

Infection status	Type of parasites identified		
	S. mansoni	*A. lumbricoides*	Hookworm spp
	No (%)	No (%)	No (%)
Negative	130 (30.8)	408 (96.7)	392 (92.9)
Light	170 (40.3)	14 (3.3)	30 (7.1)
Moderate	90 (21.3)	0	0
Heavy	32 (7.6)	0	0
Total	**422 (100)**	**422 (100)**	**422 (100)**

DISCUSSION

Soil transmitted helminths and *Schistosoma* infections are among the most prevalent afflictions of humans who live in areas of poverty in the developing world. Despite presence of the deworming program for control of STHs and *S. mansoni* currently in study area, the finding in this study showed that overall prevalence of STHs and *S. mansoni* was high 315 (74.6%) (Table 3) and the disease was still a major health problem of the study area. *S. mansoni* was most prevalent 239 (56.6 %,) followed by *S. mansoni + A. lumbricoides*, 24 (5.7%) (Table 3). This finding was different from a study conducted in Chilga, overall prevalence of 68.4% and infection due to *A. lumbricoides* was the most prevalent (42.9%), followed by the hookworms (37.7%), and *S. mansoni* (19.4%) [14].

Moreover, this study was different from a study conducted on intestinal helminthic infections in school children in Adarkay district, north-west Ethiopia [15] reported overall prevalence rates of 55.3% for *S. mansoni*, 43.0% for *A. lumbricoides* and 20.2% for hookworm spp. Furthermore, this study was also different from other similar studies undertaken in school children by the same author has recorded infection rates of 41.3%, 35.0% and 22.8% for *A. lumbricoides*, *S. mansoni* and hookworm spp infections respectively, in the Dembia plains [16]; and 35.6%, 17.3% and 3.3% for *A. lumbricoides*, *S. mansoni*, and hookworm spp, respectively, in Gondar town and surrounding areas [17]. The differences in prevalence among the different communities appear to be associated with environmental sanitation, water supply and socioeconomic status of households. This was explained in Table 2 as: 279 (66%) of the school age children didn't trimmed their finger nails, 245 (85%) of them wore their shoes sometimes, 310 (73.5%) of their family use river water for their consumption and 246 (50.3%) of the school children use open field daefication practices. Although this needs to be verified in more extensive follow up studies.

STHs and *S. mansoni* were co-endemic in the study area in this study. The overall double infection was 53 (12.6%) and most of the double infections account for *S. mansoni + A. lumbricoides* 24

(5.7%), followed by *S. mansoni* + hookworm spp., 18 (4.3%) (Table 3). This finding was lower than the findings from Chilga district [14] and Adarkay districts [15]. This might be is due to geographical and climate difference [7].

In this study, faecal egg counts was done using the Kato-Katz technique and expressed as the mean egg output of infected and uninfected persons to assess the intensity of infection. Although this method is vulnerable to sampling errors due to a variety of parasite and host factors [18], it is still widely used as an indirect measure of intensity of intestinal helminth infections particularly for samples collected from communities.

Based on this principle, categorization of intensity due to S. *mansoni, A. lumbricoides* and hookworm spp infections was done. The rate of light infection was highest for *S. mansoni* 170 (40.3%), followed by hookworms spp, 30 (7.1%) of the infected children. However, rate of moderate and heavy infections were observed only in *S. mansoni* infection, accounting for 90 (21.3%) and 32 (7.6%) respectively (Table 4). There is evidence that individuals with more than one helminthic infections have been heavier infections with STHs and *S. mansoni* because morbidity from these infections and rate of transmission are directly related to the numbers of worms harboured in the host [19], and the intensity is mainly epidemiological index used to describe soil transmitted helminthic infection. This finding was different from the finds obtained from Chilga [14] and Adarkay districts [15]. This is might be due to the reasons explained abov

Generally, the high prevalence rate of STHs and *S. mansoni* infections encountered among schoolchildren of the study area raises a serious concern. It signifies the fact that children are the highest risk groups in the community and serve as sources of infection and transmission. These parasites are well known to be associated with lowered working capacity and productivity both in children and increased susceptibility to other infections. Moreover, helminths also impair the mental and physical development of children [20].

CONCLUSION

In this study, prevalence of STHs and *S. mansoni* was high and the disease was still a major health problem in the study areas. Because of rapid re -infection after chemotherapy, the highly effective drugs now available and the control methods used in study areas have not reduced the prevalence of STHs and *S. mansoni* infections. Hence, other control activities should be focused in addition to deworming program for sustainable reduction in helminthic infection frequency and intensity of infection. Therefore, there is a need for community mobilization towards provision of safe and adequate water supply, latrine construction to reduce open field defecation, and health education aimed at bringing behavioural change in the district.

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