ORIGINAL ARTICLE

SOIL TRANSMITTED HELMINTHS AND ASSOCIATED FACTORS AMONG SCHOOLCHILDREN IN GOVERNMENT AND PRIVATE PRIMARY SCHOOL IN JIMMA TOWN, SOUTHWEST ETHIOPIA

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ABSTRACT

BACKGROUND: Soil transmitted helminth infections are among the most common human infections. They are distributed throughout the world with high prevalence rates in tropical and sub-tropical countries mainly because of lack of adequate sanitary facilities, inappropriate waste disposal systems, lack of safe water supply, and low socio- economic status.

METHODS: A comparative cross sectional study was conducted from December 2011 to June 2012 to determine and assess the prevalence of soil transmitted helminths and their associated factors among government and private primary school children. Stool samples were collected from 369 randomly selected children and examined microscopically for eggs of soil transmitted helminth following McMaster techniques. Soil samples were collected from different parts of the school compound and microscopic examination was performed for eggs of the helminths using sodium nitrate flotation technique.

RESULTS: The overall prevalence rate of soil transmitted helminth infections in private and government schools was 20.9% and 53.5% respectively. T. trichiura was the most common soil transmitted helminth in both schools while hookworm infections were identified in government school students only. Type of school and sex were significantly associated with soil transmitted helminth. Soil contamination rate of the school compounds was 11.25% with predominant parasites of A. lumbricoides.

CONCLUSION: Higher prevalence of soil transmitted helminth infection was found among government school students. Thus, more focus, on personal hygiene and sanitary facilities, should be given to children going to government schools.

KEYWORDS: Soil transmitted helminths, school children, government and private schools

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INTRODUCTION

Soil transmitted helminths (STH) have been identified as a serious public health problem, predominantly among poor communities in the developing world (1, 2). Over one billion people in the world are affected by STHs alone (3) particularly putting school age (5-15 years) children at risk (2, 4).

High incidence rate of STH infections occur in the Americas, China, East Asia and Sub-Saharan Africa (2). Prevalence rate of 15.6% (Thailand (5)), 88.4% (Turkey (6)), 69.9 % Tuvalu (7)), 53% (Guinea (8)), 40.2% (China (9)), 92.6% (India (10), and 43.5% (Ethiopia (11)) were reported from the different parts of the world.

Ascaris lumbricoides (A.lumbricoides), Hookworm (*Ancylostoma duodenale* and *Necator americanus)* and *Trichuris trichiura (T.trichiura)* are among the most common STHs which have

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been reported among several hundred millions of people worldwide (2, 12). The geographical distribution of STHs is influenced by various factors including external environmental conditions like soil (13), absence of sanitary facilities, unsafe waste disposal system, inadequacy and lack of safe water supply, types of toilet (4,11) and human factors including age, sex, socio-economic status and occupation (9,10).

A study by Soriano *et al*. (2001) suggested that all these factors should be assessed as a whole when evaluating the prevalence of intestinal parasites in a given population, taking into account the parasite-host-environment relationship (13). In addition, in developing prevention and control strategies and for the empirical treatment of STH, knowledge of the most likely causative agents, the possible risk factors and status of soil contamination are essential. However, to our knowledge, particularly in Jimma, no published research report is available on the prevalence of STH among children comparing private and government schools where the socio-economic status and other associated factors may vary. On top of this, the geographical difference in the status of contaminated source (eg. soil) was also not well studied. Therefore, this study was done to determine the prevalence of STH and assess the associated factors including status of soil contamination with STHs among government and private primary schools.

MATERIALS AND METHODS

A comparative cross-sectional survey was conducted from December 2011 to June 2012 on randomly selected two private and two government primary schools in Jimma Town, South-west Ethiopia. All students, 5-15 years, with and without clinical symptoms of gastro intestinal tract (GIT) infection who had not taken anti-helminthic treatment in the last 3 months were included based on their willingness.

The sample size was based on a predicted prevalence of STH of 60% (14) among school children ± 5% precision and 95% confidence level. To investigate the associated factors, being in government school was assumed as an exposure (15) to detect odds of 4.3 at 95% confidence interval and 80% power. Accounting for a 10% non-response rate and a design effect of 2, the final estimated sample size was 369. A multistage sampling with proportional to size sampling method was employed considering type of school, students school grade and class section. A total of 278 and 91 children were randomly selected from government and private school respectively.

Data on socio-demographic characteristics, variables related to type of latrine used and hand washing and shoe wearing habits of the children were collected. All the study subjects were supplied with labeled plastic containers with applicator sticks, and instructed to provide a recent stool sample (an interval of less than 4 hours). Then, the stool was processed and examined for STH using McMaster method as described by Charlier *et al*. (16). The laboratory results were recorded on laboratory formats. During sample collection, physical inspection was made on toilet facilities of the school compounds and fingernail status of the students.

Eighty soil samples were collected from the playgrounds, the area near the water tap, the classroom and the toilet surroundings. The samples were analyzed by sodium nitrate flotation technique as described by Mizgajska-Wiktor (17). Briefly, soil samples from the ground were collected from a depth of 3 centimeters and 40 grams of dried and sifted soil sample was suspended in 5% sodium hydroxide (NaOH) and left for 1 hour to separate eggs from the soil. The sample was centrifuged for 3 minutes at 1500 rotations per minute (rpm). The supernatant was discarded and the sediment was washed with distilled water. After the sediment was washed, it was re-suspended in saturated sodium nitrate ($NaNO_3$) solution with specific gravity of 1.30 and centrifuged at 1500 rpm for 3 minutes. The tube was then filled up to the top with the flotation fluid, $NaNO_3$. A cover slip was placed on top of the fluid for 30 minutes and it was lifted from the tube, placed on a clean glass slide and examined under the microscope for STH eggs.

Data was entered and analyzed using statistical package for social science (SPSS) version 16. Frequencies, percentages and measures of central tendency were calculated. Bivariate logistic regression of independent variables with STH infection was done to select subset of predictor variables. Multivariate logistic analysis was done to observe and identify

Single, double and triple infections were found with infection rates of 64.5%, 30.7% and 4.8% respectively. Double infections were the most common incidents among students of government primary schools (32.7%) compared to those in students of private schools (15.79%). Triple infections (5.4%) were only found in students of government schools (Table 3).

Table 3: Types of STH infections in students from private and government primary schools, Jimma, Ethiopia, 2011/12.

Type of Infection	***Private Schools No (%)***	***Government Schools No (%)***	***Total No(%)***
Single Infection	16 (84.2%)	91 (61.9%)	107 (64.5%)
Double Infection	3 (15.8%)	48 (32.7%)	51 (30.7%)
Triple Infection	0 (0%)	8 (5.4%)	8 (4.8%)
Total	***19 (100%)***	***147 (100%)***	***166(100%)***

Of the total multiple infections, (62.7%) of the students had double infection predominantly with a combination of *A. lumbricoides* plus *T.trichiura* (Table 4).

Table 4: Multiple infections in selected Private and Government Primary schools, Jimma, Ethiopia, 2011/12.

Parasites Combination	***Infection No (%)***
A. lumbricoides + *T.trichiura*	37 (62.7%)
A. lumbricoides + Hookworm	7 (11.9%)
T.trichiura + Hookworm	7 (11.9%)
A. lumbricoides + Hookworm + *T.trichiura*	8 (13.5%)
Total	***59 (100%)***

In all schools, functional pit latrine facilities were available. However, the ratio of the number of students sharing the toilet to the number of toilet facilities varied from school to school. In the government schools, the ratio of the number of toilet facilities to the number of students was 1:127 while it was 1:39 in private schools. Among government school students, 62.9% used open field or wood type latrine at home and 37.1% had

Table 5: Bivariate and multivariate logistic regression analysis of factors associated with STH infections among the students of Selected Private and Government Primary schools, Jimma, Ethiopia, 2011/12.

Variable	*STH (%)*	*NoSTH(%)*	*OR (95% CI)*	*P-value*	*AOR (95% CI)*	*P-value*
Age						
5-10	78(39.8)	118(60.2)	1		1	
11-15	88(51.8)	82(48.2)	1.624(1.072,2.459)	0.022**	1.472(0.935,2.317)	0.095
Sex						
Female	101(49.3)	104(50.7)	1		1	
Male	65(40.4)	96(59.6)	0.697(0.459,1.058)	0.090	0.637(0.408,0.995)	0.047**
School Type						
Private	19 (20.9)	72(79.1)	1		1	
Government	147(53.5)	128(46.5)	4.352(2.490,7.606)	0.000**	2.626(1.300,5.304)	0.007**
Home Latrine						
Cement (Pit)	56(38.6)	89(61.4)	1		1	
Wood	105(54.7)	87(45.3)	1.918(1.237,2.975)	0.000**	1.484(0.909,2.424)	0.115
Sink (Flush)	5(17.2)	24(82.8)	0.331(0.119,0.918)	0.004**	0.768(0.242,2.438)	0.655
Water source						
Pipe	150(45.6)	179(54.4)	1			
Others	16(43.2)	21(56.8)	0.909(0.458,1.805)	0.786	-	-
Finger nails						
Trimmed	78(41.7	109(58.3)	1		1	
Untrimmed	88(49.2)	91(50.8)	1.351(0.894,2.042)	0.153	0.960(0.608,1.513)	0.859
Hand wash BE						
Always	73(41.5)	103(58.5)	1		1	
Sometimes	93(48.9)	97(51.1)	1.353(0.895,2.045)	0.152	1.149(0.725,1.823)	0.554
Hand wash AD						
Always	50(40.3)	74(59.7)	1		1	
Sometimes	116(47.9)	126(52.1)	1.363(0.879,2.113)	0.167	0.912(0.545,1.526)	0.726
Wear shoe						
Always	84(37.2)	142(62.8)	1		1	
Sometimes	82(58.6)	58(41.4)	2.390(1.553,3.678)	0.000**	1.638(0.986,2.721)	0.057

Hand wash BE= Hand washing habit before eating, Hand wash AD= Hand washing habit after defecation
Sink = Water system/flush

DISCUSSION

This comparative cross sectional study revealed that an overall high prevalence rate of STH infections was found in government school students (53.5%) as compared to private school students (20.9%). Even though there was a slight difference in the infection rate, this finding was in line with a comparative study conducted in Nigeria where the rate of helminthiasis was higher among government school students (46.6%) than among private school students (16.6%) (15). This might be due to variation between the schools with regard to factors that contribute for the transmission of STH including socioeconomic status, shoe wearing habit, safe water supply at home and school, personal hygiene, environmental sanitation of the school compound, waste disposal system within the school, type of toilet accessible at home and availability of clean and sufficient number of toilet facilities at school, which have been observed in the present study.

In the present study, *T. trichiura* was the most common STH parasite in both private (59.1%) and government schools (46.4%). On the contrary, a study conducted on helminthiasis among pupils of private and government schools in Nigeria found out that the predominant parasites were *A .lumbricoides* (6.0%) and hookworm (26.0%) respectively (15). The finding was also incomparable with other non-comparative cross sectional studies conducted on STH among school age children in Sri Lanka (18), South-Easter Nigeria (19), Pacific Island (7), Uganda (20), Turkey (6) and other parts of Ethiopia including North West of the country (21),

Adwa (22) and Chilga (23). This might be due to differences in environmental factors like climate, topography (24), surface temperature, altitude, soil type and rainfall which have a great impact on the distribution of STH (25). In addition, recently at the study site and other parts of the world, *T. trichiura* has low drug efficacy to commonly used anthelmintic drugs unlike *A. lumbricoides* and hookworm (26). However, this study showed a similar finding to one study done on STH among primary school children in Thailand (27) where *T. trichiura* was the predominant parasite.

Regarding the associated factors, multivariate analysis showed that sex and school type were the best predictors of STH among primary school children. Accordingly, government school students were 2.6 times more likely to have STH as compared to private school students. Soil sample results from the government school compound support the finding as well. This result is similar with a study carried out in Nigeria where pupils in public primary schools were 2.5 times more infected than private school students (15).

Sex was one of the factors for STH where male students were 0.6 times less likely to have STH as compared to female students. Though a report from Nepal (28) suggest that females are at higher risk for STH, other studies have presented mixed results. A study in Nigeria (15) and Ethiopia, Chilga (23), show that males had an overall higher prevalence rate. This could be explained by personal hygiene related to trimming fingernails where in the present study the majority of the participants who had untrimmed nails were female students.

Though there was no significant association between STH infection and latrine type, an overall high prevalence rate was observed among students who used open space or wood type latrine (54.7%) as compared to pit (38.6%) and water system (17.2%) users. This finding was in agreement with a finding in Nigeria where pupils who used open spaces and bush had higher prevalence (77.7%) than those who used the pit latrine (33.79%) and water system users (11.74%) (15).

In the present study, the soil contamination rate of the school compounds was found to be lower (11.25%) than that of a previous study conducted in Nepal, Kathmandu Valley (28.5%) (28). This might be due to difference in socioeconomic status, health information, waste disposal system, sample collection season, soil type, as well as climatic and topographic factors of the countries. However, a similar finding was observed in Nepal (28) where the predominant parasite isolated from the soil samples was *A. lumbricoides*.

The prevalence of STH was significantly higher among government school students than their private counterparts. Enrollment in government school and male sex were associated with STH among primary school children. Therefore, improving availability of clean and sufficient number of toilet facilities, safe and adequate water supply, environmental sanitation of the school compound and waste disposal system at school especially within the government school, and health education on personal hygiene are highly recommended. Given the current level of the problem among school children and the immediate environmental context that these children live in, assessment and appropriate intervention should be an integral part of control and prevention strategies and programs. In addition, further study with large sample size is recommended to investigate risk factors among both government and private schools independently.

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