Schistosoma mansoni and soil-transmitted helminths among preschool-aged children in Chuahit, Dembia district, Northwest Ethiopia: prevalence, intensity of infection and associated risk factors

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Abstract

Background: Intestinal schistosomiasis and soil-transmitted helminthiasis are the major public health problems globally. Compared with any other age group, pre-school aged children and school-aged children are the most exposed. There are few studies showing the burden of intestinal schistosomiasis, and soil-transmitted helminthiasis among pre-school aged children in Ethiopia. Hence, this study aimed to assess the prevalence of Schistosoma mansoni and soil-transmitted helminths and associated risk factors among preschool aged children of Chuahit and surrounding Kebeles, Northwest Ethiopia.

Methods: A community based cross sectional study was conducted from February 2 to March 27 2015. Four hundred one preschool-aged children were included in the study by using two stage cluster sampling technique. Pretested structured questionnaire was employed to collected data via face-to-face interview technique. A single stool specimen was collected, and a portion of the sample was processed by Kato Katz method.

Results: Of the total children, 141 (35.2 %) harbored one or more intestinal helminthes. Schistosoma mansoni was found in 45 (11.2 %) of preschool age children. Ascaris lumbricoides was the predominant isolate, 77 (19.2 %) followed by S. mansoni, 45 (11.2 %). The least parasites isolated were Tania species, 2 (0.5 %). After adjusting for other variables, being mothers who did not have the habit of washing hands after toilet (AOR = 7.3, 95%CI: 2.97–17.95), being occupationally housewife mothers (AOR = 8.9, 95%CI: 2.27–25.4), using protected spring water as a main family source of water (AOR = 3.9, 95%CI: 1.2–12.3) and child habit of not wearing shoe (AOR = 1.91, 95%CI: 1.01–3.64) were significantly associated with high prevalence of soil-transmitted helminthiasis among preschool-age children in Chuahit.

Conclusion: The current study showed that relatively higher level of STH and S. mansoni among preschool-aged children in Chuahit. This finding calls for a need of public health education, promotion of women education and provision of safe water to reduce the burden of soil-transmitted intestinal helminthiasis and schistosomiasis.

Keywords: Associated risk factor, Ethiopia, Intensity of infection, Preschool-aged children, Schistosoma mansoni, Soil-transmitted helminthes
Background

Intestinal schistosomiasis and soil-transmitted helminthiasis are the major medical and public health problems in many parts of the world. Schistosomiasis remains a serious public health concern in sub-Saharan Africa (SSA) and approximately one-third of the 192 million cases of schistosomiasis in the SSA are caused by Schistosoma mansoni, the causal agent of intestinal schistosomiasis [1].

Soil-transmitted helminths (STH) of major concern to humans are Ascaris lumbricoides, Trichuris trichiura, Hymenolepis nana and STH is commonly ≤11].

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Methods

Study design, area and population
A Community based cross-sectional study was conducted in preschool aged children living in Chuahit, Dembia District, North West Ethiopia, from February 2 to March 27, 2015. Chuahit is found in North Gondar Zone of Amhara Region of Ethiopia and is located 789 kms Northwest of the capital city Addis Ababa. It is one of the four small rural town found in Dembia District. Under its administrative area, it comprises nine kebeles. Four rivers namely Tanti Kura, Ambizina, Ambagenin and Chigero flow through it. The average temperature and humidity are 28 °C and 22 % respectively. PSAC who were under the age of seven years old were the source population [17]. PSAC who had been living in Chuahit for at least 6 months before the study began and who had no history of having been treated with Praziquantel (PZQ) and anti-helminthic drug in the past 4 weeks were included.

Sample size determination and sampling technique
The required sample size was determined by using single population proportion formula with the following assumptions: prevalence (p) of 15.5 % from a previous study [20], 95 % confidence level, 5 % margin of error, design effect of 2. Accordingly, the minimum sample size (n) was found to be 401. A multi-stage sampling procedure was utilized to select study participants. At the first stage, two kebeles (Derena and Meskele kerestos) were selected randomly by simple random sampling from nine kebeles. At the second sampling stage, numbers of households included in each kebele were determined by proportional allocation according to the total number of households found in each kebele. Then, systematic sampling method was employed to select the households. The sampling interval was calculated by dividing the total households to the number of households to be included in the sample for each kebele. The initial household interviewed was randomly selected by lottery method and the next households were selected at that interval. Whenever more than one eligible children were found in the same selected household, only one of them was chosen using the lottery method. In case no eligible candidate was identified in a selected household, the next household was selected keeping the interval constant afterwards. According to Chuahit administrative health office report, 6,947 PSAC were estimated to reside in Chuahit; of whom 781 and 523 were residing in Derena and Meskele kerestos respectively. Furthermore, 2,820 households (1462 in Derena and 1358 in Meskele kerestos) were found in the selected kebeles. Two hundred eight and 193 households were selected from the Derena and Meskele kerestos kebeles respectively. Likewise, 208 and 193 PSAC were participated in the study from Derena and Meskele kerestos kebeles respectively.

Data collection and processing

Questionnaire survey
Data were collected by pretested structured Amharic version questionnaire using interview technique. Health extension workers were recruited for data collection and supervised by the Principal Investigator. Before data collection, data collectors were assigned to each Kebeles. Then each data collector conducted a house-to-house survey. During the survey, the data collectors first asked the parents of PSAC whether or not any PSAC present or not in the household. When PSAC was found, the data collectors interviewed parents or caretakers after obtaining written informed consent. Repeat visits were conducted for those individuals who were not available during the first visit. At each data collection spot, full explanation about the aim of the research was given to the parents or caretakers of PSAC before the interview.

Sample collection and laboratory procedures
A single stool specimen of about 5 g was collected from each study participant using clean, dry and leak proof plastic container labeled with unique identification number. A portion of the sample was processed by Kato Katz method using a template holding 41.7 mg of stool [21]. Examination for hookworm was performed within one hour of stool collection and Kato slide preparation. The slides were left for 24 h to clear for easy visualization of S. mansoni and other helminthes eggs. After 24 h, two experienced laboratory technologists examined each slides independently. Whenever the result of the two laboratory technologists discorded, the third experienced laboratory technologist examined the slides. Results of the laboratory investigation were recorded on a format prepared for this purpose. Infection intensity of the STHs and S. mansoni was estimated by multiplying the total number of eggs counted by 24, which gives as the eggs per gram (epg) of stool. Besides, the species specific classes of infection intensity with S.mansoni and STH were classified as light, moderate and heavy per the threshold set by WHO [22].

Data management and analysis
Data were entered in to and analyzed by statistical package for social sciences (SPSS) statistical software version 20. Study findings were explained in words, tables and other statistical summary techniques. Binary logistic regression model was used to identify factors associated with infection of S. mansoni and STHs. Multiple logistic regressions was fitted to control the possible effect of confounders, and finally the variables having independent association with dependent variables were identified on the basis of odd ratio (OR) with 95 % confidence interval (CI) and P-value less than 0.05.
Ethical considerations
The study was conducted after ethical approval was obtained from institutional ethical review committee of College of Medicine and Health Sciences, University of Gondar. Moreover, letter of support was secured from the Woreda health office and each Kebele administration. Following an explanation of the purpose, the benefits and the possible risks of the study, written consent was obtained from parents/care takers of PSAC, which assured that the participation was on voluntarily basis. Children who were positive for S. mansoni and STHs were treated by referring them to Chuahit health center.

Results
Socio-demographic characteristics of study participants
A total of 401 PSAC aged 6 months up to 6 years were included in the study. Out of these, 183 (45.6 %) were males and 218 (54.4 %) were females. The mean age of PSAC was 3.73 year (±1.75 year standard deviation). The majority of parents of PSAC were married, 374 (93.3 %); illiterate, 358 (89 %) and farmer, 388 (96.8 %) (Table 1).

Prevalence of S. mansoni and STHs
Of the total PSAC examined using single Kato-Katz method, 141 (35.2 %) had been infected with intestinal helminthes; 123 (87.2 %) with single and 18 (12.8 %) with double intestinal helminthes. S. mansoni was isolated in 45 (11.2 %) of PSAC. Regarding STHs, A. lumbricoides was the predominant parasite, 77 (19.2 %) followed by hookworms, 9 (2.2 %) and T. trichiura, 7 (1.7 %). The least parasites isolated were Tania species, 2 (0.5 %). The prevalence of S. mansoni and T. trichiura had shown increment with age whereas the prevalence of A. lumbricoides is highly prevalent in the age group 13–24 months. Prevalence of one or more intestinal helminthic infections showed significant association with age (p. value < 0.05). The prevalence of intestinal helminthic infection had not shown statistically significant difference between males and females. The overall prevalence of single and double parasitic infection was 123 (30.7 %) and 18 (4.5 %) respectively (Table 2). No PSAC is co-infected with three or more parasites. Co-infection rate was higher for S. mansoni and A. lumbricoides 5 (1.2 %) followed by S. mansoni and H. nana 4 (1 %).

Infection intensity of S. mansoni and STHs
In this study, the mean egg per gram of faeces for individuals with detectable eggs of S. mansoni, A. lumbricoides, hookworm and T. trichiura infections were 85 (Range: 24–288), 11,859 (Range: 96–118, 800), 61 (Range: 24–144) and 375 (Range: 24–2496) respectively. Among 45 PSAC who were positive for S. mansoni, 32 (71.1 %) and 13 (28.9 %) had light and moderate infection respectively. Among 77 PSAC who were positive for A. lumbricoides, 40 (51.9 %), 31 (40.3 %, 6 (7.8 %) had light, moderate and heavy intensity of infections. Moreover, except one PSAC who was moderately infected with T. trichiura, the intensity of infection with H. nana, hookworm, T. trichiura, E. vermicularis and Taenia species was light (Table 3).

Risk factor analysis for soil-transmitted helminthiasis
In the present study, multivariate logistic regression analysis showed that the prevalence of soil-transmitted helminthiasis was not significantly associated with age of children, sex of children, maternal marital status and maternal educational status. However, prevalence of soil-transmitted helminthiasis was significantly associated with maternal habit of not washing hands after toilet (AOR = 7.3, 95 % CI: 2.97–17.95), occupationally housewife mothers (AOR = 8.9, 95 % CI: 2.27–25.4), the use of protected spring water as a main family source of water (AOR = 3.9, 95 % CI: 1.2–12.3) and children habit of not wearing shoe (AOR = 1.91, 95 % CI: 1.01–3.64) (Table 4).

Risk factor analysis for S. mansoni
In bivariate logistic regression analysis, habit of bringing the child to river, child washing habit in the river, child washing habit with freshly fetched water at home, child habit of swimming in river, high frequency swimming habit of child in the river per week, child habit of crossing the river with bare foot and low distance of home from the river were significantly associated with intestinal Schistosomiasis. However, in multivariate logistic regression analysis controlling the possible cofounders, none of them was significantly associated with intestinal Schistosomiasis in PSAC (Table 5).
Table 2 Prevalence of intestinal helminthiasis among PSAC in Chuahit, Northwest Ethiopia, 2015

| Age (in months) | Frequency | S. mansoni | Hookworm | T. trichura | A. lumbricoides | E. vermicularis | H. nana | Taenia species | One or more parasitic infection | Single parasitic infection | Double parasitic infection |
|----------------|-----------|------------|-----------|-------------|----------------|----------------|---------|----------------|-------------------------------|------------------------|---------------------------|
| ≤12            | 49(12.2%) | 2(4.4%)    | 0         | 0           | 45(2.2%)       | 0              | 2(11.8%)| 0              | 8(5.7%)                      | 8(6.5%)                | 0                         |
| 13–24          | 64(16%)   | 6(13.4%)   | 1(11.1%)  | 1(14.3%)    | 60(16.7%)      | 1(11.1%)       | 8(10.4%)| 0              | 3(17.6%)                     | 24(17%)                | 23(18.7%)                |
| 24–36          | 83(20.7%) | 10(22.2%)  | 3(33.4%)  | 1(14.3%)    | 11(24.4%)      | 2(22.2%)       | 2(28.6%)| 0              | 5(29.4%)                     | 1(50%)                 | 33(23.4%)                |
| 37–47          | 47(11.7%) | 3(6.7%)    | 1(11.1%)  | 0           | 6(13.2%)       | 0              | 2(11.8%)| 0              | 14(9.9%)                     | 14(11.4%)              | 0                         |
| 49–60          | 67(16.7%) | 11(24.4%)  | 2(22.2%)  | 1(14.3%)    | 14(28.6%)      | 2(66.7%)       | 3(17.6%)| 0              | 31(22%)                      | 27(22%)                | 5(27.8%)                |
| 61–72          | 91(22.7%) | 13(28.9%)  | 2(22.2%)  | 3(42.8%)    | 17(22%)        | 1(33.3%)       | 2(11.8%)| 0              | 31(22%)                      | 24(19.5%)              | 7(38.9%)                |
| Total          | 401(100%) | 45(11.2%)  | 9(2.2%)   | 7(1.7%)     | 77(19.2%)      | 3(0.7%)        | 17(4.2%)| 2(0.5%)        | 141(35.2%)                   | 123(30.7%)              | 18(4.5%)                |

$x^2$(p value) 6.56(0.26) 2.14(0.83) 3.74(0.59) 5.85(0.32) 6.5(0.26) 1.6(0.9) 3.43(0.64) 12.82(0.025) 9.62(0.087) 7.78(0.17)

Mothers knowledge about S. mansoni and STH

Of the total 401 mothers (aged 20 up to 52 years) interviewed, 324 (80.8 %) and 166 (41.4 %) of them had never heard about intestinal schistosomiasis and soil-transmitted helminthiasis respectively. For those mothers who had ever heard of these parasitic infections, their major source of information was health professionals. From, mothers of PSAC interviewed about ways of transmission of intestinal schistosomiasis, 85 % of them responded that intestinal schistosomiasis cannot be transmitted by swimming or bathing in the river, crossing river with bare foot, washing clothes in river and fishing in river. Regarding preventive methods of intestinal schistosomiasis, 380 (94.8 %) of mothers did not know ways of prevention of intestinal schistosomiasis. Regarding the symptoms of intestinal schistosomiasis, almost all the mothers, 377 (94 %) did not know the symptoms of the disease. Nearly half and two-third of the mothers responded that they did not know about ways of transmission and the preventive methods of STH respectively.

Table 3 Intensity of infection in PSAC with S. mansoni and soil-transmitted helminthic infection in Chuahit, Northwest Ethiopia, 2015

| Intestinal Parasite | Class of infection intensity |
|---------------------|-----------------------------|
|                     | light                      | Moderate | Heavy | total |
| S. mansoni          | 32(71.1%)                  | 13(28.9%)| 0     | 45(100%)|
| A. lumbricoides     | 40(51.9%)                  | 31(40.3%)| 6(7.8%)| 77(100%)|
| H. nana             | 17(100%)                   | 0        | 0     | 17(100%)|
| Hookworm            | 9(100%)                    | 0        | 0     | 9(100%) |
| T. trichura         | 6(85.7%)                   | 1(14.3%) | 0     | 7(100%) |
| E. vermicularis     | 3(100%)                    | 0        | 0     | 3(100%) |
| Tania species       | 2(100%)                    | 0        | 0     | 2(100%) |

Discussion

The prevalence of one or more intestinal helminths infections observed among the study participants was 141 (35.2 %). This finding is lower than study conducted in different area of Ethiopia namely; Methara (89 %) [23], Wondo Genet (85.1 %) [19], Tigray (48.1 %) [24], but higher than a report from Wonji Shoa (15.5 %) [20]. In this study, infection with one or more helminths increases as age increases which is in agreement with studies conducted in Ethiopia and Kenya [20, 25].

In the present study, the prevalence of S. mansoni infections was (11.2 %). This is in agreement with previous study carried out in Sierra Leone (11.2 %) [26]. In contrary, this finding is lower than studies done Methara (29 %) [23], Wondo Genet (37.2 %) [19], Niger (43.8 %) [15], Cote d’Ivoire (25 %) [27], Kenya (17.6 %) [28] and Uganda (39.3 %) [29]. On the other hand, this finding is higher than studies conducted in Tigray (1 %) [24], Wonji Shoa (8.8 %) [20], Ghana (0 %) [30] and Uganda (7 %) [13]. Difference in water source, time of survey, environmental and socio-economic factors may account for this variation. Of the total 45 PSAC who were positive for S. mansoni 32 (71.1 %) and 13 (28.9 %), 0 % had light moderate and heavy infection respectively. However, a report from Niger [15] showed that 17.3, 23.8, 2.7 %of PSAC were light, moderate and heavily infected respectively. No a statistically significant association was observed between prevalence of S. mansoni and age of PSAC in the current study. This is in contrast with a study conducted in Wonji Shoa [20] showing statistically significant association between S.mansoni and age of PSAC. Relatively higher prevalence of S. mansoni infection in the present study was observed. Therefore including praziquantel treatment in the deworming program as per the WHO guidelines.
would be essential to decrease the burden of these diseases in this age group [17].

In the current, the overall prevalence of STH infection was found to be 22.9 %. *A. lumbricoides* (19.2 %) was the predominant parasite. This finding was in agreement with a report from Sierra Leone (17.2 %) [26]. However, this is lower than similar reports from Wondo Genet (25.7 %) [19] and Methara (40 %) [23], and higher than a study conducted in Wonji Shoa (4.6 %) [20], Cote d’Ivoire (3.1 %) [27] and Uganda (0.7 %) [13]. The prevalence of *T. trichiura* in the present study was 1.7 %, which is much more lower than studies carried out in Methara (67 %) [23] and Wondo Genet (74.7 %) [19]. The high tolerance of parasites’ eggs and larval stages to the variation of the soil temperature has been described as a key factor for the high transmission and prevalence of these parasites in the area [12].

The majority of PSAC mothers were not heard of intestinal schistosomiasis, 324 (80.8 %) and STH, 235 (58.6 %). Similar to the current study, a study conducted in Malawi reported that the awareness of mother’s about schistosomiasis was very poor, 97 % of the parents had little or no knowledge of the disease [31].

Even though it was not statistically significant in multivariate logistic regression (but significant in bivariate analysis), the habit of washing children in the river increases

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**Table 4** Bivariate ad multivariate logistic regression analysis of soil-transmitted helminthiasis in relation to selected variables among PSAC in Chuahit, Northwest Ethiopia, 2015

| Variable                      | Total     | Presence of soil-transmitted helminthiasis | COR(95 % CI) | AOR(95 % CI) |
|------------------------------|-----------|-------------------------------------------|--------------|-------------|
|                              |           | Yes (%)                                   |              |             |
|                              |           | No (%)                                    |              |             |
| Child sex                    |           |                                           |              |             |
| Male                         | 183(45.6 %) | 43(23.5 %)                                |              |             |
| Female                       | 218(54.4 %) | 49(22.5 %)                                |              |             |
| Age (in months)              |           |                                           |              |             |
| ≤ 12                         | 49(12.2 %)  | 4(8.2 %)                                  |              |             |
| 13–24                        | 64(16 %)   | 18(28.1 %)                                |              |             |
| 25–36                        | 83(20.7 %) | 22(26.5 %)                                |              |             |
| 37–48                        | 47(11.7 %) | 9(19.1 %)                                 |              |             |
| 49–60                        | 67(16.7 %) | 18(26.9 %)                                |              |             |
| 61–72                        | 91(22.7 %) | 21(23.1 %)                                |              |             |
| Marital status of mothers    |           |                                           |              |             |
| Married                      | 374(93.3 %)  | 86(23)                                    |              |             |
| Divorced                     | 27(6.7 %)  | 6(22.2 %)                                 |              |             |
| Educational status of mothers|           |                                           |              |             |
| Illiterate                   | 358(89.3 %)  | 83(23.2 %)                                |              |             |
| Read and write              | 16(4 %)    | 2(12.5 %)                                 |              |             |
| Primary school              | 27(6.7 %)  | 11(40.7 %)                                |              |             |
| Occupation of mothers        |           |                                           |              |             |
| Farmer                       | 388(96.8 %)  | 85(21.9 %)                                |              |             |
| House wife                   | 13(3.2 %)  | 7(53.8 %)                                 |              |             |
| Shoe wearing habit of the child |         |                                           |              |             |
| Always                       | 281(70.1 %)  | 50(17.8 %)                                |              |             |
| Sometimes                    | 61(15.2 %) | 21(34.4 %)                                |              |             |
| Not at all                   | 59(14.7 %) | 21(35.6 %)                                |              |             |
| Source of water              |           |                                           |              |             |
| Protected spring             | 15(3.7 %)  | 8(53.3 %)                                 |              |             |
| Well                         | 386(96.3 %)  | 122(31.6 %)                               |              |             |
| Hand washing habit after toilet |         |                                           |              |             |
| Present                      | 102(25.4 %)  | 6(5.9 %)                                  |              |             |
| Absent                       | 299(74.6 %)  | 86(28.8 %)                                |              |             |

COR crude odds ratio, AOR adjusted odds ratio, CI confidence interval, *statistically significant at P < 0.05 in multivariate logistic regression analysis
the prevalence of *Schistosoma mansoni*. Another study conducted in Côte d’Ivoire showed that children staying at home with their elders found 2 times more likely to be positive for *S. mansoni* than those who were accompanying their mothers during daily livelihood activities [27]. Both of these findings indicated that PSAC are at higher risk of infection with *S.

| Variables                              | Presence of Intestinal Schistosomiasis | Total (%) | COR(95% CI) | AOR(85% CI) |
|----------------------------------------|----------------------------------------|-----------|-------------|-------------|
|                                        | Yes (%)                                | No (%)    |             |             |
| Sex of child                           |                                        |           |             |             |
| Male                                   | 23(12.6)                               | 160(87.4) | 183(45.6)   | 1.28(0.69, 2.38) |
| Female                                 | 2(10.1)                                | 196(89.9) | 218(54.4)   | 1           |
| Age of child (in Months)               |                                        |           |             |             |
| ≤12                                    | 2(4.1)                                 | 47(95.9)  | 49(12.2)    | 1           |
| 13–24                                  | 6(9.4)                                 | 58(90.6)  | 64(16)      | 2.43(0.47, 12.61) |
| 25–36                                  | 10(12)                                 | 73(88)    | 83(20.7)    | 3.22(0.68, 15.35) |
| 37–48                                  | 3(6.4)                                 | 44(94.6)  | 47(11.7)    | 1.60(0.26, 10.1) |
| 49–60                                  | 11(16.4)                               | 56(83.6)  | 67(16.7)    | 4.62(0.97, 21.87) |
| 61–72                                  | 13(14.3)                               | 78(85.7)  | 91(22.7)    | 3.92(0.85, 18.13) |
| Maternal occupation                    |                                        |           |             |             |
| Farmer                                 | 44(11.3)                               | 344(88.7) | 388(96.8)   | 1           |
| Housewife                              | 1(7.7)                                 | 12(92.3)  | 13(3.2)     | 0.65(0.08, 5.13) |
| Habit of bringing child to river       |                                        |           |             |             |
| Yes                                    | 43(21.1)                               | 161(78.9) | 204(50.9)   | 26(6.21, 109.15)* | 2.86(0.16, 49.98) |
| No                                     | 2(1)                                   | 195(99)   | 197(49.1)   | 1           |
| Habit of washing children in the river |                                        |           |             |             |
| Yes                                    | 42(21.9)                               | 150(78.1) | 192(47.9)   | 19.23(5.84, 63.2)* | 4.5(0.89, 4.1) |
| No                                     | 3(1.4)                                 | 206(98.6) | 209(52.1)   | 1           |
| Habit of washing children with freshly fetched water at home | | | | |
| Yes                                    | 42(21.1)                               | 161(78.9) | 204(50.9)   | 26(6.2, 109.14)* | 6.7(0.98, 45.68) |
| No                                     | 2(1)                                   | 195(99)   | 197(49.1)   | 1           |
| Habit of bringing children to irrigation sites | | | | |
| Yes                                    | 1(14.3)                                | 6(85.7)   | 7(1.7)      | 1.33(0.16, 11.27) |
| No                                     | 44(11.2)                               | 350(88.8) | 394(98.3)   | 1           |
| Child’s swimming habit in river        |                                        |           |             |             |
| Yes                                    | 21(20.2)                               | 83(79.8)  | 104(25.9)   | 2.88(1.52, 5.43)* | 1.01(0.08, 12.3) |
| No                                     | 24(8.1)                                | 273(91.9) | 297(74.1)   | 1           |
| Child’s swimming frequency per week    |                                        |           |             |             |
| none                                   | 24(8.1)                                | 273(91.9) | 297(74.1)   | 1           |
| 1–2 times                              | 9(18.4)                                | 40(81.6)  | 49(12.2)    | 2.54(1.1, 5.85)* | 1.01(0.33, 3.1) |
| ≥3 times                               | 12(18.8)                               | 43(81.2)  | 55(14.2)    | 3.01(1.41, 6.45)* | 1.15(0.38, 3.47) |
| Habit of child crossing river with bare foot | | | | |
| Yes                                    | 25(18.9)                               | 107(81.1) | 132(32.9)   | 2.91(1.55, 5.45)* | 0.6(0.29, 1.24) |
| No                                     | 20(7.4)                                | 249(92.6) | 269(67.10)  | 1           |
| Distance of home from the river        |                                        |           |             |             |
| <1 km                                  | 35(15.5)                               | 191(84.5) | 226(56.4)   | 3.02(1.45, 6.29)* | 1.04(0.39, 2.77) |
| >1 km                                  | 10(5.7)                                | 165(94.3) | 175(43.6)   | 1           |

*Statistically significant at P < 0.05 in bivariate logistic regression analysis*
However, by focusing treatment upon the school-aged population, World Health Assembly (WHA) resolution 54.19 neglects PSAC, thus preventing them from benefiting from the praziquantel treatment given to their older peers, and hence creating a potential health inequity [4].

In the present study, the greater proportion of the mothers of PSAC bring children to the river, (50.9 %) and washed them in the river (47.9 %). This is in line with a study conducted in Niger [15], the majorities of mothers (76.3 %) were accompanied by their children to the canal or the pond and washed them with the contaminated water.

Limitation
The major limitation of this study is that prevalence and infection intensity of STHs and *S. mansoni* were determined by examination of single stool specimen from each study participants. Thus, we could not access the intra and inter-stool variation of egg output. Furthermore, a single Kato-Katz template was examined for each of the stool specimens that might affect the accuracy of the egg count. Moreover, we could not include all modifiable risk factors in this study.

Conclusion
The current study has demonstrated that intestinal helminthiasis and Schistosomiasis were prevalent in varying degree among PSAC in the study area. Maternal habit of not washing hands after toilet, being housewife maternal occupation, the use of protected spring water as a main family source of water and child habit of not wearing shoe were significantly associated with high prevalence of soil-transmitted helminthiasis. The study also revealed that mothers of PSAC in the study area had limited knowledge on ways of transmission, symptom of the disease and preventive methods of *S. mansoni*. It is, therefore, important to consider including PSAC in ongoing public-health interventions such as the Expanded Programme on Immunization (EPI) and praziquantel mass drug administration (PZQ-MDA) programmes because they are set to suffer from the significant morbidity effects of chronic schistosomiasis. It is important to provide health education for behavior change to avoid contaminating water for the whole village community. It is also advisable to design and implement strategies that enhance access to education and safe water to reduce the burden of soil-transmitted helminthiasis and schistosomiasis.

Competing interests
The authors declare that they have no competing interests.

Authors' contributions
AA and YT conceived, designed and drafted the manuscript. AA, YT and DD involved in data acquisition. AA, YT, DD and MM involved in data analysis and critically reviewed the manuscript. All authors contributed to the writing of the manuscript and approved the submitted version.

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