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# Prevalence of gastrointestinal helminthic infections and associated risk factors among schoolchildren in Tilili town, northwest Ethiopia

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ABSTRACT

**Objective:** To determine the prevalence of gastrointestinal helminthes and associated risk factors among schoolchildren in Tilili town, northwest Ethiopia. **Methods:** A cross-sectional study involving 385 schoolchildren was conducted between November 2011 to February 2012. Each student was selected using systematic random sampling method. Questionnaire and observation were used to identify socio-demographic and associated risk factors. Fresh stool samples were observed using formal-ether concentration technique. Data were analyzed using SPSS 16.0 statistical software. **Results:** Four species of intestinal helminthes were identified with an overall prevalence of 44.2% (170 of 385 schoolchildren). The predominant parasites were *Ascaris lumbricoides* (*A. lumbricoides*) 153 (39.7%) and *Trichuris trichiura* (*T. trichiura*) 30 (7.8%). One hundred thirty five (35.1%) had single infections and 35 (9.2%) were infected with more than one helminthic parasites in which 32 (8.4%) were double infections and 3 (0.8%) were triple infections. Significant associations were observed between intestinal helminth infection and those of age, grade level, and school variables. Prevalence of hookworm infection was significant in children who did not wear shoes regularly ($P<0.05$). **Conclusions:** intervention programs and education on personal and environmental hygiene should be implemented for the prevention and control of helminthic infections in the study area.

## 1. Introduction

Intestinal helminthes are intestinal parasites that inhabit the human gastrointestinal tracts and are one of the most prevalent forms of parasitic disease causing organisms. The soil transmitted helminthes [*Ascaris lumbricoides* (*A. lumbricoides*), hookworm and *Trichuris trichiura* (*T. trichiura*)] are parasitic nematode worms causing human infection through contact with parasite eggs or larvae that thrive in the warm and moist soil of the world's tropical and subtropical countries[1]. They are one of the world's most important causes of physical and intellectual growth retardation.

Ascariasis caused by *A. lumbricoides* causes widespread morbidity due to a variety of medical and surgical complications. It has been estimated that 1.471 billion cases of infection globally and 65 000 deaths occur due to *A. lumbricoides*[2, 3]. Hookworm in human is caused by helminthic parasites, *Necator americanus* (*N. americanus*) and *Ancylostoma duodenale (A. duodenale)* and is transmitted through contact with contaminated soil. It is one of the most common chronic infections with an estimated 1.3 billion cases globally and directly accountable for 65 000 deaths annually[4]. The two hookworm species that infect human exhibit differences in their pathogenecity, mode of transmission, geographical distribution and these differences may influence the morbidity of hookworm disease[5]. Clinical manifestations of hookworm disease are the consequences of chronic intestinal blood loss and iron deficiency anemia. In children, chronic hookworm disease retards physical growth which is sometimes most apparent at puberty[6]. Likewise, *A. lumbricoides* and hookworm, *T. trichiura* considerably affect the physical and mental

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development in children[7]. About 1.049 billion cases of infection occurred due to *T. trichiura* and 70 000 deaths occur due to *T. trichiura* annually[8-10]. *Hymenolepis nana (H. nana)* infection has cosmopolitan distribution and most commonly infects humans, especially school-aged children (aged 4-10 years)[11].

Although several studies have been conducted on the distribution and prevalence of intestinal parasitic infections in Ethiopia, still there are several localities lacking epidemiological information on intestinal helminthic infections. Tilili town, located in northwestern Ethiopia, is one of such localities without report on gastrointestinal helminthic infections. Therefore, the objective of the present study was to assess the prevalence of gastrointestinal helminthic infections and associated risk factors among schoolchildren in the study area.

## 2. Materials and methods

### 2.1. Study design and area

A cross-sectional study was conducted in Tilili, town, northwest Ethiopia, from November 2011 to February 2012. Tilili is located at a distance of 420 km from Addis Ababa. The town is also located at 2 450 meter above sea level. The mean annual temperature ranges from 10-25 ℃ and the average 30 years annual rainfall is 1 396mm[12]. There are three elementary and junior secondary schools in Tilili town. The studied schools were Hibret, Tilili and Kili-Mesk elementary and junior secondary schools. In the town, the total student population of the schools was 4 431 (1 148 from Hibret, 1 871 from Kili-Mesk and 1 412 from Tilili) and among these 2 153 and 2 278 were male and female students, respectively.

The study population consisted of 403 schoolchildren and among these, 104, 129 and 170 children were selected from Hibret, Tilili and Kili-Mesk primary schools, respectively. The study population included all age groups, both sexes and students from both urban and rural settings. Students who took anthelminthic drugs at time of the study or two weeks prior to the study were excluded.

Questionnaire was used to gather information on socio-demographic and sanitary facilities of students. The study participants were also examined physically for the presence or absence of dirt materials in their fingernails. The sample size was determined using a general formula $Z^2p\ (1-p)/d^2$ considering the level of significance at 5% and assuming the prevalence of intestinal helminthes in the study area to be 50%[13]. To lesson errors arising from likelihood of noncompliance or possible dropout, 5% of the sample size was added to the normal sample size. Allocation of students was made proportional to the number of students for each school. To select the study subjects, the students were first stratified according to their educational level (grade 1 to 8) and they were taken from each class category by systematic random sampling using class roster as a sampling frame.

### 2.2. Ethical consideration and stool sample processing

Prior to stool sample collection, verbal consent was obtained from both schoolchildren and their guardians. Schoolchildren were guided on how to bring their stool samples and then they were provided with clean plastic stool vials with toilet tissue paper. After collecting sufficient fresh stool sample with plastic vial from each participant, codes were given for all on the plastic vials and then each child was interviewed using a structured questionnaire. All stool samples were preserved in 10% formalin solution. A specimen was then transported to Biomedical and Microbiology Laboratory, Biology Department, Bahir Dar University. Part of each individual stool sample was processed using formal-ether concentration method and examined under microscope to identify helminth eggs. The remaining part of the stool sample was preserved in 10% formalin solution for further reference.

### 2.3. Data analysis

The data collected through interview, questionnaire, and parasitological examination were analyzed using SPSS 16.0 statistical software. *Chi*-square ($\chi^2$) test was used to observe the association between risk factors and prevalence of intestinal helminthes infections. Crude Odds Ratio (*COR*) and 95% confidence interval (*CI*) were performed to determine the strength of the association between infection and risk factors. *P*-values less than 0.05 were considered to be statistically significant.

## 3. Results

Out of 403 who were willing to participate in the study, only 385 students who took part in the study were included in the present analysis. Of these, 193 (50.1%) were males and 192 (49.9%) were females. The mean age of the study subject was 11.17 years old. According to their residence, 218 (56.6%) were from urban and 167 (43.4%) schoolchildren were from rural areas. The study population consisted of students from Hibret, Tilili and Kili-Mesk primary schools with 104 (27.0%), 122 (31.7%) and 159 (41.3%) students, respectively (Table 2).

Of the total 385 stool samples examined, 170 (44.2 %) were positive for one or more of intestinal helminthes. Among these, a total of 88 males and 82 females were positive for one or more helminth infections. Ninety five (43.6%) urban schoolchildren and seventy five (44.9%) rural schoolchildren were infected with one or more than one intestinal helminthes but, there was no significance difference between urban and rural dwellers ($P$>0.05) (Table 2). The prevalence of intestinal helminthic infections were statistically significant ($P$<0.05) among the schools (Table 2). Four major intestinal helminthes, namely, *A. lumbricoides*, *T. trichiura*, hookworm and *H. nana* were identified with an overall prevalence of 44.2% in this study area. The most frequent helminth infection was *A. lumbricoides* (39.7%), and the least encountered helminth was *H. nana* (1%) (Table 3). Among 170 positive individuals, majority of the students (35.1%), had single infection. Thirty five (9.2%) of the students were infected with more than one intestinal helminth parasites, in which 32 (8.4%) were double intestinal helminthes infections and 3 (0.8%) were triple infections. Only female students were infected by triple infections (Table 1).

Among age groups, the most and the least affected age groups were 6–8 and 12–14 years old with a prevalence of 55.7% and 34.6%, respectively (Table 2).

**Table 1**

Prevalence of helminth infections among Tilili town primary school children, 2011/12.

| Intestinal helminthes | | No. of infected (%) | Male (%) | Female (%) |
|---|---|---|---|---|
| Single infection | *A. lumbricoides* | 121 (31.4) | 69 (57.0) | 52 (43.0) |
| | *T. trichiura* | 11 (2.9) | 4 (36.4) | 7 (63.6) |
| | Hookworm | 2 (0.5) | 0 (0.0) | 2 (100.0) |
| | *H. nana* | 1 (0.3) | 1 (100.0) | 0 (0.0) |
| Double infection | *A. lumbricoides* + *hookworm* | 15 (3.9) | 6 (40.0) | 9 (60.0) |
| | *A. lumbricoides* + *T. trichiura* | 13 (3.4) | 7 (53.8) | 6 (46.2) |
| | *T. tichiura* + *H. nana* | 2 (0.5) | 1 (50.0) | 1 (50.0) |
| | *A. lumbricoides* + *H. nana* | 1 (0.3) | 0 (0.0) | 1 (100.0) |
| | Hookworm + *T. trichiura* | 1 (0.3) | 0 (0.0) | 1 (100.0) |
| Triple infection | *A. lumbricoides* + hookworm + *T. trichiura* | 3 (0.8) | 0 (0.0) | 3 (100.0) |
| Total | | 170 (44.2) | 88 (22.9) | 82 (21.3) |

**Table 2**

Overall prevalence of intestinal helminthic infections in relation to sex, age, residence, and school of children in Tilili town, 2011/12.

| Characteristic | | No of examined (%) | Positive(%) | Negative (%) | $\chi^2$ ($P$–value) |
|---|---|---|---|---|---|
| Sex | Male | 193 (50.1) | 88 (45.6) | 105 (54.4) | 0.33 (0.568) |
| | Female | 192 (49.9) | 82 (42.7) | 110 (57.3) | |
| Age (years) | 6–8 | 88 (22.3) | 49 (55.7) | 39 (44.3) | 11.90 (0.008) |
| | 9–11 | 113 (29.4) | 48 (42.5) | 65 (57.5) | |
| | 12–14 | 136 (35.3) | 47 (34.6) | 89 (65.4) | |
| | 15–18 | 48 (12.5) | 26 (54.2) | 22 (45.8) | |
| Residence | Urban | 218 (56.6) | 95 (43.6) | 123 (56.4) | 0.08 (0.790) |
| | Rural | 167 (43.4) | 75 (44.9) | 92 (55.1) | |
| School of students | Hibret | 104 (27.0) | 61 (58.7) | 43 (41.3) | 23.13 (0.000) |
| | Tilili | 122 (31.7) | 61 (50.0) | 61 (50.0) | |
| | Kili–Mesk | 159 (41.3) | 48 (30.2) | 111 (69.8) | |

**Table 3**

Prevalence of helminth infections among sex, age groups, and school in Tilili town schoolchildren 2011/12.

| Characteristics | | No. of examined | Helminthes | | | | $P$–value |
|---|---|---|---|---|---|---|---|
| | | | *A. lumbricoides* (%) | *T. tichiura* (%) | Hookworm (%) | *H. nana* (%) | |
| Sex | Male | 193 (50.1) | 82 (42.5) | 13 (6.7) | 5 (2.6) | 2 (1.0) | 0.570 |
| | Female | 192 (49.9) | 71 (37.0) | 17 (8.9) | 16 (8.3) | 2 (1.0) | |
| Age (years) | 6–8 | 88 (22.9) | 44 (50.0) | 6 (6.8) | 7 (7.9) | 1 (1.1) | 0.008 |
| | 9–11 | 113 (29.4) | 42 (37.2) | 12 (10.6) | 5 (4.4) | 1 (0.9) | |
| | 12–14 | 136 (35.3) | 42 (30.9) | 6 (4.4) | 4 (2.9) | 2 (1.5) | |
| | 15–18 | 48 (12.5) | 25 (52.1) | 6 (12.5) | 5 (10.4) | 0 (0.0) | |
| School | Hibret | 104 (27.0) | 58 (55.8) | 7 (6.7) | 10 (9.6) | 0 (0.0) | 0.000 |
| | Tilili | 122 (31.7) | 56 (45.9) | 13 (10.7) | 7 (5.7) | 0 (0.0) | |
| | Kili–Mesk | 159 (41.3) | 39 (24.5) | 10 (6.3) | 4 (2.5) | 4 (2.5) | |
| Total | | 385 | 153 (39.7) | 30 (7.8) | 21 (5.5) | 4 (1.0) | |

There was significant difference between intestinal helminthic infections with age-groups and school of students ($P<0.05$) (Table 3).

In univariate logistic regression analysis of factors potentially associated with gastrointestinal helminthic infections (Table 4), significant associations were observed between intestinal helminthic infections with family size, grade of students, hand washing habit after toilet, habit of cutting fingernail, dirty materials in fingernail and shoes wearing habit. The odds of being infected with gastrointestinal parasites for children from a family size of 7 and above was higher than those from a family size of less than 3 (*COR*: 1.85; 95% *CI*: 0.29-1.98). Children in grade level of 1-4 were more likely to be infected with gastrointestinal helminthes than those in grade level of 5-8 (*COR*: 1.66; 95 % *CI*: 1.08-2.55). Children that did not wash their hands after using toilet were two times more likely to be infected than those who washed their hands (*COR*: 2.06; 95% *CI*: 1.13-3.77). Similarly, children who did not have the habit of cutting their fingernails were two times more likely to be infected than those who did cut their fingernails (*COR*: 2.30; 95% *CI*: 1.16-4.57). The odds of being infected with gastrointestinal helminthes in those children whose fingernails contained dirty materials were higher than those who did not have dirty materials in their fingernails (*COR*: 1.63; 95% *CI*: 1.02-2.60). Those children who did not wear shoes regularly were almost two times more likely to be infected with hookworm than those who wore shoes regularly (*COR*: 1.89; 95% *CI*: 1.13-3.17).

## 4. Discussion

In this study, the overall prevalence of intestinal helminth infection was 44.2%. It was a bit lower when compared to other studies which were done among schoolchildren in different countries. Prevalence of 53% from Oaxaca region of Mexico, and 47.0% from Mozambique were reported[14,15]. The difference in prevalence could be attributed to timing and seasonal differences in conducting the survey, environmental conditions and other geographical factors in the study areas. The prevalence of helminthic infection in the study area of current study was also relatively higher compared to other studies conducted on primary schoolchildren (32.0%) in western Tajikistan, in Ashanti region of Ghana (11.1%), and in Saudi Arabia (1.2%)[16-18]. The relatively higher rate of helminthic infection in schoolchildren of Tilili town might be due to the lack of hand washing habit after toilet, habit of

**Table 4**

Univariate logistic regression analysis for socio-demographic factors potentially associated with intestinal helminthic infections among Tilili town primary schoolchildren, 2011/12.

| Risk factors | | *n* | Positive (%) | Negative (%) | Crude odd ratio, 95% *CI*, *P*-value |
|---|---|---|---|---|---|
| Parents educational level | Illiterate | 95 | 45 (47.4) | 50 (52.6) | 0.82, 0.38-1.79, 0.59 |
| | Literate | 150 | 64 (42.3) | 86 (57.7) | 1.47, 0.71-3.05, 0.26 |
| | Completed | 96 | 38 (39.6) | 58 (60.4) | 0.60, 0.27-1.30, 0.16 |
| | Certificated and above | 44 | 23 (52.3) | 21 (47.7) | 1.00 |
| Occupation of parents | Merchants | 154 | 60 (39.0) | 94 (61.0) | 0.98, 0.49-1.67, 0.73 |
| | Farmers | 153 | 76 (49.7) | 77 (50.3) | 1.40, 0.76-2.57, 0.25 |
| | Others | 8 | 5 (62.5) | 3 (37.5) | 2.36, 0.44-13.73, 0.25 |
| | Government employees | 70 | 29 (41.4) | 41 (58.6) | 1.00 |
| Family size | 7 and above | 115 | 58 (50.4) | 57 (49.6) | 1.85, 0.29-1.98, 0.04* |
| | 6 | 112 | 47 (42.0) | 65 (58.0) | 1.31, 0.69-2.50, 0.38 |
| | 5 | 82 | 38 (46.3) | 44 (53.7) | 1.57, 0.79-3.13, 0.17 |
| | below 5 | 76 | 27 (35.5) | 49 (64.5) | 1.00 |
| Grade of students | 1-4 | 211 | 105 (49.8) | 106 (50.2) | 1.66, 1.08-2.55, 0.02* |
| | 5-8 | 174 | 65 (37.4) | 109 (62.6) | 1.00 |
| Availability of latrine | No | 59 | 24 (40.7) | 35 (59.3) | 0.85, 0.46-1.54, 0.56 |
| | Yes | 326 | 146 (44.8) | 180 (55.2) | 1.00 |
| Habit of using latrine | No | 75 | 34 (45.3) | 41 (54.7) | 1.06, 0.62-1.82, 0.82 |
| | Yes | 310 | 136 (43.9) | 174 (56.1) | 1.00 |
| Hand washing after toilet | No | 59 | 35 (70.0) | 24 (30.0) | 2.06, 1.13-3.77, 0.01* |
| | Yes | 326 | 135 (41.4) | 191 (58.6) | 1.00 |
| Habit of cutting fingernails | No | 45 | 28 (62.2) | 17 (37.8) | 2.30, 1.16-4.57, 0.01* |
| | Yes | 340 | 142 (41.8) | 198 (58.2) | 1.00 |
| Dirty materials in fingernails | Yes | 263 | 126 (47.9) | 137 (52.1) | 1.63, 1.02-2.60, 0.03* |
| | No | 122 | 44 (36.1) | 78 (63.9) | 1.00 |
| Shoes wearing habit | No | 85 | 48 (56.5) | 37 (43.5) | 1.89, 1.13-3.17, 0.01* |
| | Yes | 301 | 123 (40.9) | 178 (59.1) | 1.00 |

*Statistically significant at $P<0.05$.

cutting fingernails, presence of dirty materials in fingernails, and shoes wearing habit.

The result of present study is also comparable with previous studies conducted in different parts of Ethiopia. High prevalence (92.7%) was recorded among schoolchildren at Lake Awassa[19]. The lower prevalence obtained in the present study in comparison with the above report could be attributed to availability and usage habit of latrine, bathing places and educational level of parents. Nevertheless, the percentage of helminthic infections in the current study was higher than other studies reported in Hintalo-Wajerat (26.53%) and in Babile town (27.2%)[20,21]. This might be due to availability of tap water for drinking, habit of cutting fingernails, family size and shoes wearing habit of students in those areas. However, the finding in current study area, Tilili town, was in agreement with other studies in Ethiopia, including eastern Ethiopia 45.9% and south Wello 43.3%[22,23].

Among 170 students who were found positive for any helminthic infections, schoolchildren with single, double and triple infections were, 35.1%, 8.4% and 0.8%, respectively. It is common to find multiple infections per an individual in Ethiopia[24]. For example, 23.2% double and 5.3% triple infections were observed among school children in Zarima town, northwest Ethiopia[25]. In the current study, three common STH and one tapeworm (*H. nana*) infections were identified in 385 schoolchildren. The most frequent helminth infection was by *A. lumbricoides* followed by *T. trichiura* and hookworm infections with prevalence of 39.7%, 7.8%, and 5.5%, respectively. Similar result was reported from Abosa around Lake Ziway[26]. The least encountered helminth was *H. nana* with prevalence of 1%.

According to this study, there was significant association between grade level of students and rate of gastrointestinal helminthic infections. This was in contrast to other studies[27,28]. This finding might be due to lack of regular health education program in the school which can enhance their awareness in the transmission and control mechanisms. When we see the prevalence and associated risk factors of intestinal helminthes among schoolchildren in this study area, 84.7% of schoolchildren had toilet in their houses. But, the rate of intestinal helminth infection was not related to the presence or absence and usage of latrines ($P$>0.05). Three hundred twenty six (84.7%) students had hand washing habit after toilet and there was significant difference between the rate of helminth infection and hand washing after toilet. Forty five (11.7%) students had not habit of cutting their fingernail regularly and among these, 62.2% were positive for one or more of helminth infections. There was a statistical significance difference between who did and did not cut their fingernails. This was probably due to lack of awareness, poor hygiene practice and socio-demographic factor of schoolchildren. This result was also supported by earlier finding[29]. Two hundred sixty three (68.3%) student had dirty material in their right and left hand fingernails, out of these 47.9% were positive for one or more helminth infections. There was significant relation between helminth infection and dirty material in their fingernails. This is probably due to poor hygienic practice, socio-economic status and also playing habit of children with soil. This result was supported by previous study[30].

Three hundred one (78.2%) children had shoes wearing habit. The absence of shoes wearing habit was the risk factor and statistically significant difference was observed between shoes wearing habit and intestinal parasitic infection. Those schoolchildren who had not shoes wearing habit were also more infected with hookworm than those schoolchildren who wore shoes regularly and this was statistically significant. This finding was similar to other studies[31,32].

Provision of health education on transmission of hookworm to schoolchildren would motivate students to wear shoes regularly and thereby contributing a lot in the prevention and control of hookworm infection. Generally, the present findings in Tilili town strongly indicated the need for a comprehensive program to combat intestinal parasites and associated risk factors in the study area. Awareness creation by physicians, school teachers and mass media should be commenced promptly for preventing and controlling intestinal parasitic infections in general and helminthic infections in particular.

In conclusion, the current study has revealed a relatively high prevalence of intestinal helminthic infections among schoolchildren in Tilili town and this situation requires prompt implementation of interventional programs and education on personal and environmental hygiene. Physicians, school teachers and mass media should create awareness among schoolchildren and their parents for effective prevention and control of helminthic infections in the study area.

## Conflict of interest statement

We declare that we have no conflict of interest.

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