Prevalence of soil-transmitted helminth infestations among children attending Integrated Child Development Service centers in a tea garden area in Darjeeling

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Abstract

**Introduction:** Helminths infestations are common in children in the tea garden areas of Darjeeling, which present unique social, cultural, and environmental conditions. The present study was conducted to determine the proportion of soil-transmitted helminth (STH) infestations and association of STH to sociodemographic variables among children attending Integrated Child Development Services centers of a tea garden area in Darjeeling.

**Methodology:** A cross-sectional descriptive study was conducted at Kiran Chandra Tea Estate, a tea garden in Naxalbari, Darjeeling, between August and September 2016. Stool samples were collected from children attending ICDS centers in the area and examined using the direct and concentration methods. A pretested and predesigned questionnaire was used to collect data on the sociodemographic profile of the children’s families.

**Results:** Stool samples could be collected from 52 (45%) of the 115 eligible children. The children were predominantly male (61.5%), from families with an income between Rs. 2000 and 4000 per month, had mothers with no formal education (75.0%) and came from households with no sanitary toilets (33.5). The proportion of children with STHs was 9.6%; with *Ascaris* found in 7.7% and *Trichuris* in 1.9%. No statistically significant differences were found in selected variables between the worm-positive and worm-negative children.

**Conclusions:** The proportion of STH infestation is low among children <6 years of age attending ICDS in the study area probably because of the mass de-worming strategy of the government of India. Some differences in infestations among groups might suggest a clustering effect.

**Keywords:** Children, helminth, tea garden

INTRODUCTION

Soil-transmitted helminths (STH), namely roundworms (*Ascaris lumbricoides*), whipworms (*Trichuris trichiura*), and hookworms (*Necator americanus* and *Ancylostoma duodenale*), affect more than a quarter of the world’s population.[1] Infections are widely distributed in tropical and subtropical areas, with the greatest numbers occurring in sub-Saharan Africa, the Americas, China, and East Asia.[2] For reasons...
not well understood, school-aged children (including adolescents) and preschool children tend to harbor the greatest numbers of intestinal worms and schistosomes.[1]

Over 270 million preschool-aged children and over 600 million school-aged children live in areas where these parasites are intensively transmitted, and are in need of treatment and preventive interventions.[2] Helminthic infestation rates vary from region to region, from state to state, from district to district, and even among schools in a particular region.[4-6]

Exposure to the environment with helminth prevalence, poor sanitation practices, and unhygienic practices result in reinfection with STH within a short interval even after a successful treatment with a course of anthelmintics. This infection–reinfection cycle of the worm can be interrupted by adopting the water, sanitation and hygiene strategy.[7,8] Other important measures to break the chain of transmission are putting a stop to open air defecation[9] and wearing of shoes or slippers. In the absence of a co-ordinated approach towards helminth elimination, the gains achieved by deworming cannot be sustained.

The subtropical monsoon climate in West Bengal is conducive to STH infestations. The tea gardens in Darjeeling present a unique environment compared to the rest of the country. Apart from the flora and fauna of the region, the workers living in these areas represent a unique sociocultural group with customs and practices different from the rest of the district. An extensive search of published and unpublished literature failed to reveal any recent study on the prevalence and types of helminthic infestation and their risk factors in this region. The present research study was planned to answer these questions.

**Aims and objectives**

1. To determine the proportion of STH infestation among children attending Integrated Child Development Services (ICDS) centers of a tea garden area
2. To determine the association of STH infestations to selected sociodemographic characteristics.

**METHODOLOGY**

**Study type and design**

A cross-sectional descriptive study was conducted at the Kiran Chandra Tea Estate in Naxalbari block of Darjeeling district, West Bengal.

**Study period**

The study was undertaken between August 1, and September 31, 2016.

**Study setting**

The Kiran Chandra Tea Estate is the rural field practice area of the department of Community Medicine, North Bengal Medical College, since 2011, located approximately 3 km from Naxalbari. The garden covers an area of 830 km² and employs 530 permanent employees. During the peak harvesting season the garden engage an additional 400 temporary workers. The department renders its services in the form of promotive, preventive, and curative outpatient services at the dispensary at the Tea Estate once a week. The department also organizes screening and other health related education activities in the garden through the participation of the health services and the tea garden authorities.

**Study population**

All children <6 years attending the three ICDS centers in the Kiran Chandra Tea Estate in Naxalbari were included in the study. None of these children had symptoms such as abdominal pain, vomiting, or were on treatment of anemia at the time of data collection. Children aged 6 months or less were excluded from the study as they were supposed to be exclusively breastfed.

**Sample size**

A complete enumeration of eligible children between 6 months and 6 years attending the three ICDS centers in the Kiran Chandra Tea Estate was done. The line list of the children showed that the sample size was 115.

**Sampling technique**

The total number of children were listed from the ICDS rolls. These children live in the households located in four different but contiguous settlements namely the Gudam, Hari and Pucca lines, and Premnagar. The houses of these children were visited and the mothers and caregivers were informed about the study and the benefits to them. If they agreed to participate they were given stool collection containers with detailed instructions as to how to collect the stool samples. Each line was visited on a particular day, containers distributed as per the list and the samples were collected on the next day at the dispensary in the garden. Stool samples were kept in vaccine boxes with ice packs and brought to the microbiology laboratory and refrigerated. In case the children failed to pass stool the following day, they were asked to submit the sample on the next collection day.

**Study tools**

- A pretested and predesigned questionnaire to collect data on the sociodemographic profile of the family to which the child belongs
• Sterile screw capped tight fitting containers with spoons attached to the caps provided to the mothers or caregivers of the children at their homes. The containers were labelled with the name and ID of the child on the side of the container. The mothers and caregivers were instructed to bring the morning stool sample without mixing water and urine, which were collected in vaccine boxes with ice packs kept at the garden dispensary and transported to the Microbiology Laboratory of the NBMC. For children passing stool in the evening, stool samples were collected and kept in vaccine carriers, kept with the ICDS worker in the garden. These samples were transported to the laboratory in the following morning along with the samples collected in the morning, maintaining the cold chain during transportation. The samples were processed for further examination.

Slide preparation and examination
Stool samples were examined within the same or next day of collection of samples samples. Slides were prepared using standard direct methods using normal saline and iodine, followed by the zinc sulfate centrifugal floatation and formalin-ether concentration techniques. Thus each sample underwent four tests. Examination was done with low power objective and the high power objective of microscope for identification of intestinal helminthic trophozoites/cysts/eggs.

Data collection techniques and data analysis
Data regarding the sociodemographic and hygiene related variables were obtained from the mothers/caregivers/ Anganwadi workers of the children using the questionnaire after prior verbal consent. Data entry and cleaning were done in Microsoft Excel and analyzed using IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp. Data were organized and presented by applying principles of descriptive statistics. Cross tables were constructed based on sociodemographic and hygiene data and presence of worm infestation. Graphs were constructed using Microsoft Excel.

Ethical approval
Ethical approval was taken from the Institutional Ethics Committee of the North Bengal Medical College (PCM 2015-16/603/AI). Verbal consent was obtained from the mother or caregiver of the child before interviewing them. Anonymity and confidentiality was ensured. The mother/ caregiver were given the reports of the stool examination in the usual proforma of the department of microbiology within a week of the examination. All children with helminthic infestation were prescribed and administered Albendazole under supervision of the department of Community Medicine.

RESULTS
There are 115 children attending the three ICDS centers located in the tea garden. Despite several attempts stool samples could be collected from 52 of the children. Table 1 shows a more or less even distribution of children in all the age groups. Female children constituted approximately two thirds (61.5%) of the study population. A little more than half (53.8%) of the children enrolled for the study were from Center 2, while the rest were distributed approximately equally between Centers 1 (25.0%) and 3 (21.2%). Most children belonged to families with an income of Rs. 2000–4000 per month, followed by incomes over Rs. 4000 in 34.6% of the families. Only 7.7% of the families had household incomes <Rs. 2000 per month. The largest section of mothers of the children in the study population had no formal education (75.0%), while almost equal proportions were educated up to the primary (5.8%), upper primary (5.8%), lower secondary (7.7%) and higher secondary (5.8%) levels. One-third (33.5) of the households of children in the study did not have sanitary toilets. The majority of the children/mothers washed their hands before eating/feeding the children (59.6%), or washed their hands with soap after defecation (71.2%). A large section (34.6%) of the studied children were seen without footwear during the visits to the garden. Nails were trimmed in approximately half of the children (48.1%) while the rest (51.9%) had untrimmed and dirty nails.

Table 2 shows the overall prevalence (9.6%) of STHs in the study population. Prevalence of Ascaris among the study

| Name of author (year) | Total parasite prevalence | Prevalence of Ascariasis |
|-----------------------|---------------------------|-------------------------|
| Present study (2016)* | 9.6                       | 7.7                     |
| Kumar et al., 2013†   | 49.38                     | 46.88                   |
| Wani and Ahmad 2009‡  | 73.36                     | 69.84                   |
| Kumar CS et al., 2003¶ | 71.73                     | 23.73                   |
| Bisht et al., 2011¶   | 38.2                      | 6.25                    |
| Shrestha 2004¶         | 81.94                     | 72.62                   |
| Khanal et al., 2004¶  | 17.6                      | 3.52                    |
| Singh et al., 2013¶   | 15.17                     | 5.72                    |
| Gunawardena et al., 2011¶ | 29.04                   | 24.44                   |

*Studies conducted in India, †Studies conducted in Nepal, ‡Studies conducted in Sri Lanka. Adopted from Kumar et al.[11]
population was 7.7% while the prevalence of Trichuris was 1.9%.

Table 3 illustrates the comparative analysis between children with and without helminths in stool. Although the proportion of worms is different in the age groups, the differences are not statistically significant (Chi-square = 6.10, \( P = 0.296 \)). The distribution between the genders is also different with a higher proportion (15%) of male children being worm positive compared to female children (6.3%). However the difference was not statistically significant (Chi-square = 1.08, \( P = 0.298 \)). Worm infestation in children differed based on the ICDS center they were attending during the study. Worm infestation was more likely in children attending Center 2, although the differences were not statistically significant (Chi-square = 2.09, \( P = 0.352 \)).

All children that were affected with helminths belonged either to monthly income of Rs. 2000–4000 (10%) or ≥Rs. 4000 (11.1%) per month group. The differences between the groups were however not statistically

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### Table 2: Prevalence of soil transmitted helminth infestations

| Prevalence of helminth infestation | Frequency (%) |
|-----------------------------------|---------------|
| STH combined                      | 5 (9.6)       |
| Ascaris lumbricoides              | 4 (7.7)       |
| Trichuris trichiura               | 1 (1.9)       |

STH: Soil transmitted helminth

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### Table 3: Distribution and comparisons of characteristics between worm positive and worm negative children (n=52)

| Variables                                      | Total, \( n \) (%) | Worm positive, \( n \) (%) | Worm negative, \( n \) (%) | \( P \) |
|------------------------------------------------|---------------------|-----------------------------|-----------------------------|-------|
| Age (years)                                    |                     |                             |                             |       |
| 0-1                                            | 8 (15.4)            | 0 (0)                       | 8 (100)                     | 0.296 |
| 1-2                                            | 7 (13.5)            | 0 (0)                       | 7 (100)                     |       |
| 2-3                                            | 9 (17.3)            | 1 (11.1)                    | 8 (88.9)                    |       |
| 3-4                                            | 10 (19.2)           | 0 (0)                       | 10 (100)                    |       |
| 4-5                                            | 10 (19.2)           | 2 (20)                      | 8 (80)                      |       |
| 5-6                                            | 8 (15.4)            | 2 (25)                      | 6 (75)                      |       |
| Gender                                         |                     |                             |                             |       |
| Female                                         | 32 (61.5)           | 2 (6.3)                     | 30 (93.7)                   | 0.298 |
| Male                                           | 20 (38.5)           | 3 (15)                      | 17 (85)                     |       |
| ICDS center                                    |                     |                             |                             |       |
| Center 1                                       | 13 (25)             | 0 (0)                       | 13 (100)                    | 0.352 |
| Center 2                                       | 28 (53.8)           | 4 (14.3)                    | 24 (85.7)                   |       |
| Center 3                                       | 11 (21.2)           | 1 (9.1)                     | 10 (90.9)                   |       |
| Economic status (Rs.)*                         |                     |                             |                             |       |
| <2000                                          | 4 (7.7)             | 0 (0)                       | 4 (100)                     | 0.788 |
| 2000-4000                                      | 30 (57.7)           | 3 (10)                      | 27 (90)                     |       |
| ≥4000                                          | 18 (34.6)           | 2 (11.1)                    | 16 (89.9)                   |       |
| Educational qualification of mother##         |                     |                             |                             |       |
| No formal education                            | 39 (75)             | 5 (12.8)                    | 34 (87.2)                   | 0.764 |
| Primary (standards 1-4)                        | 3 (5.8)             | 0 (0)                       | 3 (100)                     |       |
| Upper primary (standards 5-7)                  | 3 (5.8)             | 0 (0)                       | 3 (100)                     |       |
| Lower secondary (standards 8-10)               | 4 (7.7)             | 0 (0)                       | 4 (100)                     |       |
| Higher secondary (standards 11-12)             | 3 (5.8)             | 0 (0)                       | 3 (100)                     |       |
| Presence of sanitary toilet in house           |                     |                             |                             |       |
| Yes                                            | 33 (63.5)           | 4 (12.1)                    | 29 (87.9)                   | 0.419 |
| No                                             | 19 (35.5)           | 1 (5.3)                     | 18 (94.7)                   |       |
| Usual practice of handwashing with soap after defecation¶ | | | | |
| Yes                                            | 36 (69.2)           | 4 (11.1)                    | 32 (88.9)                   | 0.583 |
| No                                             | 21 (30.8)           | 1 (6.3)                     | 20 (93.7)                   |       |
| Usual practice of handwashing with soap before eating | | | | |
| Yes                                            | 31 (59.6)           | 1 (6.3)                     | 30 (93.7)                   | 0.758 |
| No                                             | 21 (40.4)           | 4 (15)                      | 17 (85)                     |       |
| Child wearing footwear at the time of visit to the house/ICDS center¶¶ | | | | |
| Yes                                            | 27 (51.9)           | 3 (11.1)                    | 24 (88.9)                   | 0.65  |
| No                                             | 18 (34.6)           | 2 (11.1)                    | 16 (88.9)                   |       |
| Nails of the hand trimmed at the time of examination of the child | | | | |
| Yes                                            | 24 (46.2)           | 2 (8.3)                     | 22 (81.7)                   | 0.771 |
| No                                             | 28 (53.8)           | 3 (10.7)                    | 25 (89.3)                   |       |

*One family had no income for the last 6 months, Two families had income in the range of Rs. 30,000-35,000 per month, **Primary/secondary education in India is segregated as Primary (1st standard-4th standard), upper primary (5th standard-7th standard), lower secondary (8th standard-10th standard), and higher secondary (11th and 12th standard) ¹Usual practice was obtained from interviews with the mother and the ICDS caregivers. In children fed by the mothers handwashing practices of the mother was asked during the interview. In children cleaned by the mothers after defecation, the practice of the mother regarding handwashing was asked, ²Children <1 year old who had not learned to walk, ³In the cells where the expected values were <5, Fisher’s exact test was used. ICDS: Integrated Child Development Services
significant. All (100%) children that were worm positive belonged to mothers with no education. Children living in households having sanitary toilets (12.1%), usually washing hands after defecation (11.1%), not usually washing hand with soap before eating (15%) and having untrimmed nails (10.7%) had more helminthic infestations. However none of the differences were statistically significant. The use of footwear in children (≥1 year of age) was associated with a similar level of infestation.

Table 4 shows that the among the concentration methods, formalin-ether technique had the highest yield of *Ascaris* in stool, followed by the zinc sulfate floatation techniques compared to the direct method (Normal Saline, Iodine). However, for *Trichuris*, the concentration methods provided no increase in the diagnostic yield from specimens.

### DISCUSSION

The epidemiology of STHs in India is changing. Studies from Vellore in Tamil Nadu, has shown a decrease in prevalence from 22.8% of all stool samples positive for hookworm and 0.8% positive for *Ascaris* in 1998 to prevalence in STH of 7.8% in 2014. In West Bengal, studies by Chandler in 1929 found a prevalence of STH of 90% in the district of Darjeeling. Community surveys from the hills in Darjeeling by Saha et al. reported a STH prevalence of 38.7% in 1993. Although limited to a tea garden from the foothills of Darjeeling, the present study reveals a much lower prevalence of only 9.6%, a significant decrease as reported in previous studies. This could partially be attributed to age specific doses of *Albendazole* administered to all children between 1 and 19 years of age in schools and ICDS centers, as part of the National De-worming Day programme and partially to an increase in awareness and adoption of hygienic practices.

Among worm infestations, *Ascaris* remains the most common worm type prevalent in all parts of India and other countries of the South-East Asia among all age groups. The relative prevalence of *Ascaris* in stool samples as reported by different studies are summarized above. [Table 1] Even in countries outside southeast Asia, higher number of *Ascaris* infestations are noted in children. Transmission of *Ascaris* is through the feco-oral route and re-infections after treatment reappear fast.

STH infections can occur in the entire community or in a few individuals as clusters. Even in delineated geographical areas variations in prevalence can be seen between clusters of households, schools, etc. In the present study differences in prevalence were noted between the three ICDS centers. The ICDS centers cater to different lines (groups of households) of the tea estate, suggesting a strong cluster effect. Differences in environmental sanitation, water supply and the socioeconomic status of the households may be considered responsible for the difference among clusters. Clustering can hamper attempts to control the infection, as individuals with heavy infection are likely to reintroduce it into the community. Although, mass drug administration is the cornerstone of STH disease control programs, additional measures such as changes in behavior, social, economic, and environmental factors are required to bring about a reduction in their prevalence.

In situations where the number of organisms in the stool specimen is low, the examination of direct wet mount may not detect parasites. Under these conditions, two or three different concentration techniques employing different methods increased the sensitivity of detection of helminths. Since all children were supposed to have received deworming treatment during the national deworming program in the month of August a decrease in the intensity of the infestations and hence lower egg counts in these children was anticipated.

Lack of maternal education has been found to be an important factor favoring worm infestation in children. Although not statistically significant it is interesting to note that all the helminth infestation in the present study were seen in children of mothers with no education. Studies from Nepal among children have shown a significant lower rate of helminths infestations in children practicing handwashing with soap and water. Lower infestation rates in children were noted by Wani et al. in Jammu and Kashmir among children having clean nail (58.3%) compared to those with dirty nails (83.3%). The results were however statistically not significant. Another study from Ethiopia also noted similar findings.

Although sanitary toilets have been constructed in the households through the active participation of the
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panchayat and the tea garden authorities, a large section of the population still do not use them or use it for other reasons like storing wood for the rains. Thus the presence of sanitary toilets does not necessarily mean their use.

Limitations

The response rate of the study was poor resulting in the collection of stool samples in about 50 percent of the children. This may have resulted in an exaggerated calculation of the prevalence. The stool samples collected had to be transported to the microbiology laboratory at the North Bengal Medical College, which is approximately 25 km away. The time delay in stool sample collection and laboratory processing of the samples could have decreased the fecal egg counts significantly especially for hookworms.

CONCLUSION

It can be concluded from the present study that the proportion of children with STH infestation is low among children <6 years of age attending ICDS centers in the study area probably because of the MDA or de-worming strategy of mass prophylaxis adopted by the government of India. However, certain features were observed in the study like differences in infestation among the three ICDS centers in the village suggesting clustering of cases. High priority must be given to identify high prevalence clusters and institute effective treatment and preventive measures.

Acknowledgments

The authors gratefully acknowledge the support from the Indian Council of Medical Research (ICMR) to the first author under the Short-Term Studentship (STS) project (reference ID: 2016-07413). Mr Protyush Ganguly, Manager, Kiran Chandra Tea Estate also deserves mention for his continued support and logistic help with the study. The authors would also like to acknowledge the assistance and encouragement shown by Professor Arunava Sarkar, Head of the Department, and Mr. Tapan Kumar Bhowmik, Senior Technologist, of the department of Microbiology, North Bengal Medical College, Sushrutanagar, Darjeeling.

Financial support and sponsorship

The study was funded by the STS grant 2016 of the ICMR.

Conflicts of interest

There are no conflicts of interest.

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