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Prevalence and intensity of *Trichuris trichiura* infection and associated determinants in rural tea garden areas of sylhet, Bangladesh

Abstract

The current study of the prevalence, intensity and associated determinants of *Trichuris trichiura* infection was carried out from June' 2014 to May' 2015 among five tea gardens of Sylhet Sadar Upazila of Sylhet district, Bangladesh. Out of 300 participants 42(14.00%); 95% CI 10.28-18.45) were found robustly infected with *T. trichiura* of the age groups 11-20 years age group showed highest prevalence 31.58% (95% CI 12.58-56.55) than other age groups. Multivariate analysis identified season (OR=6.15; 95% CI 2.27-16.66, P= 0.01), areas, periodic anthelmintic does not taking, unhygienic disposal of the stool (OR=2.79, 95% CI 1.44-5.43, P= 0.02) are as the potential determinants contributing to the intensity of *T. trichiura* infection. Low income of the family significantly (OR=2.15; 95% CI 1.11-4.15, P=0.02) associated with *T. trichiura* infection. Low level of education of the parents associated with moderate intensity of *T. trichiura* infection. Therefore deworming of the tea garden children and worker are warranted. Preventive measures should be emphasized on important determinants like regular taking of anthelmintics, proper disposal of children's stool, appropriate water management and children should be avoided entering to household dirt.

Keywords: prevalence, trichuris trichiura, intensity, determinants, tea garden community

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Introduction

The intestinal parasitic infection particularly *T. trichiura* causes hundreds of thousands of deaths every year.[1] It has been recorded that over one billion people are infected with Ascaris lumbricoides, 800 million with hookworm and 770 million with *T. trichiura*.[2] Trichuriasis prevalent throughout the tropical areas especially the areas associated with the conditions of poverty, unsafe water, sanitation and hygiene particularly in developing nations.[3–5] Previous studies have shown the main risk factors for helminths infection are rural residency, low economic status and poor knowledge on hygiene.[6,7] There are few data on the epidemiology of helminths infection in tea garden community of Sylhet[8] but no data available on risk factors of helminths infections. Negative effects of trichuriases infection include diminished physical fitness, growth retardation, delayed intellectual development and cognition.[6,9] To investigate the epidemiology of helminths infection in tea garden children and workers we analyzed collected data during the study period in tropical Sylhet. Current stratagem for controlling helminths infections are primarily based on periodic anthelmintic treatment of community people, and secondarily on education and sanitation improvement. The use of pit latrines and improved drinking water has been associated with reduction of prevalence of helminths infections.[10] Treatment based control strategies goal to control rate of mortality through reductions of transmission of helminths infection in the community.[11] An understanding of the determinants of infections would assist in designing the most appropriate control measures. The aim of the present study was to determine robustly the prevalence and determinants and clinical features associated with trichuriases infection in tea garden community.

Materials and methods

Study area

The tea garden areas of Sylhet district located 315km north east from capital city Dhaka were selected for this study as it is the poorest area of Bangladesh. Sylhet is located at 24.8917°N and 91.8833°E. It has 86074 units of house hold and total area 323.17 km².[12] More than 75% rainfall occurs in the monsoon period. Average temperature of the country ranges from 17 to 20.60°C during winter and 26.90 to 31.10°C during summer. Average relative humidity for the whole year ranges from 70.50% to 78.10% in Bangladesh.[13] This district is occupied by high proportion of ethnic minorities, stingy household condition, poor road condition, no prohibition for preventive and curative measures (Figure 1).

Duration of the study

The study was conducted for a period of 12 months starting from June' 2014 to May' 2015.

Ethical approval

The study was approved by the Ethical Committee for public health research, Sylhet Agricultural University, Sylhet-3100. Verbal consent was obtained from the parents or legal caretakers of the children. Children positive with intestinal parasites were treated with appropriate drugs by physicians from Upazila Hospitals free of cost.

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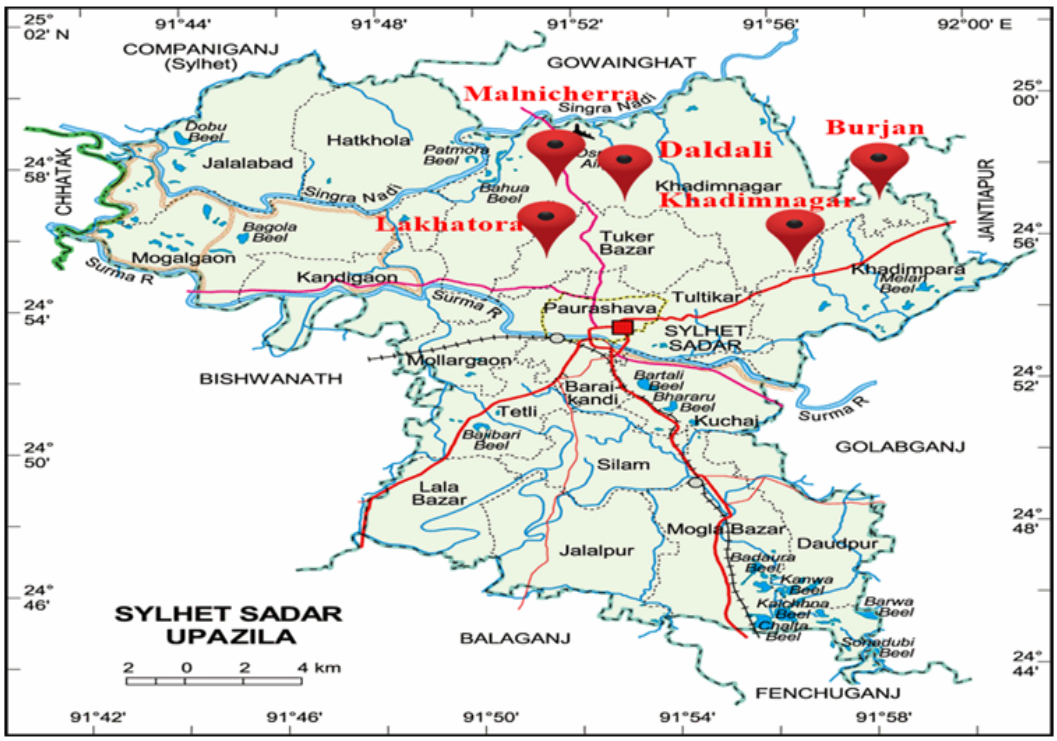

Figure 1 Location of tea garden in Sylhet Sadar Upazilla

Data collection

Demographic and socio-economic information of the participant and other member of the family were collected using standard questionnaire. The probable potential determinants like age, sex, participants schooling, Parent's occupation, taking anthelmintic, type of latrine, toilet floor, how often toilet clean, washing hand and feet coming from toilet, access to safe drinking water, and work in bare foot. The parents were also asked for if any ill health condition last six month as itching, abdominal pain, diarrhea, weight loss, fatigue and weakness, and blood in stool etc. Household socio-economic status like monthly income of family, education of the house head, household floor, ownership of the animal cattle, sheep, goat, dog, cat and pigs.

Sample collection

Labeled stool containers were provided to the parents of each child. The filled containers were collected in the following morning and were carried in a cool ice-box to the Laboratory and examination was performed within 24 hour of collection**.**

Study design and selection of the tea garden

In first step, the heads of respective tea garden from all five tea garden were asked for community outreach activities in June' 2014 to prepare a list of all primary schools in their respective tea garden including the number of children attending grades 2 and 3. All interested participants of the selected household were also enlisted for the study with making proper consent of the household head.

Analysis of collected stool sample

Direct smear method and Kato Katz Techniques

The collected stool samples were examined by direct saline smear for the presence of parasitic ova and the same sample also were subjected to Kato Katz thick smear[14] and in every slide egg of each parasite species evaluated and recorded (Figure 2). The intensity of infection [egg per gram (EPG)] was determined. Based on the criteria of the [15]: A. lumbricoides: light, 0–4999 EPG; moderate, 5000-49999 EPG; and heavy, ≥50 000 EPG; *T. trichiura*: light, 0–999 EPG; moderate, 1000–9999 EPG; and heavy, ≥10 000 EPG; and hookworm: light, 0–399 EPG; moderate, 400–2999 EPG; and heavy, ≥3000 EPG.

Data analysis

Statistical analysis was performed by Logistic Regression procedure using STATA 13 (College Station, Texas 77845 USA) and the level of significance was considered as $P<0.05$. In the univariable analysis, λ^2 test done for determinants associated with infection. In the multivariable logistic regressions, variables with a P-value of ≤0.20 in the univariable analysis were included as predictors. ORs and 95% CI were reported. P-values <0.05 were regarded as significant.

Results

Household, education and income of the family

Of the participants 91.67% live in the house floor made up of mud, 08.00% concrete made and 0.33% in semi cemented floor house. In the tea garden community 34.67% had primary education, 05.33%

secondary education and 60% Illiterate. The participant's father possesses higher literacy than mother. Primary education 28.67% and 21.00%; Secondary 24.00% and 01.00%; Illiteracy 47.33% and 78.00% respectively for male and female (Table 1). Occupation and family income of the participants playing a crucial role in trichuris infection (Table 2) (Table 3).

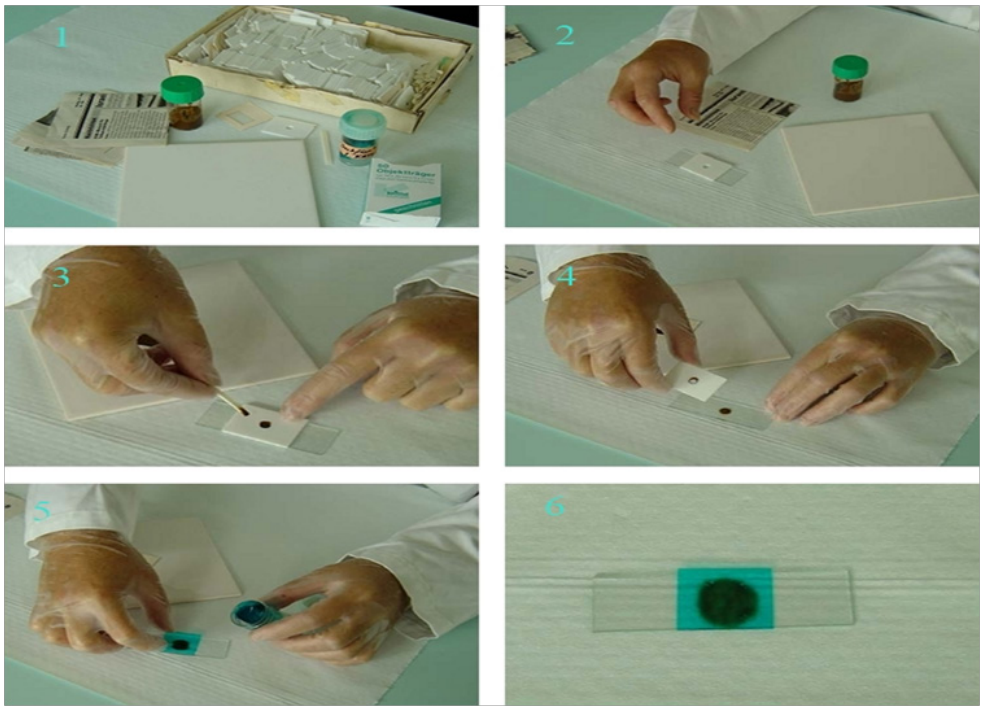

Figure 2 Preparation of Kato Katz slides (Step 1: All the required tools are accommodated; Step 2: Setting up the slide and plastic strip with pit; Step 3: Placement of required quantity of stool in the pit; Step 4: Removal of the plastic strip and desired amount of stool remained in the glass slide; Step 5: Placing the nylon screen over the stool sample; Step 6: Slide prepared and ready for ova counting under microscope).

Table 1 Educational status of the 300 participants and their parents in tea garden community

Characteristics	Frequency	Percentage
Participants schooling		
Primary	104	34.67
Secondary	16	5.33
No schooling	180	60
Mother's schooling		
Primary	63	21
Secondary	3	1
No schooling	234	78
Father's schooling		
Primary	86	28.67
Secondary	72	24
No schooling	142	47.33

Table 2 Occupational status of the parents of 300 participants in tea garden community

Level of occupation	Frequency	Percentage
Father's occupation		
Unemployed	11	3.67
Day labourer	182	60.67
Service	80	26.67
Tea garden worker	9	3
Business	18	6
Mother's occupation		
Housewife	167	53.33
Service	1	0.33
Business	132	44

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Table 3 Other demographic information of the 300 participants of tea garden community

Other demographic information	Frequency	Percentage
Age group		
≤10	242	80.67
20-Nov	19	6.33
21-30	13	4.33
31-40	12	4
41-up	14	4.67
Sex		
Male	177	59
Female	123	41
Name of the areas		
Khadim tea estate	47	15.67
Burjan tea estate	79	26.33
Lakkatora tea estate	65	21
Malnichara tea esstate	63	21.67
Daldali tea estate	46	15.33
Category of weight (kg)		
≤20	186	62
21-40	65	21.67
41-up	49	16.33
Income of house (Taka)		
≤5000	103	34.33
>5000	197	65.67
No of people living in house		
≤4	145	48.33
≥5	155	51.67
Name of the season		
Rainy	65	21.67
Winter	116	38.67
Summer	119	39.67

Demographic information (Table 4)

Prevalence of Trichuris infection

The T. trichiura organism has been identified from stool specimens with the overall prevalence 14.00% (95% CI 10.28-18.45). The prevalence of trichuriases is higher in male 14.69% (95% CI 09.83-20.78) than female 13.01% (95% CI 07.62-20.26). Highest infection occurred during Rainy season and which is 24.62% (95% CI 14.77-36.87) then the infection gradually decreases from 17.24% (95% CI 10.86-25.36) to 05.04% (95% CI 01.87-10.65) respectively for Winter and Summer. The highest infection recorded in the age group 11-20 years 31.58% (95% CI 12.58-56.55) and lowest infection in ≥41 age groups 07.14% (95% CI 0.18-33.87) (Table 4). Interesting finding of our work was no *T. trichiura* infection in Daldali tea garden, it is most likely because of the geographical and hygienic condition of this area. People of this area are quietly abided by the hygienic health regulations rules.

Table 4 Prevalence of Trichuris trichiura infection in tea garden community of Sylhet

Points	Total no. of tested	Total no. of positive	Prevalence (95% confidence Intervals)
Season			
Rainy	65	16	24.62% (14.77-36.87)
Winter	116	20	17.24% (10.86-25.36)
Summer	119	6	05.04% (01.87-10.65)
Age			
≤10	242	30	12.39% (08.52-17.22)
20-Nov	19	6	31.58% (12.58-56.55)
21-30	13	3	23.08% (05.04-53.81)
31-40	12	2	16.67% (02.09-48.41)
≥41	14	1	07.14% (0.18-33.87)
Areas			
Khadim tea estate	47	14	29.79% (17.34-44.90)
Burjan tea estate	79	18	22.78% (14.10-33.60)
Lakkatora tea estate	65	2	03.08% (00.38-10.68)
Malnichara tea estate	63	8	12.70% (05.65-23.50)
Daldali tea estate	46	-	
Sex			
Male	177	26	14.69% (09.83-20.78)
Female	123	16	13.01% (07.62-20.26)

Intensity of *T. trichiura* infection in tea garden community of Sylhet (Table 5)

Determinants for *T. trichiura* infection

The univariable analysis disclosed season, areas, participant's schooling, receiving anthelmintic periodically, family income and disposal of the stool were significantly P<0.05 associated with Trichuris infection (Table 6). The rural slum of the tea garden poorly arranged and the unhygienic condition of the areas favor the transmission cycle of the infection.

The multivariable logistic regression shows that season are keenly associated with *T. trichiura* infection and the Rainy season revealed OR=6.15(95% CI 2.27-16.66) than the Winter OR=3.92(95% CI 1.51-10.17). Periodic anthelmintic taking reduces the chance of infection than those are not taking anthelmintics OR=2.07(95% CI 1.07-4.01). The tea garden location also favors the transmission cycle of *T. trichiura* due to poor hygiene maintenance in the rural slums (Table 7).

Table 5 Intensity of T. trichiura infection in tea garden community of Sylhet

Trichuris trichiura	Percentage of infection
No infection	258(86.00)
Light	30(10.00)
Moderate	08(02.67)
Heavy	04(01.33)
Total	300(100.0)

The epg (egg per gram) counting by Kato Katz revealed light, moderate and heavy infection of *T. trichiura* and which were 10.00%, 02.67% and 01.33% respectively **(Table 5)**

Table 6 Univariable analysis by λ2 test of the factors associated with *T. trichuria* infection in tea garden community of Sylhet

Characteristics	Positive n=42(%)	Negative n=258(%)	P-value
Season			
Rainy	16(69.23)	49(30.77)	
Winter	20(26.05)	96(73.95)	
Summer	06(42.40)	113(57.76)	<0.01***
Areas			
Khadim tea estate	14(63.83)	33(36.17)	
Burjan tea estate	18(55.70)	61(44.30)	
Lakkatora tea estate	02(29.23)	63(70.77)	
Malnichara tea esstate	08(39.68)	55(60.32)	
Daldali tea estate	0	46(84.78)	<0.01***
Participant's schooling			
Primary	22(50.96)	82(49.04)	
Secondary	03(18.75)	13(81.25)	
No schooling	17(38.33)	163(61.67)	0.02
Father's occupation			
Unemployed	03(63.64)	08(36.36)	
Day labourer	24(46.70)	158(53.30)	
Service	11(28.75)	69(71.25)	
Tea garden worker	02(33.33)	07(66.67)	
Other	02(38.89)	16(61.11)	0.67
Monthly family income (Taka/Month)			
≤5000	21(50.49)	82(49.51)	
>5000	21(37.06)	176(62.94)	0.02
Receive treatment			
No	24(65.60)	101(34.40)	
Yes	18(24.57)	157(75.43)	0.03
Treatment 4 month interval			
No	33(62.29)	142(37.71)	
Yes	09(12.80)	116(87.20)	0.04
Toilet floor			
Mud	26(58.59)	175(41.41)	
Bamboo	16(33.33)	83(66.67)	0.45
Where dispose stool			
Around house	21(34.12)	190(65.88)	
Jungle/Tea garden	21(59.55)	68(40.45)	0.02
Rub hand after toilet			
No	35(39.84)	221(60.16)	
Yes	07(52.27)	37(47.73)	0.69
Use disinfectant toilet cleaning			
No	13(56.76)	61(43.24)	
Yes	29(36.73)	197(63.27)	0.31
Have foot ware			
No	02(04.76)	05(01.94)	
Yes	40(95.24)	253(98.06)	0.26
Use shoe inside home			
Always	04(09.52)	24(09.30)	
Most time	11(26.19)	117(45.35)	
Rarely	25(59.52)	112(43.41)	
Never	01(02.38)	04(01.55)	
Not applicable	01(02.38)	01(0.04)	0.17
Activity outside home			
Always	07(16.67)	37(14.34)	
Most time	14(33.33)	147(56.98)	
Rarely	20(47.62)	71(27.52)	
Never	00(0.00)	02(0.07)	
Not applicable	01(02.38)	01(0.04)	<0.01***
Work in bare foot			
No	09(21.43)	46(17.83)	
yes	33(78.57)	212(82.17)	0.58
Wash feet coming from out			
Not always	23(54.76)	149(57.75)	
Always	19(45.24)	109(42.25)	0.72

*P<0.05 Significant association with positive sample, ***= highly significant

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Table 7 Multi-variable logistic regression analysis of *Trichuris trichiura* infection in Tea garden community of Sylhet

Name of variable	Odds ratio (95% confidence Intervals)	P-value
Season		
Rainy	6.15(2.27-16.66)	<0.01***
Winter	3.92(1.51-10.17)	
Summer	1	
Areas		
Khadim tea estate	2.92(1.11-7.69)	
Burjan tea estate	2.03(0.82-5.04)	0.03
Lakkatora tea estate	0.22(0.04-1.07)	
Malnichara tea estate	0.15(0.07-.03)	
Daldali tea estate	1	
Income (Taka/Month)	2.15(1.11-4.15)	
≤5000	1	0.02
>5000		
Receive anthelmintic		
No	2.07(1.07-4.01)	0.03
Yes	1	
Receive anthelmintic 4 month interval		
No	2.99(1.38-6.51)	0.01
Yes	1	
Disposal of stool		
Jungle/garden	2.79(1.44-5.43)	0.02
Around house	1	

*P<0.05 Significant association with positive sample, ***= highly significant

Discussion

This cross sectional study included 300 participants in rural slum of tea garden community in Sylhet district. These numbers of participants are representative of the local population in this poor remote setting as previous study.[16] The overall prevalence of *T. trichiura* infection was 14.00% (95% CI 10.28-18.45). This finding was higher than the reports from other study of Bangladesh.[7,16] The variation of prevalence of *T. trichiura* infection in different studies would be due to differences in climate and geographical location of the areas. What's more, socio-economic condition as well as environmental, household, personal hygiene plays a pivotal role for the variation in the prevalence of infection.[17] There is a paucity of information in the prevalence of *T. trichiura* because at the best of my knowledge this is the first time reporting the age category. Previous study targeted the overall infection of the regular female tea pluckers.[16] Prevalence of Trichuris infection in the slums of urban areas was 03.43%[1,7] which is lower than the rural slum areas 31.58% (95% CI 12.58-56.55). Exposure of older children to the infection is higher as they show different way of behaviors. However, older children accumulate infection during their lifetime.[18] The existence of this parasite higher among the children might be due to the resistant nature of the eggs against different environmental factors.[19] Trichuris infection is higher in older children which was consistent to other researchers.[20,21] Trichuris infection is comparatively higher in male than female which is contradictory to[7,18] but similar to.[22]

It is known that a single Kao Katz thick smear done on a single sample has a relatively lower sensitivity.[23] Therefore it could be assumed that the true prevalence of infection is higher than which documented here. In addition the Kato Katz technique does not allow detection of a broader range of parasite species.

In this study the infection intensity of *T. trichiura* measured as an indirect tool of morbidity. *T. trichiura* infection was identified as light, moderate and heavy infection but in study of[18] only light and moderate infection found. However, there was prevalence of malnutrition and anemia in the study subjects but no association with the Trichuris infection although *T. trichiura* were associated with higher level of anemia.[24]

Determinants analysis showed that the areas were significantly associated with *T. trichiura* infection which is similar to the findings of.[22] This might be due to the climatic condition like humid and warm weather, poor hygiene of the rural slum, lack of provision for potable water.

In the multivariate analysis, *T. trichiura* is best predicted by season. Rainy season contributed significantly the infection because children spend more time outside of the house and eat frequently unwashed fruit from the gardens. OR=6.15(95% CI 2.27-16.66; P=<0.01) than winter OR=3.92(95% CI 1.51-10.17; P=<0.01). This study is slight contradictory by the Matthys B & Gungoren B et al.[25,26] that speculated parasitic infection might be higher in summer.

We identified periodic anthelmintic taking reduces the parasitic infection significantly. The participants who does not take anthelmintic four month interval they had opportunity of getting infection OR=2.99(95% CI 1.38-6.51; P<0.01). Unhygienic disposal of human stool significantly associated with Trichuris infection because disposal of stool in jungle or tea garden canal showed OR=2.79(95% CI 1.44-5.43; P<0.02), where children and workers regularly enter in stool conveying canal which ultimately promotes the transmission cycle (Figure 3).[27]

Figure 3 House yard of rural tea garden community of Sylhet, Bangladesh, early 2014.

The economic condition of the household is significantly associated with *T. trichiura* infection because with low family income the rate of infection increases as we found in our study 2.15 (95% CI 1.11-4.15; P<0.02) which is similar to the findings of[28] when the family income increases then they had privileges to maintain all hygienic measures.

Factors like education, occupation, toilet floor and work in bare foot did not correlate with *T. trichiura* infection which seems to have an association with infection. Steenhard NR et al.[22] reported illiterate mother is significantly associated with infection.

Chemotherapy on regular basis for prevention has been shown to reduce parasitic infection in a cost effective way.[29,30] Hygienic practices needed additionally to ensure a long term benefits.[31] To keep the children free from parasite for longer period, treatment should be started in early life. The ahead challenges is how best we can reach to the tea garden communities and identify innovative approaches for delivery of anthelmintic to the vulnerable age groups.

Study limitations

Financial constraints made it difficult to check for false negatives using a more sensitive method like formal-ether concentration technique as it is known that Kato- Katz technique tends to have low sensitivity in the diagnosis of intestinal helminths particularly in areas with high proportions of low intensity of infections.[31,32] Therefore, there could be some false negative, thus underestimating the prevalence.

Conclusion

T. trichiura infection is prevalent both in the children and adult. The determinants of the infections suggest proper disposal of human stool, anthelmintic taking four month intervals in the slum rural areas to reduce the worms' burden in the community.

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Conflict of interest

There is no conflict to publish the article in this Journal.

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