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Research Article

Prevalence and associated factors of *Enterobius vermicularis* infection in children from a poor urban community in Sri Lanka: a cross-sectional study

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ABSTRACT

Background: Enterobiasis (pin worm infection) is caused by *Enterobius vermicularis* (*E. vermicularis*). According to World Health Organization, over a billion people are infected worldwide. A cross-sectional study was carried out to determine the prevalence and factors associated with the transmission of *E. vermicularis* infection in children from a poor urban community in Sri Lanka.
Methods: This study was conducted in the Hantana Tea Estate (HTE) in Kandy district of Sri Lanka. A cross-sectional study was conducted from September to December 2013. After obtaining informed consent, data (socio economic data, educational level, deworming history, conditions and availability of the sanitary and housing facilities) were collected using an interviewer administered questionnaire. Clean rectangular (2x3 cm) transparent adhesive cellulose tapes (scotch tape) were distributed among all participants to collect samples.
Results: Out of the 204 children 65 (31.9%) were positive for *E. vermicularis* eggs. Children aged 1-3 years showed the highest prevalence rate (37.5%). The risk factors significantly associated with *E. vermicularis* infection were, a lack of parental knowledge about pinworm infection ($p<0.001$), hand washing only with water before a meal ($p<0.001$) and after defecation ($p<0.029$) and de-worming period more than three months ($p<0.001$). Age, sex, family clusters, sucking fingers, toilet facilities and socioeconomic status were not found to be significantly associated with the infection ($p>0.05$).
Conclusion: This study showed a high prevalence of enterobiasis in children in Hantana Tea Estate indicating a high level of transmission. A lack of parental knowledge and poor personal hygiene were significantly associated with the transmission of *E. vermicularis*. Furthermore, the present study recommends mass medication of residents and their contacts to reduce the transmission of pin worm infection could be suggested. Further, it seems that singledose treatment may not be effective against enterobiasis. Therefore, treatment should be repeated 2 to 3 times at 3 weeks intervals.

Keywords: *Enterobius vermicularis, Enterobiasis,* Scotch tape, Prevalence, Sri Lanka

INTRODUCTION

Enterobiasis or pin worm infection is caused by a small round worm namely *Enterobius vermicularis.* It is considered to be the most common human parasitic infection in the world affecting over a billion people worldwide and it occurs virtually in all socioeconomic communities in both developing and developed countries.[1,2]

E. vermicularis is commonly found in young children between five to ten years old. This may be due to their poor hygienic practices and the behavioral habits

associated with the infection. [3] Generally, enterobiasis is considered as asymptomatic disease. However, with heavy worm burdens, neurological symptoms such as restlessness, nervousness, distraction and irritability can be seen particularly in children.[4] Pruritis ani is the most striking symptom which is developed as a result of laying eggs in the perianal skin by female worms. [5] Scratching may cause skin irritation with subsequent dermatitis, haemorrhage and secondary bacterial infections.[1] Moreover, ectopic infections of lung, liver and kidneys can occur.[6,7] In rare instances, female pinworms can enter the female genital tract to lay eggs leading to vulvovaginitis. In addition, pinworm infections adversely affect on the utilization of vitamin B_{12} and leading to lowered child's intelligence.[7,8] The control of enterobiasis is still difficult due to re-infection, incomplete treatment, and its simple transmission though effective treatments have been established decades ago.[9]

The most common mode of transmission is through the fecal-oral route or transmission of pinworm eggs through handling of contaminated clothes or bed linens and also eggs can become airborne and inhaled. In addition, retro-infection is possible.[1] Diagnosis of pin worm infection is mainly based on demonstrating eggs or adult worms. This is achieving by sampling the perianal and perineal skin in the morning before washing the anal area using an adhesive cellulose tape.

It is revealed that 4-28% of children are infected with *E. vermicularis* worldwide.[3] In Sri Lanka, only a few studies have been carried out to investigate the prevalence of enterobiasis in children. As a result of that we have limited data on the prevalence and potential factors associated with pin worm infection in local communities. Therefore, this study was undertaken to determine the prevalence and associated factors of *E. vermicularis* infection among children (1-12 years old) in an estate community in Sri Lanka.

METHODS

Study area and population

This study was conducted in the Hantana Tea Estate (HTE) in Kandy district of Sri Lanka. It is a mountainous area and located from 600 m to 1100 m above sea level. It covers about 1130.38 hectares with an estimated population of 5511 (national census 2012). In general, socio economic status of people living in this estate is very low compared to that of other communities living in the peripheral. People live with low sanitation facilities and in heavily crowded houses with a limited space and resources. A cross-sectional study was carried out in two divisions, namely Factory Division and West Division. All children aged from 1 to 12 years were included in the study. Informed consent was obtained from parents and/or legal guardians of minors before data collection and sampling.

Ethical clearance for the study was obtained from Ethics Review Committee of the Faculty of Medicine, University of Peradeniya.

Data collection

A cross-sectional study was conducted from September to December 2013. After obtaining informed consent, data (socio economic data, educational level, deworming history, conditions and availability of the sanitary and housing facilities) were collected using an interviewer administered questionnaire.

Detection of Enterobius vermicularis eggs

Clean rectangular (2X3 cm) transparent adhesive cellulose tapes (scotch tape) were distributed among all participants to collect samples. These scotch tapes were fixed on to an x-ray paper and labeled each tape with a specific number to identify them. Standard procedure of sample collection was clearly demonstrated to the parents and /or guardians using dummies. Samples were collected in the morning (before washing the perianal region). Then, scotch tapes were transported to the Department of Parasitology, Faculty of Medicine, University of Peradeniya for laboratory investigation. Scotch tapes were then fixed on glass slides and examined under a light microscope for the presence of *E. vermicularis* eggs. The number of eggs present on each scotch tape (2X3 cm) was counted and recorded separately.

Statistical analysis

SPSS (version 17) was used to analyze data. Chi-squared and Fisher's tests were used to examine the association between socio-demographic factors and *E. vermicularis* infection. The descriptive data was given as mean ± standard deviation (SD). The differences were considered statistically significant if *p*-value was less than 0.05.

RESULTS

Prevalence of Enterobius vermicularis

A total of 204 scotch tape samples was collected from the children. The mean age of children was 6.1 (SD ± 3.1) years. Table 1 has shown the prevalence rate of *E. vermicularis* in the study population. Of the 204 children, 104 (51%) were males and 100 (49%) were females. Overall prevalence of *E. vermicularis* infection was 31.9% (65/204). Males had a slightly higher prevalence (32.7%) than females (31.0%). However, difference was not statistically significant (χ^2=0.67; $p > 0.05$). Children aged one to three years showed the highest prevalence (37.5%).

Association of socioeconomic factors and hygienic practices with Enterobius vermicularis infection

Table 2 shows the personal hygiene and other socioeconomic factors that may potentially be associated

with *E. vermicularis* infection. Parent's knowledge on pinworm infection, hand washing with soaps before a meal and after defecation and de-worming period were significantly associated with *E. vermicularis* infection ($p<0.001$). The level of education, occupation and monthly income of the parents were not found to be associated with enterobiasis. Furthermore, a number of members in the family, drinking boiled water, sucking fingers, availability of toilet facilities, age and gender were not significantly associated with the enterobiasis ($p>0.05$).

Table 1: Prevalence of *E. vermicularis* infection in children.

Age (years)	Male		Female		Total	
	No. of examined	No. of positives (%)	No. of examined	No. of positives (%)	No. of examined	No. of positives (%)
1 – 3	31	9 (29.0)	25	12 (48.0)	56	21 (37.5)
4 – 6	32	8 (25.0)	34	12 (35.3)	66	20 (28.8)
7 – 9	25	11 (44.0)	24	3 (12.5)	49	14 (28.6)
10 – 12	16	6 (37.5)	17	4 (23.5)	33	10 (30.3)
Total	104	30 (32.7)	100	31 (31.0)	204	65 (31.9)

Table 2: Relationship between enterobiasis and associated factors.

Variables	Categories	No. of examined	No. of positives	Egg positive rate (%)	*p*-value
Age (years)	1 – 3	56	21	37.5	0.711
	4 – 6	66	20	28.8	
	7 – 9	49	14	28.6	
	10 – 12	33	10	30.3	
Gender	Male	104	30	32.7	0.795
	Female	100	31	31	
Family clustering	1 – 6	147	48	32.6	0.527
	>6	57	16	28.1	
Drinking boiled water	Always	145	46	31.7	0.865
	Rarely	59	18	30.5	
Toilet facility	Separate	159	47	29.6	0.294
	Shared	45	17	37.7	
Hand washing with soap					
a) before a meal	Always	110	12	10.8	0.001
	Rarely	94	53	57	
b) after defecation	Always	188	56	29.8	0.029
	Rarely	16	9	56.3	
Sucking fingers	Yes	58	18	32.4	0.948
	No	146	46	30.5	
Parents knowledge about enterobiasis	Sufficient	24	3	12.5	0.001
	Insufficient	180	62	34.4	
De-worming history	<1 month	90	20	22.2	0.001
	1 – 2 months	67	23	34.3	
	2 – 3months	29	12	41.4	
	>3 months	18	10	55.6	
Educational level of parents	Illiterate	9	3	33.3	0.993
	Primary school	106	35	33	
	Middle school	76	23	30.3	
	Higher school	13	4	30.8	
Occupation	Unemployed	4	2	50	0.303
	Unskilled	91	32	35.2	
	Semi skilled	85	24	28.2	
	Skilled	24	6	25	
Monthly income (Rs.)	<8000	10	2	20	0.099
	8000-16000	138	49	35.5	
	>16000	56	14	25	

DISCUSSION

This was the first study carried out to investigate *E. vermicularis* infection in an estate community in Sri Lanka. Studies on enterobiasis are very important to understand the epidemiology and public health significance of the disease. We strongly feel that the findings of this study will provide new data to plan and execute innovative and yet effective control program in estate sector in Sri Lanka. The overall prevalence of *E. vermicularis* infection reported in this study was 31.9%. It was very high compared to a previous study conducted in school children (6.2%) in Hambantota district[10] however it was less than the prevalence reported in primary school children (38%) in Ragama in Sri Lanka. [11] Furthermore, the prevalence in our study population was very high compared to those reported in other countries including Korea (9.2%-18.5%),[12] China (6.85%),[13] Taiwan (0.62%),[14] rural coastal Tanzania (16.7%-26.3%) [15] and Venezuela (19.1%). [16] In contrast, a comparatively high prevalence was reported in Turkey (43.8%),[17] Thailand (38.7%)[18] and Mongolia 35.8%. [19] Meanwhile, a very low prevalence was reported in an urban area in Thailand (0.0%).[20] Transmission of this disease is greatly dependent upon the socioeconomic factors such as awareness of the disease, personal hygiene and close contact between individuals. Males showed slightly higher prevalence (32.7%) than females (31%). However, it was not statistically significant (p>0.05). In contrast, some studies have shown a significant association between enterobiasis and gender.[12,21] Enterobiasis is widely distributed among children in the study area despite annual single doze (mebendazole 500 mg) deworming program conducted in the government schools. Probably, it may be due to a poor personal hygiene and other socioeconomic factors involved in transmission of the disease and also single-dose treatment may not be effective in its control. Similar findings were reported in previous studies conducted in Sri Lanka, Korea and China.[4,10,20]

Our study showed that the children's susceptibility to pinworm infection decreases with age. This variation in susceptibility may partly be due to a change of children's behavior or activities. Older children are less likely to play on the floor, suck their fingers and fail to wash their hands before meals than younger children. However, according to the statistical analysis, age was not found to be a significant factor associated with pin worm infection in the present study. Similar results were found in a study conducted in Korea.[12]

Enterobiasis is very common in crowded environments. It can spread directly from human to human by close contact. In the present study, a high infection rate (32.6%) was reported in the families consisting with six or less than 6 members compared to over 6 members in the family. However, statistical analysis has shown that a number of members in one family were not significantly associated with *E. vermicuaris* infection in the present study. Nevertheless, some studies have reported that pinworm infection were more prevalent in families having more members.[21] Sucking fingers was not identified as a factor significantly associated with enterobiasis in this study though some researchers showed that thumb-sucking and fingernail-biting were associated with enterobiasis.[22,23] Hand washing before a meal and after defecation is a very important hygienic practice to avoid *E. vermicularis* transmission. The current study has demonstrated that children who did not wash their hands before meals and after defecation were at a higher risk of getting the infection. Therefore, we suggest that the infective stages of intestinal parasites may enter the body mainly through the oral route. Studies conducted in Nepal[23] and Taiwan[25] provides similar findings to support our hypothesis.

The present study suggests that there is an association between pin worm infection and parental knowledge on transmission dynamics of enterobiasis. Therefore, it is essential to consider health educational aspects, in particular, parent's knowledge on enterobiasis in communities with a poor educational background. Moreover, children who were treated with anthelminthic drugs during last three months had a lower pinworm infection than those who did not. Therefore, our results suggest that parent's awareness on enterobiasis is one of the most critical factors that needed to be considered in any control program of *E. vermicularis* infection. Furthermore, there are diagnostic limitations in the anal swab method as it does not provide the information about the current infection and worm burden.

CONCLUSION

The results of the present study showed that the prevalence of *Enterobius vermicularis* infection was relatively high (31.9%) in children from Hantana Tea Estate in Sri Lanka. Parent's knowledge on pinworm infection, hand washing with soaps before a meal and after defecation and de-worming period were significantly associated with *E. vermicularis* infection in the study population. Our findings suggest that *E. vermicularis* infection is a public health concern particularly in children indicating a high level of transmission. Further investigations involving rural and estate communities in Sri Lanka are required to get the true picture of epidemiology. Finally, we would like to suggest that coordinated national and regional levels control and prevention programs should be planned with the active participation of all stake holders in the society. Furthermore, there are diagnostic limitations in the anal swab method as it does not provide the true information about the current infection and worm burden. It seems that single dose treatment is not effective against enterobiasis. Therefore, treatment should be repeated 2 to 3 times at 3 weeks intervals.

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REFERENCES

1. Cook GC. *Enterobius vermicularis* infection. Gut. 1994;35:1159-62.
2. Haswell-Helkins M, Elkins D, Manjula K. The distribution and abundance of *Enterobius vermicularis* in a South Indian fishing community. Parasitology. 1987;95:339-54.
3. Nithikathkul C, Changsap B, Wannapinyosheep S, Poister C, Boontan P. The prevalence of *Enterobius vermicularis* among primary school students in Samut Prakan Province, Thailand. Southeast Asian J Trop Med Public Health. 2001;32:133–7.
4. Kang S, Jeon HK, Eom KS, Park JK. Egg positive rate of *Enterobius vermicularis* among preschool children in Cheongju, Chungcheongbuk-do, Korea. Korean J Parasitol. 2006;44:247-9.
5. Tandan T, Pollard AJ, Money DM, Scheifele DW. Pelvic inflammatory disease associated with *Enterobius vermicularis*. Arch Dis Child. 2002;86:439–40.
6. Burkhart CN, Burkhart CG. Assessment of frequency, transmission, and genitourinary complications of enterobiasis (pinworms). Int J Dermatol. 2005;44(10):837–40.
7. Cook GC. *Enterobius vermicularis* infection. Gut. 1994;35(9):1159–62.
8. Bahader SM, Ali GS, Shaalan AH, Khalil HM, Khalil NM. Effects of *Enterobius vermicularis* infection on intelligence quotient (I.Q) and anthropometric measurements of Egyptian rural children. J Egyp Soc Parasitol. 1995;25:183-94.
9. Olivares JL, Fernández R, Fleta J, Ruiz MY, Clavel A. Vitamin B_{12} and Folic Acid in Children with Intestinal Parasitic Infection. J Am Coll Nutri. 2002;21:109-13.
10. Gunawardena GSA, Gunatilleke MH, Ismail MM. Prevalence of *Enterobius vermicularis* infection among schoolchildren attending four selected schools in the Hambantota district of Sri Lanka. Sri Lankan J Infect Dis. 2013;3:17-20.
11. Gunawardena NK, Chandrasena TN, de Silva NR. Prevalence of enterobiasis among primary school children in Ragama, Sri Lanka. Ceylon Med J. 2013;58:106-10.
12. Sang EL, Jin HL, Jung-WJ, Won JL, Shin HC. Prevalence of *Enterobius vermicularis* infection among preschool children in Gimhae-si, Gyeongsangnam-do, Korea. Korean J Parasitol. 2011;49:183-5.
13. Wu CG, Luo XJ, Xie J, Jiang SG, Li SS, Xiao BZ. Prevalence of *Enterobius vermicularis* infection of children and its influencing factors in Chongqing City. Chinese J Schistosomiasis Control. 2012;24:703-6.
14. Chang TK, Liao CW, Huang YC, Chang CC, Chou CM, Tsay HC, et al. Prevalence of *Enterobius vermicularis* infection among preschool children in kindergartens of Taipei City, Taiwan in 2008. Korean J Parasitol. 2009;47:185–7.
15. Salim N, Schindler T, Abdul U, Rothen J, Genton B, Lweno O, et al. Enterobiasis and strongyloidiasis and associated co-infections and morbidity markers in infants, preschool- and school-aged children from rural coastal Tanzania: a cross-sectional study. BMC Infect Dis. 2014;14:644.
16. Cazorla D, Acosta M, García E, Garvett M, Ruiz A. *Enterobius vermicularis* infection in preschool and schoolchildren of six rural communities from a semiarid region of Venezuela: A clinical and epidemiological study. Helminthologia. 2006;43:81-5.
17. Ali C, Mehmet A, Serpil D, Ahmet AM, Çetin A. Egg positive rate of *Enterobius vermicularis* and *Taenia* spp. by cellophane tape method in primary school children in Sivas, Turkey. Korean J Parasitol. 2005;43:61-4.
18. Nithikathkul C, Changsap B, Wannapinyosheep S, Poister C, Boontan P. The prevalence of *Enterobius vermicularis* among primary school students in Samut Prakan Province, Thailand. Southeast Asian J Trop Med Public Health. 2001;32(Suppl 2):133–7.
19. Lee DS, Chung BH, Lee NS, Nam HW, Kim JH. A survey of helminthic infections in the residents of rural areas near Ulaanbatar, Mongolia. Korean J Parasitol. 1999;37:145-7.
20. Pethleart A, Saichua P, Rhongbutsri P, Leelawongtawon R, Aree K, Tiengtip R, et al. Prevalence and risk factors for pinworm infection in the kindergarten of Thammasat University, Thailand. Southeast Asian J Trop Med Public Health. 2010;41:306–10.
21. Mirandilla MA. Teresa A, Villanueva MR, Ciruelos NB, Verzosa RL, Marbella VMM, et al. A survey of *Enterobius vermicularis* among children in the 2nd district of the province of Albay, Philipenes. BU Faculty e-Journal. 2013;1:1-7.
22. Kim BJ, Lee BY, Chung HK, Lee YS, Lee KH, Chung HJ, et al. Egg positive rate of *Enterobius*

vermicularis of primary school children in Geoje Island. Korean J Parasitol. 2003;41:75-7.
23. Gyawali N, Amatya R, Nepal HP. Intestinal parasitosis in school going children of Dharan municipality, Nepal. Trop Gastroenterol. 2009;30:145-7.

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