

Short Communication

The correlation between contamination of soil with *Ascaris* sp. eggs in school yards and ascariasis among primary school children in Mai Trung Commune, Northern Vietnam

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Abstract: Four hundred and six soil samples collected from five schoolyards in Mai Trung Commune, Bac Giang Province, Northern Vietnam, from 2005 to 2007 were examined for helminth eggs using a sucrose centrifugal flotation method. The soils around latrines was found to be heavily contaminated with *Ascaris* sp. eggs. The contamination rate of *Ascaris* sp. eggs at each school and prevalence of ascariasis among the school children showed a positive correlation ($P < 0.05$). This indicated that examination of soil from the area around latrines for *Ascaris* sp. eggs is a useful method to estimate the prevalence of ascariasis among school children.

Key words: intestinal helminth; ascariasis; *Ascaris* egg; soil contamination; Vietnam

INTRODUCTION

It is estimated that 33.9 million people in Vietnam are infected with *Ascaris lumbricoides*, 17.6 million people with *Trichuris trichura*, and 21.8 million people with hookworm [1]. In the areas in which soil-transmitted forms of helminthiasis are endemic, the living environment is contaminated with eggs and people are exposed to helminth infection [2]. These forms of helminthiasis are widespread in suburban areas of the nation's capital, Hanoi, and some 67% of school children there are infected with *T. trichura*, 34% with *A. lumbricoides*, and 3% with hookworm [3]. It is likely, therefore, that the primary school environment is contaminated with eggs and that children are exposed to infection or reinfection. However, since little is known regarding the degree of contamination, we studied the contamination of soil with helminth eggs in order to develop control measures for helminthiasis in primary schools.

MATERIALS AND METHODS

Study area

The survey was conducted at five primary schools in Mai Trung Commune, which is approximately 60 km from Hanoi and has a population of 13,400. Most residents are engaged in agriculture, and the main occupation is farming. About 1,200 children attend eight primary schools in this region.

Materials

In October 2005, 90 sites were selected in the schoolyards of three primary schools. Another 154 sites in three schools were selected in October 2006 and 162 sites in three schools in October 2007. Approximately 200 g of soil per site was collected from the superficial layer of soil (0-3 cm) by thrusting a plastic pipe (6 cm in diameter) into the ground. If the soil surface was covered with cement, 20 g or more of sand was collected from the surface by sweeping.

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Table 1. Soil Contamination with Helminth Eggs and Ascariasis among School Children

Year /:Soil contamination with helminth eggs						Ascariasis in schoolchildren				
School	Sites	Exam- ined	Contaminated			Subjects, Grade	Exam- ined	Prevalence (% Intensity (Av.))		
			Helminth eggs (%)	<i>Ascaris</i> sp. eggs (%)	No. <i>A.</i> sp. eggs / sample (Av.)			Others		
2005										
PS1 Main	Latorine	20	3 (15.0)	3 (15.0)	2 to 18 (10)		1st, 2nd, 3rd	19	9 (47.3)	13 to 1490 (414.9)
	Others	10	0	0	0					
PS1 CTC	Latorine	10	5 (50.0)	5 (50.0)	1 to 3 (2.0)		1st, 2nd, 3rd	85	45 (52.9)	8 to 3981 (635.2)
	Others	20	1 (5.0)	1 (5.0)	1	<i>C. h.</i>				
PS2 Main	Latorine	10	1 (10.0)	1 (10.0)	2		1st, 2nd, 3rd	173	66 (38.1)	6 to 12110 (1015.1)
	Others	20	1 (5.0)	0	<i>E. v.</i>					
Total	Latorine	40	9 (22.5)	9 (22.5)	1 to 18 (4.6)		Total	277	120 (43.3)	6 to 12110 (827.5)
	Others	50	2 (4.0)	1 (2.0)	1	<i>C. h., E. v.</i>				
	Total	90	11 (12.2)	10 (11.1)	1 to 18 (4.3) <i>C. h., E. v.</i>					
2006										
PS1 Main	Latorine	50	2 (4.0)	2 (4.0)	1 (1.0)	<i>F. b., T. t.</i>	2nd, 3rd, 4th	48	16 (33.3)	2 to 2644 (377.1)
PS1 CTC	Latorine	54	23 (42.5)	21 (38.8)	1 to 8 (1.7)		2nd, 3rd, 4th	78	42 (53.8)	10 to 9894 (853.9)
PS2 Main	Latorine	50	6 (12.0)	6 (12.0)	1 (1.0)		2nd, 3rd, 4th	142	34 (23.9)	2 to 3685 (538.7)
2007										
PS1 CTC	Latorine	54	17 (31.5)	14 (25.9)	1 to 43 (10.5) <i>C. h., T. t.</i>		3rd, 4th	48	19 (39.5)	2 to 95 (175.3)
PS1 NXC	Latorine	54	24 (44.4)	22 (40.7)	1 to 21 (7.0) <i>T. t.</i>		3rd, 4th	20	7 (35.0)	24 to 985 (366.5)
PS2 CXG	Latorine	54	2 (3.7)	2 (3.7)	2, 4	(3.0)	3rd, 4th	17	2 (11.7)	34 to 214 (104.3)
Total		316	74 (23.4)	67 (21.3)	1 to 43 (5.2) <i>T. t., F. b., C. h.</i>		Total	343	120 (34.9)	2 to 985 (217.6)

A., *Ascaris*; Av., Average; C.h., *Capillaria hepatica*; CTC, Cam Trang Campus; E. v., *Enterobius vermicularis*; F. b., *Fasciola buski*; NXC, Noi Xuan Campus; PS1, Primary School No.1; PS2, Primary School No.2; T. t., *Trichuris trichura*; XGC, Xuan Giang Campus.

Methods

The soil and sand samples were dried overnight at room temperature and then filtered through a 150 µm mesh sieve. Approximately 2 g of soil was then extracted into a test tube. These specimens were treated using a sucrose centrifugal flotation method [4] to detect helminth eggs.

The correlation between the level of soil contamination with *Ascaris* sp. eggs and ascariasis prevalence in the school children was analyzed, and the coefficient was evaluated at the 5%-or-less level using Pearson's correlation coefficient [5].

RESULTS

In October 2005, a total of 90 soil samples were collected from the areas around latrines, footpaths, corridors and shady places in three schools: PS1 Main, PS1 CTC, and PS2 Main (Table 1). Eleven samples, or 12.2%, were found to be positive for helminth eggs. Nine of the positive samples (81.8%) were collected from the areas around latrines, showing that the soil surrounding toilets was the most heavily contaminated with helminth eggs.

A total of 52 helminth eggs were detected from 11 positive specimens, and 73% of the eggs were surviving *Ascaris* sp. eggs, while 21% were dead *Ascaris* sp. eggs. *Ascaris* sp. eggs therefore comprised 94% of the detected eggs.

The number of *Enterobius vermicularis* and *Capillaria hepatica* eggs was very low, and no *T. trichura* eggs were detected. These results showed that the soil surrounding latrines was mainly contaminated with *Ascaris* sp. eggs.

In the subsequent studies conducted in October 2006 and 2007 only the soil surrounding latrines was collected, and a total of 316 soil samples were examined for helminth eggs. The soil surrounding the latrines was found to be contaminated with *Ascaris* sp. eggs to the same degree as in the 2005 survey. A few *T. trichura* and *Fasciola buski* eggs also appeared in these two subsequent surveys. The rate (number of positive specimens/ number of examined specimens) of contamination with *Ascaris* sp. eggs in soil around latrines differed widely among schools, ranging from 3.7% to 40.7%. The difference in contamination rates may depend upon ascariasis prevalence among the school children.

In view of these findings, we examined the relationship between the soil contamination rates observed in the present surveys and ascariasis prevalence among the school children. The contamination rates ranged from 3.7% to 50.0%, while ascariasis prevalence ranged from 11.7% to 52.9% and appeared to fluctuate in association with the contamination rate.

To further examine the relationship, we created a scatter plot with the contamination rate as the x-variable and ascariasis prevalence as the y-variable (Figure 1) and con-

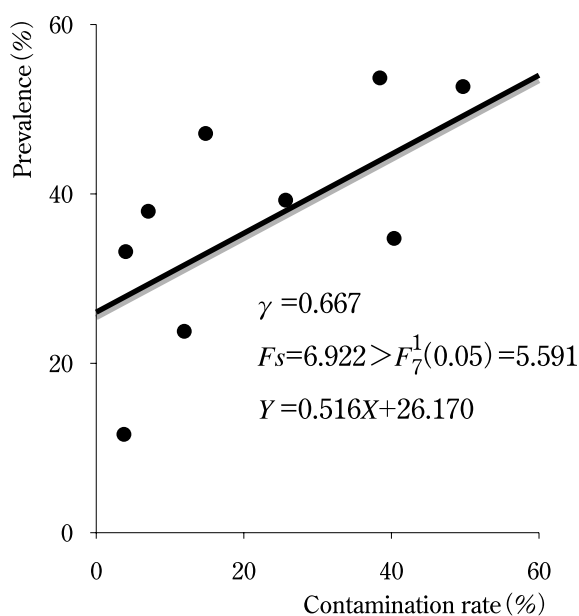


Fig. 1. Correlation between ascariasis prevalences in children and rate of soil contamination with *Ascaris sp.* eggs in each school

firmly that the contamination rate tended to increase with increasing ascariasis prevalence, with a correlation coefficient of $r=0.667$. This value was statistically significant at the 5%-or-less level using Pearson's correlation coefficient test. The regression line was expressed as $y=26.170+0.516x$.

DISCUSSION

Reports on environmental contamination with helminth eggs in Vietnam are scarce despite the horrendous prevalence in this country. Previously, 84% of soil samples from rice paddies, vegetable fields and households, and 33% of water samples from wells, ponds and ditches, were found to be contaminated with helminth eggs [2, 6].

In a study on contamination of the household environment using soil samples from within and around households, Toan [7] showed that 98.8% and 59.9% of samples were contaminated with *Ascaris sp.* eggs and *T. trichura* eggs, respectively, in areas in which ascariasis (prevalence: 93.6%) and trichuriasis (prevalence: 79.3%) were endemic. This demonstrates the extreme degree of contamination.

In the present study, soil samples were collected from areas around latrines, footpaths, corridors and shady places in primary schoolyards, which represent the children's living environment, and these were examined for contamination with helminth eggs. The results showed that the soil near latrines was particularly contaminated with *Ascaris* spp. eggs.

In helminth-endemic areas, contamination with eggs generally involves *Ascaris sp.* eggs and *T. trichura* eggs,

but the present study revealed little contamination with *T. trichura* eggs. This may be due to the fact that the prevalence of trichuriasis was lower than that of ascariasis among school children (ascariasis: 47.1%, trichuriasis: 16.4%).

In countries other than Vietnam, the living environment of households was contaminated with helminth eggs in soil-transmitted helminth-endemic areas, that is, the household interior (kitchens, living rooms, and bedrooms), verandas, gardens, washing areas, waste-disposal areas, and areas near latrines, under trees, alleyways and bushes. In short, the places where people gather and defecate tend to be highly contaminated [8, 9].

In the present study, the soil from the area around latrines was severely contaminated. This could be caused by water leakage from the latrines, but the contamination of soil with helminth eggs was considered to be associated with the defecation habits of school children. Fujimaki et al. [6] reported that approximately 25% of secondary school children defecate in places other than latrines. During the preliminary survey for the present study, a small child was witnessed defecating near a latrine in a schoolyard, and a human fecal mass was found in a dump site close to a latrine in another schoolyard.

There have been a few studies analyzing the relationship between soil contamination with helminth eggs and helminthiasis in Thailand. Waikagul et al. [10] suggested that contaminated soil around latrines is the main source of infection. Chongsuvivatwong et al. [11] found a consistent association between infection and soil contamination in ascariasis and trichuriasis, and they suggested that soil analysis for eggs of *Ascaris sp.* and *T. trichura* may be a useful way to predict infection among household members. In the present study, the correlation between the rate of soil contamination with *Ascaris sp.* eggs and ascariasis prevalence was statistically significant. This showed that the degree of soil contamination with helminth eggs reflects the infection status of helminthiasis in the community.

Thus, examination of soil from the area around latrines for *Ascaris sp.* eggs may not only be a useful method to estimate the prevalence of ascariasis among school children, but may also help to promote epidemiological studies on ascariasis in school children and to develop ascariasis control measures.

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