INTESTINAL PARASITIC INFECTIONS IN SCHOOLCHILDREN IN A SUBURBAN AREA OF HANOI, VIETNAM

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Abstract. An epidemiological study on intestinal parasitic infections among schoolchildren in a suburban area of Hanoi, Vietnam, was conducted. Of the 217 schoolchildren involved in this study, 166 (76%) were positive for at least one of nine species of parasite (six helminths and three protozoa). Among the helminth parasites, *Trichuris trichiura* (67%) was detected the most frequently followed by *Ascaris lumbricoides* (34%) and hookworm (3%). In the case of protozoan parasites, *Entamoeba coli* (8%) was the most frequently detected followed by *E. histolytica* (2%). No *Cryptosporidium parvum* or *Cyclospora* sp were found. A questionnaire survey revealed that there was no positive relationship between parasite infection and the children's school records, educational background or parental income, which have been known to play a role.

INTRODUCTION

Intestinal parasitic infections are the most common cause of health problems in developing countries. It is estimated that at least one quarter of the world's population is chronically infected with intestinal parasites (WHO, 1996). Of the various infectious parasites, soil-transmitted helminth infections are the most common and are an important cause of human morbidity and mortality (Hall *et al*, 1992). WHO estimated that *Ascaris lumbricoides*, hookworm, and *Trichuris trichiura* infect 1.4, 1.3, and 1 billion people worldwide, respectively. According to Chan *et al* (1994), it is estimated that the global burden of diseases caused by these three major intestinal nematodes is 39.0 million disability adjusted life years (DALYs), compared with malaria at 35.7 million and schistosomiasis at 4.5 million.

In spite of this, number of papers on parasitic infections reported from Vietnam are limited (Colwell *et al*, 1971; Goodrich, 1967); therefore, the importance of these diseases in Vietnam has not been fully appreciated by either Vietnamese or foreign scientists. In 2003, three review papers on soil-transmitted helminths (van der Hoek *et al*, 2003), food-borne trematode zoonoses (De *et al*, 2003) and cysticercosis (Willingham *et al*, 2003) were published from Vietnam. Soil-transmitted Nematoda surveys conducted in 29 of the 61 provinces in Vietnam were reviewed by van der Hoek *et al* (2003). According to the findings, it was estimated that in Vietnam 33.9 million people (44.4%) were infected with *Ascaris*, 17.6 million (23.1%) with *Trichuris*, and 21.8 million (28.6%) with hookworm. Although surveys have been conducted in many areas in Vietnam by local institutions, the results are not reported in International journals; furthermore, there are some areas where surveys have yet to be carried out. Some newly emerging protozoan parasites such as *Cyclospora* sp and *Cryptosporidium parvum* have recently been reported (Curry and Smith, 1998). However, no precise surveys on protozoan infection have been conducted with regard to these parasites in Vietnam, and their prevalence among Vietnamese is unknown.

This epidemiological study was conducted to identify helminth and protozoa infections

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among schoolchildren in a suburban area of Hanoi, Vietnam. In addition, the relationship between parasitic infection and related factors was analyzed through a questionnaire survey.

MATERIALS AND METHODS

Survey area and period

The survey was conducted from August 2003 to February 2004 at a secondary school in a hamlet in the suburbs of Hanoi, Vietnam. The school has about 1,600 children, and is located 10 km southwest of Hanoi, Vietnam's capital. This hamlet was surrounded by fields at least three years prior to this study; however, the hamlet has seen rapid urbanization since then. The population of this hamlet is 4,100 (1,010 households); and, of these individuals, 75% were engaged in agriculture. Of the 292 5th -grade children, most were 14 to 15 years old, 217 (94 boys and 123 girls) were included in this survey.

Sample collection and fecal examination

Prior to commencing the survey, we explained our purpose to the children, their parents, and teachers. We distributed a plastic container for fecal collection to the children who showed understanding of our purpose and offered cooperation in obtaining samples. Fecal samples were suspended in more than five volumes of MIF (merthiolate, iodine, and formalin) fixative solution, mixed thoroughly, and stored at room temperature. About 3 ml of fecal suspension, equivalent to 0.5g of feces, was examined for helminth eggs using the formalin-ether sedimentation technique (FES). Twenty microliters of the fecal sediment was used for microscopic observation (x100) and all eggs observed in the wet mount were counted if the sample was positive. In our preliminary experiment, we confirmed that the number of eggs in 20 µl of sample was almost equivalent to 1/20 of the egg per gram (EPG) count.

Cryptosporidium parvum and *Cyclospora* sp were examined using primarily the sucrose flotation technique (SFL). Briefly, a sucrose solution with a specific gravity of 1.200 was added to the 0.5 g of fecal sediment, mixed thoroughly, and centrifuged at 1,100*g* for 10 minutes. The surface solution was recovered using a bacteriological loop (4 mm in diameter) and observed using a phase contrast microscope (x400) for *C. parvum* and a fluorescent microscope (wave length: 330-360 nm, x200) for *Cyclospora* sp. Specimens showing no oocysts (cysts) in 40 microscopic fields were regarded as negative.

Questionnaire survey

To investigate the relationship between parasitic infection and the children's life styles, a questionnaire survey was conducted. The questionnaire included 10 questions regarding the children's body height, weight, and school records; and parents' educational background, income, and occupation. During analysis of the survey results, children who showed more than 2,000 EPG for *A. lumbricoides* or more than 600 EPG for *T. trichiura* were regarded as high positive and compared with parasite-negative children.

Statistical analysis

Statistical analyses were conducted using the chi-square test and/or Student's *t*-test.

RESULTS

Of the 217 schoolchildren examined, 166 (76%) showed positive for at least one of the parasites. Infection rate was marginally higher in females (78%; 96/123) than males (74%; 70/94), but this difference was not significant ($p > 0.05$) (Table 1). Among the 166 positive children, 97 (58%) were infected with a single parasite, 53 (32%) with double parasites, and 16 (10%) with triple parasites. Parasites obtained during this survey and their respective prevalence are shown in Table 1. In total, nine species of parasites (six helminths and three protozoa) were detected. Among the helminth parasites, *Trichuris trichiura* (67%) was detected the most frequently followed by *Ascaris lumbricoides* (34%) and hookworm (3%). Of the 73 *A. lumbricoides* positive children, 31 (42%) had fertilized eggs, 32 (44%) had unfertilized eggs, and the remaining 10 (14%) had both types of eggs. Fig 1 shows the relationship between the intensity of *A. lumbricoides* infection and appearance of fertilized/unfertilized eggs found in feces. When the intensity of infection was low, unfertilized eggs were found more frequently than fertilized eggs.

However, with increasing intensity, the frequency of fertilized egg increased. Fasciolidae eggs (144 x 75 µm) were detected from two children (boys who were also infected with *T. trichiura*). In the case of protozoan parasites, *Entamoeba coli* (8%) were the most common followed by *E. histolytica* (2%). No *C. parvum* or *Cyclospora* sp oocysts were found (Table 1).

Table 2 displays the questionnaire survey results and compares the parasite-positive and -negative groups. To distinguish more clearly between the groups, only high positive children (n=34) were compared with the negative group (n=42); that is, children who showed more than 2,000 EPG in the case of *A. lumbricoides* infection and/or more than 600 in the case of *T. trichiura*. The mean body weight and height of high positive and negative children were 40 kg and 152 cm in both groups (no difference was observed even with regard to sex; data not

Table 1
Parasitic infections of schoolchildren in suburban area of Hanoi, Vietnam.

Species	No. of positives (%)		Total no. of positive samples (%)	Mean no. of egg/cysts in:	
	Male	Female		Test[b]	Adjusted EPG[c]
Trichuris trichiura	61 (28)	85 (39)	146 (67)	9	180
Ascaris lumbricoides	34 (16)	39 (18)	73 (34)	44	880
Hookworm	4 (2)	3 (1)	7 (3)	4	80
Enterobius vermicularis	1 (0)	0 (0)	1 (0)	1	20
Fasciolidae	2 (1)	0 (0)	2 (1)	3	60
Hymenolepis diminuta	2 (1)	0 (0)	2 (1)	5	100
Entamoeba coli	7 (3)	10 (5)	17 (8)	792	15,840
E. histolytica	0 (0)	4 (2)	4 (2)	396	7,920
Giardia intestinalis	1 (0)	0 (0)	1 (0)	468	9,360
Total	70 (74)	96 (78)	166 (76)[a]		

[a]Of the 217children (94 male and 123 female) examined, 166 (76%) were positive.
[b]Number of eggs/cysts in 20 µl of the plug. Helminth and protozoa were tested by FES and SFL, respectively.
[c]This value corresponds to 20 times of the test value.

Table 2
Comparison of the questionnaire survey results between parasite positive and negative groups.

Items	Positive (34 children)[a]	Negative (42 children)	Student's *t*
Children			
Body weight (kg)	40±4.95 (m, 40; f, 42)	40+/-8.12 (m, 41; f, 39)	p>0.05
Height (cm)	152±5.39	152±8.69	p>0.05
School records[b]	6.6±1.03	6.6±0.84	p>0.05
Parent			
Education (Father)[c]	2.2±0.54	2.3±0.69	p>0.05
Education (Mother)	2.2±0.83	2.2±0.65	p>0.05
Income (Father)[d]	33±42	44±66	p>0.05
Income (Mother)	23±16	29±20	p>0.05
Other			
No. of family members	5.5±1.11	5.6±1.16	p>0.05

[a]Of the 166 parasite-positive children, 34 high positive (EPG of *A. lumbricoides* is >2,000 and/or *T. trichiura* is >600).
[b]School academic records provided by teachers (a perfect score, 10).
[c]1:Primary school, 2: Secondary school, 3: High school, 4: University, 5: Graduate school.
[d]Expressed in US dollars.

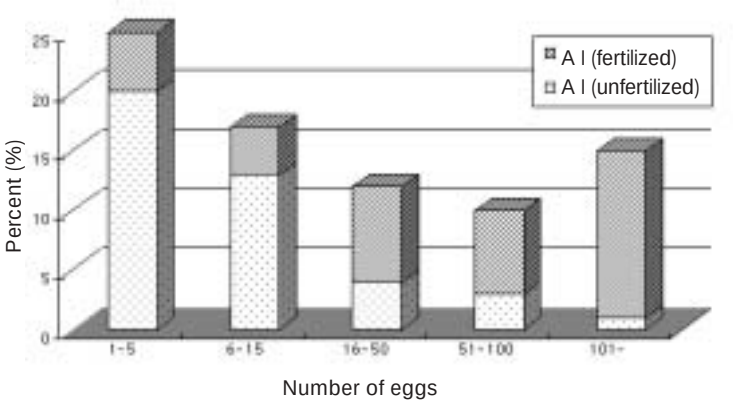

Fig 1–Relationship between intensity of *Ascaris lumbricoides* infection and appearance of fertilized/unfertilized eggs.

shown). No other items such as education level, and parental income and/or occupation were significantly different ($p>0.05$) between groups (Table 2).

DISCUSSION

It is estimated that 23-44% of the Vietnamese population is infected with *A. lumbricoides*, *T. trichiura*, or hookworm (Dalsgaard, 2003). Van der Hoek *et al* (2003) reviewed the epidemiological studies on parasitic infections that have been reported from 61 provinces in Vietnam. According to the findings, soil-transmitted nematoda infections among Vietnamese are higher in northern regions than southern regions. Particularly, in the Red River Delta area, mean infection rates of *A. lumbricoides*, *T. trichiura*, and hookworm are reportedly 58, 51, and 29%, respectively. In our study, however, *T. trichiura* was dominant and hookworm infection was less than 5%. This result does not agreed with the results reported by Colwell *et al* (1971) and Verle *et al* (2003). Van der Hoek *et al* (2003) has suggested that children aged 5 to 15 years showed a higher prevalence than those in younger or older age groups. This might be the reason why the prevalence of *A. lumbricoides* and *T. trichiura* in our study, which targeted older students, showed higher rates than past reports. No differentiation in hookworm infection was made between *Necator americanus* and *Ancylostoma duodenale* infections. We assume, however, that the hookworms obtained in our survey are *N. americanus* because this species is the most abundantly found hookworm in Vietnam. De (1995) cultured more than 1,000 fecal specimens and revealed that 98% were *N. americanus.*

We previously reported *C. parvum* (10%) infection in Thailand (Uga *et al*, 1998), *Cyclospora* sp (0.4%) in Indonesia (Uga *et al*, 2002), and *Isospora* sp (6%) in Lao PDR (Takemasa *et al*, 2004), but we could not find these protozoa in Vietnam. During the survey, we found only two boys who were positive for Fasciolidae eggs. It is known that *Fasciolopsis buski* is widely distributed all over Vietnam at rates of 1.2 to 3.8% (De *et al*, 2003), but *Fasciola gigantica* is also common among cattle (Hien *et al*, 2001); we did not identify these trematoda eggs.

In a previous nationwide survey of Vietnamese, low educational levels and/or low socioeconomic status were associated with hookworm infections (Yip, 1996). We therefore analyzed the relationship between parasitic infection and the above parameters. We could not find any positive relationship, although this might have been because of the small numbers involved in our survey.

The high prevalence of *A. lumbricoides* and *T. trichiura* among schoolchildren indicated that intestinal helminthiasis was a prevalent health problem in a suburban area of Hanoi, Vietnam. Countermeasures such as health education, improvement of environmental conditions, and/or a deworming program should be adopted to improve the health status of schoolchildren.

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REFERENCES

Chan MS, Medley GF, Jamison D, *et al.* The evaluation of potential global morbidity attributable to intestinal nematode infection. *Parasitology* 1994; 109: 373-87.

Colwell EJ, Welsh JD, Boone SC, *et al.* Intestinal parasitism in residents of the Mekong Delta of Vietnam. *Southeast Asian J Trop Med Public Health* 1971; 2: 25-8.

Curry A, Smith HV. Emerging pathogens: *Isospora*, *Cyclospora* and microsporidia. *Parasitology* 1998; 117: 43-59.

Dalsgaard A. Preface. *Southeast Asian J Trop Med Public Health* 2003; 34 (suppl 1): i-ii.

De NV. Hookworm infection and efficacy of some anti-hookworm drugs used in three cultivation areas in Northern Vietnam, Hanoi. Hanoi, VN: University of Hanoi, 1995. PhD Thesis.

De NV, Murrell KD, Cong LD, *et al.* The food-borne trematode zoonoses of Vietnam. *Southeast Asian J Trop Med Public Health* 2003 (suppl 1); 34: 12-34.

Goodrich I. Prevalence of intestinal nematodes in a civilian, adult, South Vietnamese population. *Am J Trop Med Hyg* 1967; 16: 746-9.

Hall A, Anwar SK, Tomkins MA. Intensity of reinfection with *Ascaris lumbricoides* and its implications for parasite control. *Lancet* 1992; 339: 1253-7.

Hien TV, Dung TK, Tri NH, *et al.* Fascioliasis in Vietnam. *Southeast Asian J Trop Med Public Health* 2001 (suppl 2); 32: 48-50.

Takemasa K, Kimura K, May SI, *et al.* Epidemiological survey of intestinal parasitic infections of diarrhoeal patients in Nepal and Lao PDR. *Nepal Med J* 2004; 6: 7-12.

Uga S, Kunaruk N, Rai SK, *et al*. *Cryptosporidium* infection in HIV-seropositive and seronegative populations in southern Thailand. *Southeast Asian J Trop Med Public Health* 1998; 29: 100-4.

Uga S, Kimura D, Kimura K, *et al.* Intestinal parasitic infections in Bekasi District, west Java, Indonesia and a comparison of the infection rates determined by different techniques for fecal examination. *Southeast Asian J Trop Med Public Health* 2002; 33: 462-7.

van der, Hoek W, De NV, Konradsen F, *et al.* Current status of soil-transmitted helminths in Vietnam. *Southeast Asian J Trop Med Public Health* 2003 (suppl 1); 34: 1-11.

Verle P, Kongs A, De NV, *et al*. Prevalence of intestinal parasitic infections in northern Vietnam. *Trop Med Int Health* 2003; 8: 961-4.

WHO. The World Health Report – conquering suffering enriching humanity. Geneva: WHO, 1996.

Willingham AL, De NV, Doanh NQ, *et al.* Current status of cysticercosis in Vietnam. *Southeast Asian J Trop Med Public Health* 2003 (suppl 1); 34: 35-50.

Yip R. Final report of the 1995 Vietnam national nutrition anemia and intestinal helminth survey. Jakarta: UNICEF, 1996.