Intestinal parasitic Infections of school children in Los Baños, Philippines

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ABSTRACT

Intestinal parasites can cause serious health problems in people. Globally, it is estimated that some 450 million people suffer ill health from such infections and, as children are disproportionately affected, those in developing countries are particularly at risk. To determine the prevalence and distribution of intestinal infections in school children, we examined fecal samples for the presence of soil transmitted helminth (STH) eggs. We conducted questionnaire surveys and examined fecal samples from school children at an elementary school in Luzon, Philippines, from February to March, 2012. As a result, four genera of parasites were detected in the fecal samples from 45 (64%) of the 70 school children surveyed; these parasites included *Ascarislumbricoides* and *Trichuris* sp. The prevalence of fecal eggs in the children was higher than in other regions of the Philippines thus far surveyed. Examination of the *Trichuris* spp. eggs revealed two different sizes with morphologies consistent with *T. trichiura* and *T. vulpis*. Additionally, the questionnaires revealed that the high prevalence of intestinal parasites was probably related to the defecation habits of the younger village children; 82% of those surveyed reported seeing both school and preschool children defecating outdoors despite adequate numbers of latrines in the village. These results suggest that the high prevalence of parasites in school children is related to life-style habits (hygiene) and the local geography (soil moisture content and potential for contamination with human, dog, or cat feces). Hence, measures to control parasite transmission and treat human intestinal infections and zoonoses are necessary.

Keywords: Soil transmitted helminths, school children, Philippines

INTRODUCTION

Up to two billion people are affected by intestinal parasites including soil transmitted helminth infections (STH), a disproportionate number being children in developing countries.[1] STH infections, which are associated with environmental and lifestyle factors such as poor sanitation, are widely distributed across tropical countries.[2] Children are more susceptible to infection with STHs than adults.[3] STH infections, which are known to cause various health problems such as abdominal pain, diarrhea, anemia, and growth retardation, can also be a cause of school absenteeism and poor academic performance.[4] Therefore, such infections are an important public health issue and control programs or surveys involving children have been conducted worldwide.

In the Philippines, STH infections are a major health concern, and epidemiological surveys thus far conducted[4-6] have revealed that between 4 and 51% of preschool children, school children, and/or adolescents have been infected with STHs (including intestinal parasites). [4-7] Despite ongoing Department of Health and Department of Education control programs in the Philippines, STH infections are still a major public health problem. Hence, it is thought that such control programs are not functioning as well as they could.[8] Furthermore, because almost all of the epidemiological surveys for Luzon Island were conducted in the surrounding city of Manila, the epidemiology of STHs in other areas of this region is unknown.

The present survey aimed to determine the current status of intestinal parasitic infections in school children from a fishing village in a rural area of Luzon Island, in the Philippines. The work presented here on intestinal infections in these children is discussed in the context of our recently published study on soil contamination by STH eggs which was conducted in the same area as that of the present survey.[9] Although many studies have examined fecal or soil contamination with STH eggs in different geographical areas, to the best of our knowledge, no studies have investigated contamination of fecal and soil samples in the same area, at the same time. Therefore, the relationship between the prevalence of STH in school children and soil contamination by STH eggs was also discussed.

MATERIALS AND METHODS

Survey area and study period

The survey was conducted at an elementary school in Barangay Bayog, Laguna State, Luzon, in the Philippines, from February to March, 2012. Barangay Bayog village has a population 10,000 people and is located about 60 km southeast of Manila.[9]Village life is focused on farming and fishing. The village is bordered by Laguna de Bay in the north and has agricultural land that comprises about half of the size of the village in the south. According to the data published by the Barangay Health Center in 2011, 27% of the population comprised youngsters aged 0 to 14 years old, whilst 69% were of working age aged from 15 to 64 years old. Although deworming may be done personally, mass treatment is not performed in this area, at least for the past few years (personal information from health worker).

Sample collection and fecal examination

We explained our purpose of this survey to the principal of the elementary school, parents, and school children before undertaking our survey and only people who volunteered were involved. A total of 70 school children (32 males and 38 females) aged 8 to 11 who agreed to participate were involved in this study. Regarding collection of fecal samples, plastic bags were distributed and 5 to 10 g samples of feces were collected from each participant. Fecal samples were brought back to the laboratory, immediately suspended in 10% formalin and stored at room temperature.

Fecal examination involved collecting 0.5 gm of the sediment obtained after centrifugation of 550 × *g* for 10 min of a fecal suspension. The formalin-ether sedimentation method was used to detect parasite eggs andcysts.[10]The number of STH eggs and protozoan cysts detected in a 20 µL plug (mean quantity of plug recovered was 40 µl) were counted under an optical microscope at a magnification of 100-400. The developmental stages of the STH eggs were recorded at the same time. The number of *Ascarislumbricoides* and *Trichuris* sp. eggs detected in each sample were expressed as the number present in 1 gm of feces (by multiplying by four) and was used to assess the intensity of an infection.[11] The intensity of infection in a sample was determined in accordance with the standards set by the World Health Organization (WHO) i.e., light, moderate, and heavy intensity infections are represented by 1-4,999 eggs per gram (epg), 5,000-49,999 epg, and ≥50,000 epg, respectively for *A. lumbricoides*, and 1-999 epg, 1,000-9,999 epg, and ≥10,000 epg, respectively, for *Trichuris* sp. *Trichuris* sp. eggs identified in this survey were measured along their major and minor axes using a micrometer and were compared with *Trichuristrichiura* and *T. vulpis* eggs. [12-14]

Questionnaire surveys

During the study period, each of the 70 school children completed a questionnaire about their daily living habits and knowledge of parasitic diseases. This questionnaire consisted of 20 questions, whichwere aimed at determining whether a child has a latrine in the house, where a child defecated when not using a latrine, if any children had witnessed other children defecating outside of their homes, if they had taken or were taking antihelmintic drugs, and if they washed their hands after playing and/or defecating.

Data analysis

A chi-square test with Statcel 2 was used to examine differences in the detection rate of parasite eggs between male and female subjects. The level of statistical significance was set at 0.05.

Ethical considerations

This survey was approved by the Municipal Health Office of Los Baños, University of the Philippines Los Baños, and the Ethical Committee of Kobe University Graduate School of Health Science, Japan. The aim of this survey was conveyed to the school children, their parents, and schoolteachers in advance, and consent was obtained from each of the participants.

RESULTS

Table 1: Parasite eggs isolated from fecal samples from school children

Species	No. of samples		Positive rate (%)
	examined	positive	
Ascarislumbricoides	70	25	36
*Trichuris*sp.	70	34	49
Hookworm	70	1	<1
Giardia intestinalis	70	4	6
Total	70	45	64

Table 1 shows the results of the fecal examinations for the 70 school children (aged eight to 11) that participated in this study. In total, 45 (64%) of these children were infected with intestinal parasites. Four genera were identifie d, i.e., *A. lumbricoides*, *Trichuris* sp., hookworm, and *Giardia intestinalis*. The *A. lumbricoides* egg detection rate was 36% (25/70) and 97% of them were fertilized. A higher detection rate was seen for *Trichuris* sp. eggs (49%, 34/70). In contrast, the hookworm egg detection rate was extremely low at < 1% (1/70).

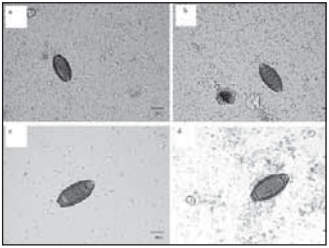

Fig. 1: Morphological differentiation of *Trichuris*sp. eggs. a and b represent eggs categorized as *Trichuristrichiura* based on their sizes (small). c and d represent eggs categorized as *T. vulpis* based on their sizes (large).

We measured the major and minor axes of the 309 *Trichuris* spp. eggs collected from 34 infected subjects and compared them to the dimensions of *T. trichiura* and *T. vulpis*eggs. The data showed that 78% (241/309) were categorized as belonging to the *T. trichiura*group (21 - 26 × 50 - 57 µm; Fig. 1 - a, b), 16% (49/309) to the *T. vulpis*group (32 - 40 ×72 - 99 µm; Fig. 1- c, d), whilst the remaining 6% (19/309) did not belong to either of these groups.

Table 2: Comparison of egg prevalence rates between male and female school children

Species	No. of positive (%)			p-value
	Male (n=32)	Female (n=38)	Total (n=70)	
A. lumbricoides	15 (47)	10 (26)	25 (36)	<0.05
*Trichuris*sp.	21 (66)	13 (34)	34 (49)	<0.05
Hook worm	1 (3)	0	1 (1)	
Giardia intestinalis	0	4 (11)	4 (6)	
Total	25 (78)	21 (55)	46 (66)	<0.05

Table 2 shows the parasite egg prevalence rates between males and females. The infection rate in males was 78% (25/32), which was significantly higher ($p < 0.05$) than in the females (55%; 21/38). Regarding the gender-segregated breakdown of the data, 47% of the males and 26% of the females were positive for *A. lumbricoides*, whilst 66% of the males and 34% of the females were positive for *Trichuris* sp.

In addition, we counted the total number of *A. lumbricoides* eggs to determine the intensity of the STH infections in the school children. Based on geometric mean calculations, 316 fecal eggs/gm (range: 4 to 5348) were recovered from 25 (36%) of the *A. lumbricoides*-positive subjects. According to the WHO classification of the intensity of infection in terms of *A. lumbricoides* egg numbers, 23 (92%) of the 25 school children had light infections (4-4,668epg), while two (8%) had moderate intensity infections (5,124 and 5,348 epg) (Fig. 2). Similarly, a total of 4,788 and a geometric mean of 141 eggs/g (range: 4 to 928) of *Trichuris* sp. eggs were recovered from 34 (49%) of the school children; all of these were categorized as light intensity infections (≤928 epg).

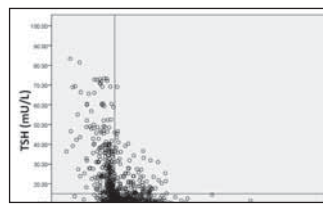

Fig.2: Intensity of *A. lumbricoides* infection in school children.

Interestingly, the questionnaire survey revealed that all of the school children had a latrine in their house. Nevertheless, 82% (54/66) of these children had witnessed preschool and school age children defecating outdoors. In addition, 68% (46/68) of school children had taken antihelminthic drugs in the past and 72% (50/69) of them had been infected with *A. lumbricoides* before. The school children who washed their hands after play and defecation were 99% (69/70) and 100% (70/70), respectively.

DISCUSSION

We conducted a survey of intestinal parasitic infections in children at a public school in Barangay Bayog, Luzon, in the Philippines. This revealed that 64% of the participants were infected with intestinal parasites, including STH. Similar surveys have been conducted at different places in the Philippines and, of these, 4 - 45% of the school children sampled were positive for STH infection.[4-6] Thus, the prevalence of STH infection in Barangay Bayog is considered to be higher than in the other areas surveyed in the Philippines. Nguie*t al* reported that STH infections are inversely proportional to the diffusion rates of the latrines in rural and remote West Malaysia.[15]However, Chong suvivatwonge*t al* reported an extremely high prevalence of STH infections in southern Thailand despite a latrine diffusion rate of 88%. Our survey found a high prevalence of STH infections despite the presence of sufficient numbers of

latrines within the study area.[16]Hence, it is likely that the high infection rate observed was related to the defecation habits of the village children, because 82% of them stated that they had witnessed school or preschool children defecating outdoors.

Another factor that may have contributed to the high infection rate is the location of Barangay Bayog village itself. The village is located next to a lake and residents use water to clean their houses and surrounding areas each day. Hence, the village soil has high moisture content and this may promote survival of STH eggs. Indeed, a high rate of embryonated*A. lumbricoides* and *T. trichiura*eggs were recovered from soil in this village.[9] In this survey of soil contamination by parasite eggs, which was conducted in the same area as the present study, we found that 32-62% and 28-53% of the soil samples examined (in different seasons) were positive for *A. lumbricoides* and *T. trichiura* eggs, respectively.[9] As a consequence, we suggested that *A. lumbricoides*represented the highest risk of infection for the following reasons: firstly, among a total of 1,450 STH eggs recovered from the soil, 909 (63%) were *A. lumbricoides*, while only 240 (17%) were *Trichuris* spp.; secondly, 49% of the *A. lumbricoides* eggs were embryonated.[9] In addition, a feco-oral infection route for STH is considered likely in this survey area, if the high prevalence of *A. lumbricoides* among school children is taken into account. Regarding the sizes of eggs that were classified as belonging to *Trichuris*; two different groups were isolated. Ferrer-Rodriguez *et al* have reported that the shape, size, and color of *Trichuris* sp. eggs, which were recovered from human feces, were different from those of *T. trichiura*. Moreover, *Trichuris* sp. eggs, of which the average size was 90 µm in length and 44 µm in width, were detected in the feces of a nine years old girl.[17]These eggs were identified as *T. vulpis* eggs.[14] This result suggests the possibility that some of the *Trichuris* sp. eggs detected in this survey were, in fact, *T. vulpis* eggs. Scientific literature in the public domain on zoonoses in developing countries (including the Philippines) is limited. Therefore, our study suggests the need for measures to control zoonotic intestinal infections in children (in addition to the established STH infection control programs).

The intensity of an infection, in terms of the number of eggs estimated in a sample, was, in this survey, lower than that reported in other areas of the Philippines.[4,18] In the Philippines, parasitic infections are considered a major public health problem, and the Philippine government directs helminth control initiatives at school children in endemic areas.[4] The questionnaire survey revealed that 68% (46/68) of school children had taken antihelminthic drugs. Although deworming reduces the intensity of an infection, it is not effective at reducing the prevalence rate because of reinfection.[19]

The annual global morbidity rates for human hookworm infections amount to 151 million; this rate is lower than for *A. lumbricoides* (250 million), but higher than for *T. trichiura* (46 million).[12] Although we are unable to comment on hookworm morbidity in the present study, we found the hookworm prevalence to be extremely low (<1%).

The egg prevalence rate for males in this survey was significantly higher than that for females ($p < 0.05$). Similar results have been reported by Flores *et al*, Andy *et al* and Uhuo*et al*. [20-22] The reasons underlying these gender-related differences might be related to the following: in general, males participate more in activities such as sport and might also be less concerned about hygiene than females; males may also pay more visits to their farms with their parents. [23, 22] Such activities mean that males may have more opportunities than females to come in contact with STH contaminated soil. The susceptibility to STH infection and STH prevalence in children under 16 years old is higher than in adults. This may be due to poor personal hygiene, as well as more frequent exposure to the outdoors environment.[3] This is why, globally, epidemiological surveys of intestinal parasitic infections tend to focus on school children.[12] Indeed, 6 to 48% of school children in developing countries in Southeast Asia were found to be infected with STH. [4,5, 24,25] Farmers comprise another group at high risk of contracting STH infections.[26] In Barangay Bayogvillage, therefore, it is possible that STH infection is prevalent not only among children, but also among adult farmers.

Although the number of school children involved in our study (70) is relatively small and insufficient at providing a comprehensive analysis of the parasitic fauna of this area, nevertheless, the results are interesting from a STH epidemiological perspective.

In summary, the reasons for the high prevalence of intestinal parasitic infections among school children in Barangay Bayog appear to be related to their life style habits and local environment (and include their defecation habits, geographical features related to the moisture content of the soil and contamination of such soil with dog or cat feces). This situation could be improved by better health education for children to raise awareness about the importance of personal hygiene, and for adults to enable them to understand that intestinal parasites can be transmitted by contact with soil. For the reasons discussed above, measures to eradicate parasitic intestinal STHs should not only be targeted at children, but also at soil contaminated by parasite eggs. Furthermore, countermeasures against zoonotic intestinal parasites are needed.

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