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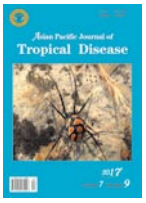

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Prevalence of intestinal protozoan infections among schoolchildren in Bang Khla District, Chachoengsao Province, Central Thailand

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ABSTRACT

Objective: To determine the prevalence of intestinal parasitic infections among primary schoolchildren in rural areas from Bang Khla District, Chachoengsao Province, Central Thailand.

Methods: A cross-sectional study was carried out between January and March 2017 among 203 schoolchildren in four rural schools using purposive sampling. All stool samples were examined using simple direct smear method and formalin ethyl acetate concentration technique.

Results: The overall prevalence of intestinal parasitic infections was 14.8% (30/203). Seven intestinal parasite species (two helminths and five protozoa) were identified in the stool samples. The most common intestinal protozoa in schoolchildren was *Giardia intestinalis* (n = 11, 5.4%) followed by *Blastocystis hominis* (n = 9, 4.4%), *Entamoeba histolytica/Entamoeba dispar* (n = 5, 2.5%), *Entamoeba coli* (n = 2, 1.0%) and *Endolimax nana* (n = 1, 0.5%). Hookworm (n = 1, 0.5%) and *Strongyloides stercoralis* (n = 1, 0.5%) were the most frequent helminths. No significant statistical differences in the prevalence rates of infections were observed by gender, age and school location ($P > 0.05$).

Conclusions: Intestinal parasitic infection is a significant public health problem among schoolchildren in rural areas of Thailand. Therefore, health education and environmental sanitation improvement are recommended as preventive control measures.

1. Introduction

Intestinal protozoan infections are classified as neglected tropical diseases (NTDs)[1] which remain a significant public health problem, especially in developing countries. The World Health Organization (WHO) estimated the number of infections, deaths, and Disability-Adjusted Life Years (DALYs) of intestinal protozoa diseases by age and region for 2010. These diseases caused 48.4 million cases and 59 724 deaths annually, resulting in 8.78 million DALYs[2]. Infectious protozoa are ingested with contaminated water and food and pass through the entire gastrointestinal tract. Three intestinal protozoa *Giardia intestinalis*, *Cryptosporidium* spp., and *Entamoeba* spp. were the most commonly reported protozoa associated with diarrheal illnesses of humans[2,3]. The diseases caused by these intestinal protozoa parasites are known as giardiasis, cryptosporidiosis, and amoebiasis, respectively. Others, such as *Cyclospora cayetanensis*, *Dientamoeba fragilis*, *Balantidium coli*, *Cystoisospora belli*, and *Blastocystis* spp., are emerging as important causes of illness, with serious implications for travellers to developing regions, immunocompromised populations, and young children[3]. Intestinal protozoan infections are common in children in developing regions and they are frequently associated with malabsorption syndromes and gastrointestinal morbidity[4]. The epidemiology of pathogenic intestinal protozoa has been reported from many countries in Southeast Asia[1,3]. In Thailand, a national epidemiological survey of intestinal parasitic infections from 75 provinces in 2009 reported that overall prevalence of intestinal protozoan infections was 4.9%[5]. However, many previous studies showed that the prevalence of intestinal protozoan infections varied widely

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The study was conducted according to the tenets of the Declaration of Helsinki, and all procedures involving human subjects were approved by the Ethics Committee of Rajabhat Rajanagarindra University, Thailand (approval number: RRUPH 602001). Written informed consent was obtained from parents and legal guardians on behalf of their children before data collection.

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from 2.3% to 37.7% in Thai children[6-14], but no studies on the epidemiology of infectious disease involved study of the prevalence of intestinal protozoan infections among schoolchildren from Bang Khla District, Chachoengsao Province. Therefore, the present study was conducted to determine the prevalence of intestinal parasitic infections among schoolchildren in rural areas from four primary schools at Bang Khla District, Chachoengsao Province in the central region of Thailand, using simple direct smear method and formalin ethyl acetate concentration technique.

2. Materials and methods

2.1. Study area

A cross-sectional study was conducted with purposive sampling in four rural primary schools (A, B, C and D) in Bang Khla District, Chachoengsao Province located in the central region of Thailand, approximately 100 km from Bangkok (Figure 1).

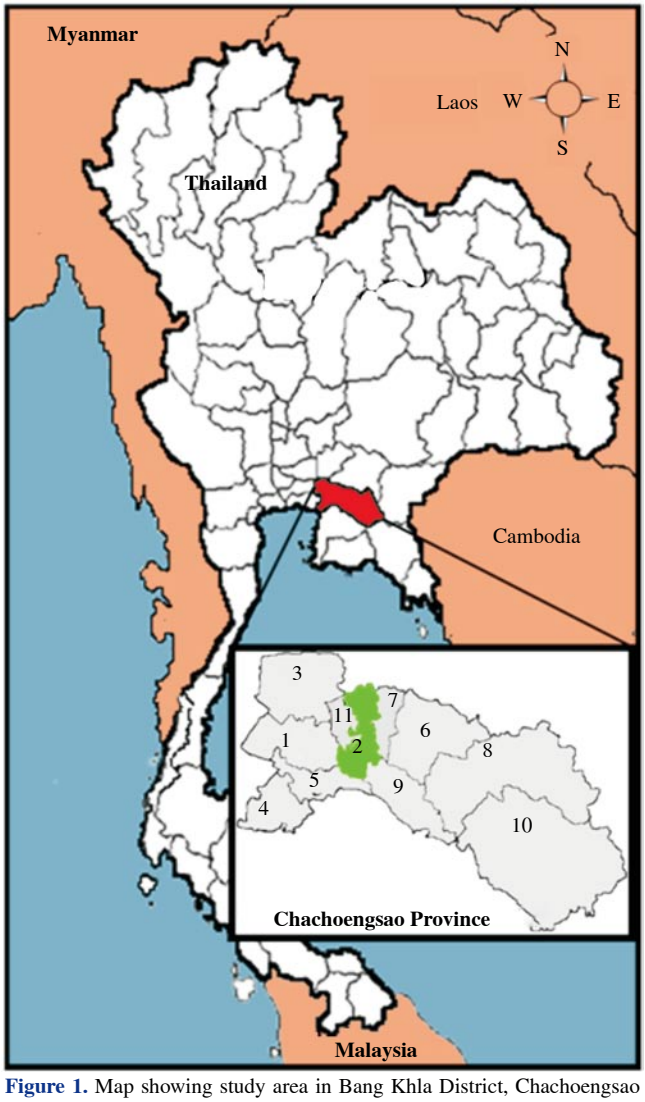

Figure 1. Map showing study area in Bang Khla District, Chachoengsao Province (green colour).

2.2. Stool collection and examination

Data collection for intestinal parasitic infections was carried out between January and March 2017. Stool samples were obtained from 203 schoolchildren aged between 7 and 12 years old. Fresh stool samples were collected early in the morning in sterile plastic containers and conserved in ice boxes before being sent to the laboratory at Department of Biology, Faculty of Science and Technology, Rajabhat Rajanagarindra University for examination. Stool samples were examined under a light microscope by simple direct smear method and formalin ethyl acetate concentration technique[15].

2.3. Ethical consideration

The study was conducted according to the tenets of the Declaration of Helsinki, and all procedures involving human subjects were approved by the Ethics Committee of Rajabhat Rajanagarindra University, Thailand (approval number: RRUPH 602001). Written informed consent was obtained from parents and legal guardians on behalf of their children before data collection. All children involved have the same rights to decline to participate or withdraw from the study at any time without prejudice. At the end of the study, each child was offered an anti-helminthic and anti-protozoan treatment free of charge based on the stool microscopy results.

2.4. Data analysis

Data analysis was performed using Statistical Package for Social Sciences (SPSS) version 22 for Windows. The prevalence of intestinal parasitic infections was calculated as the ratio of the number of schoolchildren positive for any parasite species to the total number of schoolchildren in the study. *Chi*-square (χ^2) tests were used to compare proportions and to test for association between the prevalence rates of infections and differences in age, gender and school location. All tests were considered significant at $P < 0.05$.

3. Results

A total of 203 out of 304 (66.8%) schoolchildren within age range of 7–12 years old were voluntarily enrolled into the study. The overall prevalence rate of intestinal parasitic infections among schoolchildren was 14.8% (30/203) with 15.2% (16/105) of males and 14.3% (14/98) of females infected. Thus, there was no significant difference in prevalence rate between males and females ($\chi^2 = 0.037$; $P = 0.848$). Among the four schools involved in the study, the highest prevalence rate of intestinal parasitic infections in schoolchildren was 20.4% (10/49) from school “C” while the lowest prevalence of 10.8% (4/37) was found in school “A”. However, no significant differences were found between the four schools ($\chi^2 = 2.119$; $P = 0.548$). The highest prevalence rate of intestinal parasitic infections was found in schoolchildren around nine years old (20.6%) and the lowest prevalence was found in schoolchildren around ten years old (10.3%), with an insignificant difference between ages ($\chi^2 = 2.317$; $P = 0.804$) (Table 1).

Table 1
Prevalence of intestinal parasitic infections by gender and age among schoolchildren from 4 schools at Bang Khla District, Chachoengsao Province (n = 203).

Characteristics		No. of examined (%)	Positive (%)	Negative (%)	χ^2 (P-value)
Gender	Male	105 (51.7)	16 (15.2)	89 (84.8)	0.037 (0.848)
	Female	98 (48.3)	14 (14.3)	84 (85.7)	
Age	7	35 (17.2)	5 (14.3)	30 (85.7)	2.317 (0.804)
(years)	8	31 (15.3)	6 (19.4)	25 (80.6)	
	9	34 (16.7)	7 (20.6)	27 (79.4)	
	10	29 (14.3)	3 (10.3)	26 (89.7)	
	11	35 (17.2)	4 (11.4)	31 (88.6)	
	12	39 (19.2)	5 (12.8)	34 (87.2)	
Schools	A	37 (18.2)	4 (10.8)	33 (89.2)	2.119 (0.548)
	B	59 (29.1)	7 (11.9)	52 (88.1)	
	C	49 (24.1)	10 (20.4)	39 (79.6)	
	D	58 (28.6)	9 (15.5)	49 (84.5)	
Total		203 (100)	30 (14.8)	173 (85.2)	

Seven intestinal parasite species (two helminths and five protozoa) were identified in the stool samples. Protozoa were the most predominant parasites detected [13.8% (28/203)]. The prevalence rates of both pathogenic and nonpathogenic intestinal protozoa were 12.3% (25/203) and 1.5% (3/203), respectively. The most common pathogenic protozoan parasite was *Giardia intestinalis* (*G. intestinalis*) [5.4% (11/203)], followed by *Blastocystis hominis* (*B. hominis*) and *Entamoeba histolytica/Entamoeba dispar* (*E. histolytica/E. dispar*) at 4.4% (9/203) and 2.5% (5/203) respectively. Furthermore, the prevalence rates of other non-pathogenic protozoan infections were 1.0% (2/203) for *Entamoeba coli* and 0.5% (1/203) for *Endolimax nana*. The overall prevalence of soil-transmitted helminths (hookworm and *Strongyloides stercoralis*) was 1.0% (each 0.5%) (Table 2).

Table 2
Prevalence of intestinal protozoan and helminth infections among schoolchildren in Bang Khla District, Chachoengsao Province (n = 203).

Types of parasite	No. of infection	Prevalence (%)
Protozoa	28	13.8
Pathogenic protozoa	25	12.3
G. intestinalis	11	5.4
B. hominis	9	4.4
E. histolytica/E. dispar	5	2.5
Non-pathogenic protozoa	3	1.5
Entamoeba coli	2	1.0
Endolimax nana	1	0.5
Helminths	2	1.0
Hookworm	1	0.5
Strongyloides spp.	1	0.5
Total	30	14.8

4. Discussion

The overall prevalence of intestinal parasites from four schools located in Bang Khla District, Chachoengsao Province was 14.8%, which is lower than that previously reported among preschool children in Sanamchaiket District (18.0%)[6] and primary schoolchildren (25.2%)[7] in a rural community in Chachoengsao Province, the central region. Moreover, it was also lower than that reported among children living in Pathum Thani Province (18.0%)[8] in the central region, Chon Buri Province (23.9%)[9] in the eastern region, Sakon Nakhon Province (39.0%)[10], Khon Kaen Province (43.6%)[9] in the northeastern region, Phatthalung Province (41.0%)[9] in the southern region, Nan Province (54.6%)[9] in the northern region, and Kanchanaburi Province (82.8%)[9] in the western region. However, the results of these studies were higher than the prevalence in Pathum Thani Province (13.9%)[11], Ang Thong Province (14.5%)[9] in the central region, and Phitsanulok Province (5.4%)[12] in the northern region of Thailand. The highest prevalence rate of intestinal parasitic infections was found in children aged nine years old (20.6%) in the present study, which is similar to that reported previously among primary schoolchildren from suburban schools in Pathum Thani Province[11].

The differences in parasite prevalence reported from various geographic areas may be due to a variety of factors such as climate change, unsafe drinking water, inadequate food sanitation, poor hygiene behaviour, immune disorders and low socioeconomic status of each participating child. Furthermore, different diagnostic techniques may also influence detection rates.

Our study findings showed that the rate of protozoan infection (13.8%) was higher than that of soil-transmitted helminth infections (1.0%). Similarly, studies from other regions of Thailand reported the prevalence rate of protozoa infections in the range of 13.4% to 34.4%[6,8,11], using common methods including simple direct smear method and concentration techniques for detecting intestinal parasites from stool samples.

Our study found a low prevalence rate of soil-transmitted helminth infections [hookworm (0.5%) and *Strongyloides stercoralis* (0.5%)], which is in agreement with other studies reporting prevalence rate in the range of 0.4% to 1.6%[7,9]. The reason for the high protozoan infection rate may be the simple life cycle. Many intestinal protozoa do not require an intermediate host to complete development, and can be transmitted to the host by the fecal-oral route. On the other hand, most helminths have extremely complex life cycles, which may involve one or more intermediate hosts and a final host to complete their development. This further complicates the ability of helminths to survive and reproduce, and hence makes them less likely to be transmitted to children.

In this present study, the most common intestinal parasites found were *G. intestinalis* (5.4%), followed by *B. hominis* (4.4%) and *E. histolytica/E. dispar* (2.5%). This result was similar to that in previous studies among Thai children, which found prevalence rates of *G. intestinalis* in the range of 5.2% to 6.2%[6,7,13], but our results were higher than those of other previous studies conducted among similar populations, where the prevalence of *G. intestinalis* was in the range of 0.2% to 4.2%[9-11] using simple direct smear method and concentration techniques. This difference in prevalence rate may be due to different geographic areas and age groups of inspected individuals.

The prevalence of *B. hominis* in our study was lower than that previously reported among schoolchildren from seven provinces,

which was in the range of 7.9% to 80.2%[9,14] using culture method for detection. The difference in prevalence may be due to the culture method for *B. hominis* being more sensitive than the simple direct smear method and concentration techniques[9].

The prevalence of *E. histolytica/E. dispar* in our study was similar to that in previous studies among schoolchildren in Pathum Thani Province (1.5%)[11]. *E. histolytica* and *E. dispar* cannot be differentiated by microscopy. Consequently, molecular biology techniques should be used to differentiate these two species in order to avoid unnecessary treatment of patients infected with the non-pathogenic *E. dispar*.

In this present study, the three major pathogenic intestinal protozoa *G. intestinalis*, *B. hominis*, and *E. histolytica/E. dispar* were more commonly found in stool analysis, which agrees with other studies on Thai children[8,9,11]. These findings have public health significance because children can be inadvertently infected by the ingestion of cysts in contaminated water and food, or via the fecal-oral route through the absence of hand washing. Therefore, hand washing before eating and after defecation can prevent diseases transmission. In addition, maintenance and improvement of the water supply is needed to reduce waterborne transmission of protozoan parasites.

In conclusion, our study revealed that intestinal parasitic infections are still an important public health problem among schoolchildren in rural areas at Bang Khla District, Chachoengsao Province, Central Thailand. The findings of this study provide useful information for infectious disease surveillance, outbreak management and health promotion campaigns to create awareness about health and hygiene for school staff, parents, and students. Further prospective studies should investigate factors influencing hygiene behaviour among schoolchildren, including detection of parasite infective stages in environmental contamination.

Conflict of interest statement

We declare that we have no conflict of interest.

Acknowledgments

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