

# SCHOOL-BASED HELMINTHIASES CONTROL: I. A BASELINE STUDY OF SOIL-TRANSMITTED HELMINTHIASES IN NAKHON SI THAMMARAT PROVINCE, THAILAND

Malinee T Anantaphruti<sup>1</sup>, Praphasri Jongsuksuntigul<sup>2</sup>, Thanawat Imsomboon<sup>2</sup>,  
Nobuhiko Nagai<sup>3</sup>, Chatree Muennoo<sup>1</sup>, Surapol Saguankiat<sup>1</sup>, Somchit Pubampen<sup>1</sup> and Somei Kojima<sup>3</sup>

<sup>1</sup>Department of Helminthology, Faculty of Tropical Medicine, Mahidol University, Bangkok; <sup>2</sup>Department of Communicable Diseases Control, Ministry of Public Health, Nonthaburi; <sup>3</sup>Asian Center for International Parasite Control, Mahidol University, Bangkok, Thailand

**Abstract.** A baseline study of soil-transmitted helminthiases was carried out in Nakhon Si Thammarat Province, southern Thailand. The study sites were Wat Krou Chou Primary School and nearby villages in Sichon district, and Wat Thang Phoon Primary School and nearby villages in Chalerm Phrakiat District. Surveys of the schoolchildren's stools were conducted by the Kato-Katz technique. The results showed that 23.7% of schoolchildren in Wat Krou Chou and 24.7% of those in Wat Thang Phoon were infected with soil-transmitted helminths, with a 24.1% overall infection rate. The major infection was hookworm (22.2% and 19.6%) and the minor one was trichuriasis, (2.9% and 8.7% respectively). The intensity of infection was similar in both schools, 85.7% and 90.2% respectively for light intensity hookworm. Schoolchildren with hookworm infection were not anemic. The hemoglobin value of children with hookworm infection was not significantly different from that of uninfected children. Data regarding the health behavior of children's parents in both schools were reported.

## INTRODUCTION

Nakhon Si Thammarat Province is one of the field training stations for the International Course for School-based Malaria and Soil-transmitted Helminthiases Control for Program Managers. The province is known to be endemic for soil-transmitted helminthiases. However, the reported prevalence of infection has varied in each area of the province: from 16.7% (Anantaphruti *et al*, 2000) to 92.3% (Muennoo *et al*, 1992). Baseline data, including the prevalence, and intensity of soil-transmitted helminths (STH) and the anemic status of schoolchildren are necessary for the activities of a control program. Important socio-behavioral data relating to STH infection in the children's families were also measured in this baseline study.

## MATERIALS AND METHODS

### Study areas

The study was carried out in February 2001 in Nakhon Si Thammarat Province which is 780 km south of Bangkok, on the east coast of Thailand (Fig 1). Health behavior interviews were conducted with residents of Sichon and Chalerm Phrakiat districts. The

distance between the two districts is approximately 90 km.

### Stool surveys and anemia assessment

Surveys of the stools of the schoolchildren of two primary schools, Wat Krou Chou Primary School in Sichon district and Wat Thang Phoon Primary School in Chalerm Phrakiat district, were conducted by the Kato-Katz technique. The intensity of infection was classified according to the number of eggs per gram of feces (NEPG). Anemia was assessed by measuring hemoglobin and hematocrit (packed cell volume) of the fingertip blood samples of the schoolchildren.

### Health behavior data

Health behavior data relating to STH infection were gathered by interview with the adult population living in the study areas. The interviewees were the parents of the children who attended either of the two selected schools. Forty households in each district surrounding the school were selected by simple random sampling. The data were composed of general information about Chalerm Phrakiat and Sichon districts, baseline data relating to soil-transmitted helminths, and health behavior relating to soil-transmitted helminth infection of the study population.

## RESULTS

### General information

**Sichon district.** The total population was 80,503; 40,171 (49.9%) males and 40,332 (50.1%) females.

---

Correspondence: Dr Malinee T Anantaphruti, Department of Helminthology, Faculty of Tropical Medicine, Mahidol University, 420/6 Rajvithi Road, Bangkok 10400, Thailand.

Tel: 66 (0) 22469000-12; Fax: 66 (0) 26435600

E-Mail: tmmtr@mahidol.ac.th

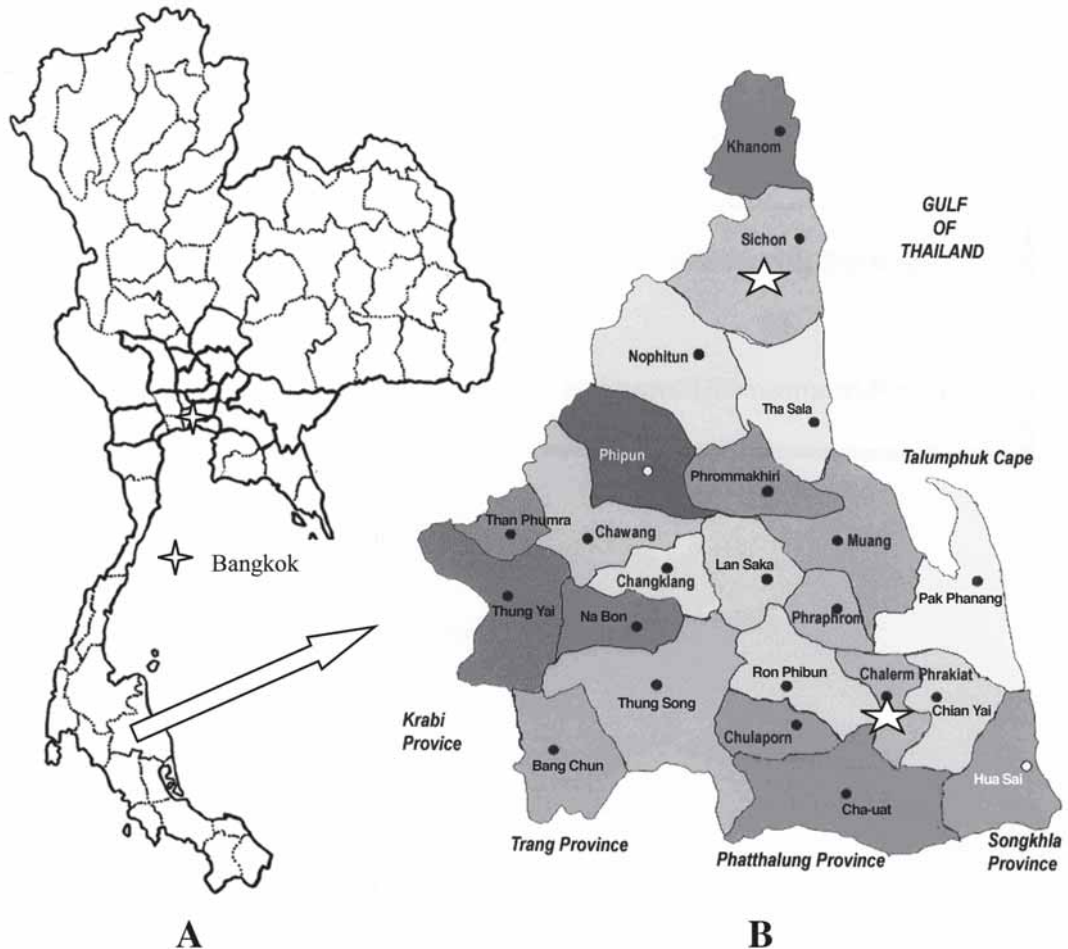


Fig 1-Map of Thailand (A), and Nakhon Si Thammarat Province (B) showing Chalerm Phrakiat and Sichon districts.

There were 9 sub-districts, 102 villages and 15,521 households. The population was mainly Buddhist (95.5%), while the rest were Muslim (4.4%) and Christian (0.1%). Their main fields of occupation were agriculture, gardening, rubber plantations, farming and fisheries.

**Chalerm Phrakiat district.** The total population was 32,992; 16,156 (49.0%) males and 16,836 (51.0%) females. There were 4 sub-districts, 35 villages and 5,665 households. All were Buddhists. The main occupation was farming.

**The villages of Chalerm Phrakiat district: baseline data**

The villages studied were No. 1, Tambon Don Traw and No. 2, Thang Phoon, with 352 and 346 households respectively. The results showed that every household had a sanitary latrine. There were no existing helminthiases

control programs in 2001. The villagers had not had a stool examination in the past year, but about 10% of them had had a stool examination before (Table 1). However, 70% of them had taken anthelmintic drugs (Table 2).

**The villages of Sichon district: baseline data**

The sites studied were villages 5, 6, 7 and 10, Tambon Sao Phao. There were 240, 201, 131 and 250, households respectively. All of the interviewees had sanitary latrines. Only the villagers in village No. 7 had ever had a stool examination (in 1999), while the rest had never had one. There were no helminthiases control programs in 2001. About 75% had had experience of taking anthelmintic drugs (Table 2).

**Health behaviors relating to helminth infection (Table 3)**

In Chalerm Phrakiat district, the interviewees

Table 1  
Percentage of study population having had stool examination in Chalerm Phrakiat district and Sichon district.

Stool examination	Chalerm Phrakiat district No. (%)	Sichon district No. (%)
History of stool examination	14 (11.6)	15 (12.1)
No history of stool examination	107 (88.4)	109 (87.9)
Total	121(100)	124(100)

Table 2  
Percentage of study population that had taken anthelmintics in Chalerm Phrakiat district and Sichon district.

Administration of anthelmintics	Chalerm Phrakiat district No. (%)	Sichon district No. (%)
Every year	22 (18.2)	34 (27.4)
Some years	62 (51.2)	58 (46.8)
Never	37 (30.6)	32 (25.8)

believed that helminth infections occurred by walking on the soil without proper shoes/boots wearing (96%), consuming food contaminated with parasite eggs (98%), and consuming food without prior handwashing (97%). A smaller percentage of the population of Sichon District shared these beliefs (84, 85 and 92% respectively). In these two districts, more than 93% of the population sampled understood the harmful results of intestinal helminth infections, *ie* anemia, physical growth retardation and intellectual retardation.

It was found that more than 90% of those surveyed understood that helminthic infections could be prevented by proper wearing of shoes/bo'ts, washing hands before a meal, and washing vegetables properly prior to eating them. A similar percentage was found for the control of helminthic infections. The perceived control methods were stool examination, taking anthelmintics once or twice a year and defecating in a sanitary latrine.

Whereas those surveyed appeared to have a good knowledge of the prevention and control of STH infection, only about 50% of the studied population practised the wearing of shoes and handwashing; there was greater conformity of knowledge and practice in vegetable washing and sanitary latrine defecation (Table 4).

With regard to the schoolchildren of both districts, some 50% of them usually practised wearing shoes and handwashing before meals; 90% usually defecated

in a sanitary latrine (Table 5). Almost 90% of them had never had a stool examination, but about 60% had had anthelmintics (Table 6).

#### Soil-transmitted helminthiases data

The prevalence of STH infection in the two schools is shown in Table 7. Ninety-seven of the 410 children of Wat Krou Chou (23.7%) and 77 of the 312 children of Wat Thang Phoon (24.7%) were positive for soil-transmitted helminths, with an overall infection rate of 24.1%. The major infection was hookworm (22.2% and 19.6% respectively). There was a lower prevalence of *Trichuris* infection, 2.9% and 8.7% respectively. No *Ascaris* infection was detected in the schoolchildren in this study.

The intensities of infection were classified as high, moderate and heavy according to the criteria of the WHO (1987). Hookworm infection in these schoolchildren was generally of light intensity: 85.7% in Wat Krou Chou School and 90.2% in Wat Thang Phoon School. Only 1% had heavy infection. Of the trichuriasis, 3.7% of children in Wat Thang Phoon had moderate intensity infections while all the rest had light intensity infections (Table 8).

The schoolchildren of grades 3 and 4, aged between 9 and 10, were investigated for anemia. In total, 206 schoolchildren, (94 males and 112 females) were examined. The overall hookworm positive rate was 20.9% (43 of 206 schoolchildren were positive for hookworm eggs). The mean hemoglobin value was

Table 3  
Beliefs about helminth infection, its harmful results, means of prevention and control methods of intestinal helminth infections in Chalerm Phrakiat district and Sichon district.

Beliefs	Chalerm Phrakiat district No. (%)	Sichon district No. (%)
<b>About transmission of helminthiases</b>		
Walking on the soil without proper shoes or boots	116 (95.9)	104 (83.9)
Consuming foods contaminated with helminth eggs	119 (98.3)	109 (84.7)
Consuming foods without proper handwashing	117 (96.7)	114 (91.9)
Consuming improperly cooked or uncooked pork	117 (96.7)	109 (87.9)
<b>Perceptions on harmful results</b>		
Anemia	113 (93.4)	117 (94.4)
Physical growth retardation	116 (95.9)	122 (98.4)
Mental retardation	115 (95.0)	119 (96.0)
<b>Means of prevention</b>		
Wearing shoes or boots properly	120 (99.2)	111 (89.5)
Washing hands properly before eating	120 (99.2)	113 (91.1)
Washing vegetables properly before eating	116 (95.9)	116 (93.5)
Eating properly cooked pork or beef	120 (99.2)	123 (99.2)
<b>Control methods</b>		
Taking individual stool for helminth egg examination	111 (91.7)	111 (89.5)
Taking anthelmintics once or twice a year	119 (98.3)	116 (93.5)
Always using a sanitary latrine	119 (98.3)	120 (96.8)

Table 4  
Practices relating to the prevention and control of helminth infections in Chalerm Phrakiat district and Sichon district.

Practice	Chalerm Phrakiat district			Sichon district		
	Frequently practised %	Occasionally practised %	Not at all %	Frequently practised %	Occasionally practised %	Not at all %
Wearing shoes or boots while walking on the soil	53.7	40.5	5.8	34.7	52.4	12.9
Washing hands before eating	52.1	47.1	0.8	66.9	33.1	-
Washing vegetables before eating	98.3	1.7	-	96.8	3.2	-
Consuming uncooked or improperly cooked pork or beef	5.0	0.8	94.2	11.3	4.0	84.7
Defecating in a sanitary latrine	94.2	3.3	2.5	92.7	6.5	0.8

Table 5  
Schoolchildren's practices relating to the prevention and control of helminth infection.

Practice	Chalerm Phrakiat district No. (%)	Sichon district No. (%)
Wearing shoes		
Frequently	69 (57.0)	70 (56.5)
Occasionally	50 (41.3)	45 (36.3)
Not at all	2 (1.7)	9 (7.3)
Washing hands before eating		
Frequently	52 (43.0)	73 (58.9)
Occasionally	65 (53.7)	47 (37.9)
Not at all	4 (3.3)	4 (3.2)
Defecating in sanitary latrines		
Frequently	110 (90.9)	107 (86.3)
Occasionally	9 (7.4)	16 (12.9)
Not at all	2 (1.7)	1 (0.8)

Table 6  
Schoolchildren's practices relating to stool examination and anthelmintics.

Practice	Chalerm Phrakiat district No. (%)	Sichon district No. (%)
Stool examination		
History of stool examination	16 (13.2)	14 (11.3)
No history of stool examination	105 (86.8)	110 (88.7)
Taking anthelmintics		
History of treatment	74 (61.2)	77 (62.1)
No history of treatment	47 (38.8)	47 (37.9)

Table 7  
Soil-transmitted helminthiases in Wat Krou Chou Primary School and Wat Thang Phoon Primary School.

School	No. children examined	Prevalence (%)		
		STH <sup>a</sup>	Hookworm	Trichuriasis
Wat Krou Chou	410	97 (23.7)	91 (22.2)	12 (2.9)
Wat Thang Phoon	312	77 (24.7)	61 (19.6)	27 (8.7)
Total	722	174 (24.1)	152 (21.1)	39 (5.4)

<sup>a</sup>STH = soil-transmitted helminthiases.

12.6 g/dl; in hookworm-positive children it was 12.7; hookworm-negative children it was 12.6. There was no significant difference between the hemoglobin values of the children with hookworm infection and normal children ( $p = 0.44$ ). There was a very high

correlation between hemoglobin and hematocrit levels (data not shown) in these schoolchildren ( $r = 0.93$ ,  $p < 0.01$ ). It takes a hookworm intensity of 1,000 NEPG to reduce hemoglobin by 0.3 g/dl after adjusting for school and age ( $p = 0.03$ ) (Table 9).

Table 8  
Intensity of hookworm and *Trichuris* infections in Wat Krou Chou Primary School and Wat Thang Phoon Primary School.

Intensity of infection <sup>a</sup>	Type of infection (%)	
	Hookworm	Trichuriasis
Wat Krou Chou Primary School		
Light	78 (85.7)	12 (100)
Moderate	12 (13.2)	0
Heavy	1 (1.1)	0
Total	91 (100)	12 (100)
Wat Thang Phoon Primary School		
Light	55 (90.2)	26 (96.3)
Moderate	5 (8.2)	1 (3.7)
Heavy	1 (1.6)	0
Total	61 (100)	27 (100)

<sup>a</sup>Hookworm: Light = NEPG < 2,000; Moderate = NEPG 2,001-7,000; Heavy = NEPG > 7,000

<sup>a</sup>Trichuriasis: Light = NEPG < 1,000; Moderate = NEPG 1,001-10,000; Heavy = NEPG > 10,000

Table 9  
Relationship between number of eggs per gram (NEPG) of hookworm (Hw) and hemoglobin (Hb) levels (multiple linear regression method).

Variable	Coefficient	95% Confidence Interval	p-value
NEPG of Hw	-0.0003	-0.0006	0.03
Age	-0.85	-1.6	0.02
School <sup>a</sup> (Thang Phoon)	-0.94	-1.6	< 0.01

<sup>a</sup>Referent: Krou Chou; multiple R = 0.15

## DISCUSSION

The results revealed that more than 85% of the population of both districts had beliefs about the transmission, prevention and control of the infection. Several factors may have influenced the infection rates of the helminths. Religion may be one of them. The main religion of the population in the two studied schools is Buddhism. From our experience, they have lower helminth infection rates.

Regarding the anemic status, there was no significant difference in the hemoglobin values in children with and without hookworm infection. This finding agreed with the study of Yokogawa *et al* (1983) who used hematocrit values as indicators. However, there was a significant difference in hemoglobin values after adjusting for school and age.

It is recommended that the infected schoolchildren should be treated and school-based health education should be implemented in order to prevent re-infection. Health education must concentrate on building people's knowledge of the parasites, their modes of transmission and the prevention of infection. Before health education initiatives are launched, schoolchildren's knowledge, attitudes and parasite-control practices should be investigated in order to obtain baseline data. These data can be used to compare with those after the implementation of health education.

## ACKNOWLEDGEMENTS

The study was supported financially by the Asian Center for International Parasite Control (ACIPAC). Sincere thanks are due to Professor Dwip Kitayaporn,

Head of the Department of Social and Environmental Medicine, Faculty of Tropical Medicine, Mahidol University, for his help with the analysis of the data.

REFERENCES

Anantaphruti MT, Nuamtanong S, Muennoo C, Sanguankiat S, Pubampen S. *Strongyloides stercoralis* infection and chronological changes of other soil-transmitted helminthiases in an endemic area of southern Thailand. *Southeast Asian J Trop Med Public Health* 2000; 31: 378-82.

Muennoo C, Chiamratana B, Sanguankiat S, Yamput S, Waikagul J, Charoenlarp P. Study on prevalence

and intensity of soil-transmitted helminths in primary school children, Nakhon Si Thammarat Province. *J Trop Med Parasitol* 1992; 15: 31-8.

World Health Organization. Prevention and control of intestinal parasitic infections. Report of a WHO Expert Committee. *WHO Tech Rep Ser* 1987;749: 86.

Yokogawa M, Vajrasthira S, Waikagul C, *et al.* Control of soil-transmitted helminthiasis and its impact on the nutritional status. In: Yokogawa M, Hayashi S, Kobayashi A, *et al.*, eds. *Collected Papers on the Control of Soil-transmitted Helminthiases*. Vol II. Tokyo: APCO. 1983: 295-308.