นิพนธ์ต้นฉบับ

High prevalence of hookworm infection in a population of Northeastern Thailand after an opisthorchiasis control program

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Background : *Opisthorchiasis is still a public health problem in northeastern Thailand. The Department of Communicable Disease Control, Ministry of Public Health implemented a 10-year control program for opisthorchiasis for the period 1984 to 1994.*

Objective : *In order to study the impact of the control program, we studied the prevalence of opisthorchiasis and other intestinal parasites in a population of northeastern Thailand.*

Setting : *Tadfah and Dong-Sakarn Villages, Poo-Paman District, Khon Khen Province.*

Design : *A total of 154 individuals provided stool samples for examination. Forty-six percent were male and 54% were female. Twenty-eight percent were children aged under 15 years.*

Methods : *Stool samples were examined by the formalin-ether concentration technique.*

Results : *We found at least one intestinal parasite in 51 (34%) individuals. Among infected individuals, hookworm infection was found at the*

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highest prevalence (28%) in both males and females, and in all age groups. Strongyloidiasis and opisthorchiasis were found in 6% and 5% of the samples, respectively. Ascariasis and enterobiasis were each found in 1% of the samples.

Key words : *Parasite, Thailand, Prevalence.*

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สุรางค์ ไตรธีระประภาพ, เพ็ญแข อัครบวร, จันทร์เพ็ญ พรมทอง, กมลวรรณ ชื่นตา. ความชุกของโรคพยาธิปากขอสูงในประชากรกลุ่มหนึ่งของภาคอีสานของไทย ภายหลังการควบคุมโรคพยาธิใบไม้ตับระยะยาว. จุฬาลงกรณ์เวชสาร 2542 ก.พ; 43(2): 99-108

ที่มาของปัญหา : *โรคพยาธิใบไม้ตับยังคงเป็นปัญหาทางสาธารณสุขในภาคอีสานของประเทศไทย กรมควบคุมโรคติดต่อ กระทรวงสาธารณสุขได้มีโครงการควบคุมโรคพยาธิใบไม้ตับในช่วง 10 ปี ระหว่าง พ.ศ. 2527-2537*

วัตถุประสงค์ : *เพื่อศึกษาผลกระทบของการควบคุมดังกล่าว ผู้วิจัยได้ศึกษาความชุกของโรคพยาธิใบไม้ในตับตลอดจนพยาธิลำไส้ชนิดอื่นในประชากรกลุ่มหนึ่งของภาคอีสานของไทย*

สถานที่ทำการศึกษา : *หมู่บ้านตาดฟ้า และคงสะคร่าน ตำบลวังสวาบ อำเภอภูผาม่าน จังหวัดขอนแก่น*

รูปแบบการวิจัย : *เป็นการศึกษาแบบ Cross - sectional*

ผู้เข้าร่วมการศึกษา : *มีผู้ส่งตรวจอุจจาระทั้งหมด 154 ราย เป็นชาย 46% และหญิง 54% โดยในจำนวนทั้งหมดนี้เป็นเด็กอายุต่ำกว่า 15 ปี 28%*

วิธีทำการศึกษา : *ตรวจอุจจาระโดยวิธี formalin - ether*

ผลการศึกษา : *พบพยาธิในลำไส้เป็นจำนวน 34% (51 ราย) ของผู้ที่ได้รับการตรวจอุจจาระโดยโรคพยาธิปากขอมีอัตราความชุกสูงสุด (28%)ในทุกเพศทุกวัย โดยโรคพยาธิเส้นด้ายและโรคพยาธิใบไม้ตับ 6% และ 5% ตามลำดับ โรคพยาธิไส้เดือนกลมและโรคพยาธิเข็มหมุด พบชนิดละ 1%*

Among pathogenic parasitic infections in Thailand, the highest prevalence is hookworm infection (22%) followed by liver fluke infection (12%).[1] In southern Thailand hookworm infection is most prevalent and is considered a major public health problem, while opisthorchiasis is prevalent in the northeastern region.[2,3] Opisthorchiasis has been prevalent in northeastern Thailand for more than 4 decades.[3] Therefore, the 10-year control program of opisthorchiasis in northeastern Thailand was implemented by the Department of Communicable Disease Control (CDC), Ministry of Public Health for the period during 1984-1994. The program focused on the community level by performing yearly stool examinations and treatment of all positive cases with praziquantel, as well as health education. As a result, this program has significantly reduced the disease prevalence and high risk behaviors (frequent consumption of uncooked fish) of the people. The disease prevalence decreased from 34.6% in 1984 to 18.5% in 1994.[3] However, a large variation of infected rates is observed (5.20-56.25%). This means that in some areas of the Northeast, more than half of the population still carry liver fluke infections.

People in rural areas of Thailand have difficulty to access good health care and basic health education.[4] Subsequently, preventable diseases such as parasitic infections are still prevalent in many remote areas of the country. The national control programs for parasitic diseases (*e.g.* opisthorchiasis), which may not reach the most remote areas of Thailand, can result in a modest amount of success. The difficulty of obtaining stool specimens from villagers also impedes the success and evaluation of the control programs. To determine the prevalence of intestinal parasitic infections after the 10-year control program of opisthorchiais, we performed stool examinations in a remote population of northeastern Thailand.

We report here the results of stool examinations of the people in a rural area of Khon Kaen Province of northeastern Thailand. The data showed a low prevalence of opisthorchiasis, but a very high prevalence of hookworm infection was detected.

Materials and Methods

Studied area and population

The studied area was located at Tadfah and Dong-Sakarn Villages, Poo-Paman District, Khon Kaen Province. Most of the people here had agriculture as their walk of life. All of them were willing to participate in this study. There were a total about 300 individuals living in the studied area.

Health education

During the field visit, all villagers were informed about the health effects and danger from parasitic infections. The prevention methods for common parasitic disease (*e.g.* consumption of well-cooked food, hygienic defecation, and no bare-foot behavior) were explained to the villagers as well.

Stool examination

Cartons were distributed to the residents in the district the day before sample collection. Specific precautions were explained to the population on how to handle the specimens to avoid contamination. In order to maximize the coverage rate, we collected stool samples for 3 days. All stool specimens were fixed with formalin and carefully stored before examination in the laboratory at the Department of Parasitology,

in the laboratory at the Department of Parasitology, Faculty of Medicine, Chulalongkorn University, as previously described.[4,5] The formalin-ether concentration technique was used to process all specimens. The presence of intestinal parasite eggs or larvae was determined microscopically. The samples were independently examined by two examiners.

Data analysis

Data were recorded, analysed and plotted by using the Microsoft Excel 6.0 spread-sheet program.

Results

Characteristics of the studied area and population

There were total 154 individuals examined for intestinal parasites; 71 (46%) were males and 83 (54%) were females (Table 1). The percentage of children aged under 15 was 28%. The majority of the males were from the >30-45 age group (34%). There were 18 (25%) males in the age group of less than 15 years old. The numbers of those in the age groups >15-30, >45-60, and >60 years old were 9 (13%), 13 (18%) and 7 (10%), respectively. Among the females examined, most were under 30 years old (60%), while females from the age groups >30-45, >45-60, and >60 years old were 12 (14%), 18 (22%) and 3 (4%) individuals, respectively.

Table 1. Numbers of the studied population classified by sex and age.

Age	Sex		Total
	Male Number(%)	Female Number(%)	Number(%)
≤ 15	18 (25)	25 (30)	43 (28)
>15-30	9 (13)	25 (30)	34 (22)
>30-45	24 (34)	12 (14)	36 (23)
>45-60	13 (18)	18 (22)	31 (20)
> 60	7 (10)	3 (4)	10 (7)
Total	71 (46)	83 (54)	154 (100)

Hookworm infection was the most common parasitic infection

Among the 154 individuals, 34% were found to harbor at least one intestinal parasite. Infections caused by hookworms were most common and were identified in 28% of the population (data not shown). Opisthorchiasis, caused by *Opisthorchis viverrini*, and Strongyloidiasis, caused by *Strongyloides stercoralis*, were recovered in 6% and 5% of the population, respectively. Ascariasis, caused by *Ascaris lumbricoides*, and enterobiasis, caused by *Enterobius vermicularis*, were each found in one case.

Intestinal parasites recovered classified by carrier sex

When classified by sex, females harbored more parasitic infections (56%) than male (44%) (Table 2). Hookworm infections were found almost equally in both males (64%) and females (71%). Strongyloidiasis was found as the 2nd most common parasite recovered in both males (18%) and females (14%). Among infected males, *Opisthorchis viverrini* was found in 18%. Among infected females, *O. viverrini*, *A. lumbricoides* and *E. vermicularis* were found in 9%, 3% and 3%, respectively.

Table 2. Types of intestinal parasites classified by sex.

Parasites	Sex		Total number (%)
	Male number (%)	Female number (%)	
Ascaris lumbricoides	0 (0)	1 (3)	1 (1.5)
Hookworm	18 (64)	25 (71)	43 (68)
Opisthorchis viverrini	5 (18)	3 (9)	8 (13)
Strongyloides stercoralis	5 (18)	5 (14)	10 (16)
Enterobius vermicularis	0 (0)	1 (3)	1 (1.5)
Total	28 (44)	35 (56)	63 (100)

Intestinal parasites classified by age

When classified by age, the highest prevalence of intestinal parasites recovered was found in the >45-60 age group (30%) (Figure 1). The highest prevalence was also found in this age group of females (37%). Among the males, the highest prevalence was found in the >30-45 age group (29%). The lowest prevalence of parasites was found in the >60 age group

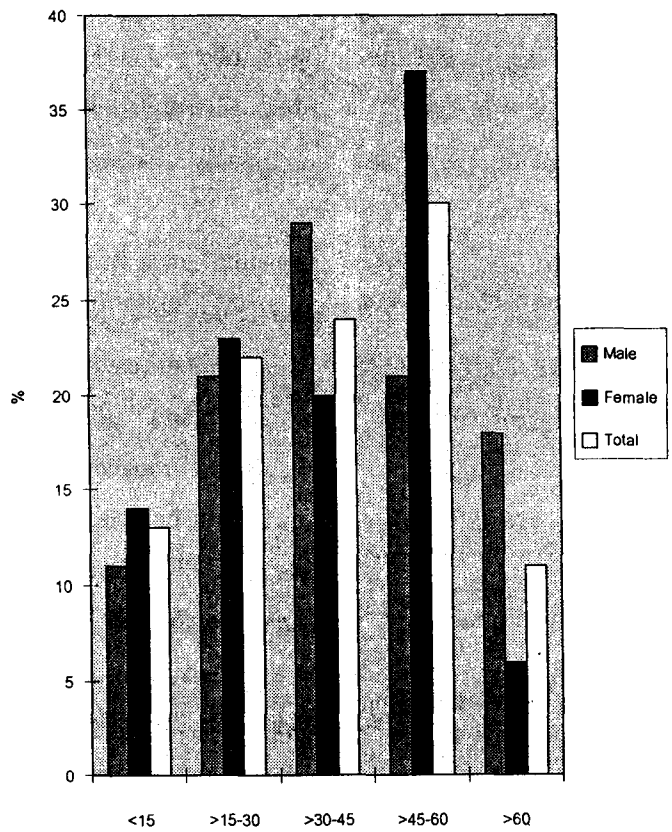

Figure 1. Prevalence of intestinal parasites classified by age.

(11%). The lowest prevalence in females was also found in this old-age group at 6%, while the lowest prevalence in males was in those aged less than 15 years old (14%).

Hookworm infections were most common in all age groups

Table 3 shows the distribution of intestinal parasitic infections classified by age and sex. Interestingly, hookworm infections were detected in most individuals in all age groups. The prevalence rate of hookworm infection was found highest among the female >45-60 age group(44%). The hookworm prevalence rate of males was highest in the >15-30 years old age group (28%). Strongyloidiasis was also found in all age groups, while opisthorchiasis was found in adults aged more than 30 years old.

In conclusion, hookworm infection was found at the highest prevalence rate, followed by strongloidiasis and opisthorchiasis.

Discussion

Infections caused by parasitic helminths affect more than 35% of the Thai population. [6] Hookworm infection is a major health problem in the south while opisthorchiasis is more prevalent in the north and northeast (Jongsuksuntigul, 1997). Infection with hookworms is the most common parasitic infection found in Thailand, followed by liver fluke infection. However, in the past the data showed that the highest prevalence of helminth infections in Northeastern Thailand was due to the liver fluke *Opisthorchis viverrini*.[3]

Table 3. Distribution of parasitic infections classified by age and sex of carrier.

	Parasites														
	As (number)			HW (number)			Ov (number)			Ss (number)			Ev (number)		
Age (years)	M	F	Total	M	F	Total	M	F	Total	M	F	Total	M	F	Total
≤ 15	0	1	1	2	2	4	0	0	0	1	1	2	0	1	1
>15-30	0	0	0	5	5	10	0	0	0	1	3	4	0	0	0
>30-45	0	0	0	4	5	9	3	1	4	1	1	2	0	0	0
>45-60	0	0	0	4	11	15	1	2	3	1	0	1	0	0	0
> 60	0	0	0	3	2	5	1	0	1	1	0	1	0	0	0
Total	0	1	1	18	25	43	5	3	8	5	5	10	0	1	1

Note : As = Ascaris lumbricoides , HW = Hookworm, Ov = Opisthorchis viverrini,
Ss = Strongyloides stercoralis, Ev = Enterobius vermicularis
M = Male, F = Female

During the past 4 decades, the prevalence of opisthorchiasis increased from 25% in 1953 to 34.6% in 1981.[3] Such a high prevalence rate of liver fluke infection encouraged the Department of Communcable Disease Control (CDC) of the Thai Ministry of Public Health to establish four liver fluke control units in the northeast located in Khon Kaen, Roi Et, Sakhon Nakhon, and Ubon Ratchathani Provinces. Subsequently, control on a region-wide scale was included in the sixth 5-year National Public Health Development Plan (1987-1991). As a result, the prevalence of liver fluke infection decreased from 34.6% in 1981 to 18.57% in 1994. The data in 1997 showed that the majority of the cases (83%) were considered to have low intensity.[3] However, moderate risk food consumption remains as high as 42%, which can potentially cause infection among a risk group population.

The National survey in 1996 at the end of the seventh 5-year plan (1992-1996) showed that liver fluke infection rate had decreased to 11.8%[1] with the highest prevalence of liver fluke infections found in the north (29.7%) followed by the northeast (12.4%) of Thailand. The prevalence of hookworm infection decreased to 21.6% with the highest prevalence (34.1%) found in the South of Thailand.

After the long-term opisthorchiasis control program, our study showed that the prevalence of liver fluke infection was low in this population of Khon Kaen Province. Our data showed that hookworm infection was the most common cause of parasitic infection in this rural region of northeastern Thailand, followed by strongyloidiasis and opisthor-chiasis. It was demonstrated that most parasitic infections were found in working age group (>15-60) (Figure 1). Hookworm infection was also common among this group (Table 3). Moreover, hookworms were identified most common in all age groups, followed by strongyloidiasis (Table 3). The routine working in fields without wearing appropriate shoes, and the lack of sanitary latrines, seems to be the major causes of both soil-transmitted parasitic infections. Hookworm infection, like strongyloidiasis, is transmitted through skin by contacting the third-infective stage larvae living in soil. The main walk of life for most Thais in rural areas is agriculture. Therefore, the combined lack of good sanitary latrines and bare foot habits, puts villagers at risk to obtain hookworm infections as well as strongyloidiasis.[4] Opisthorchiasis was recovered in adults aged >30 years old (5%), while ascariasis and enterobiasis were found in children at low prevalence rates. In this northeastern population, the liver fluke prevalence (5%) was much lower than the national prevalence (12.4%) while hookworm infection had higher prevalence rate (28%) than the national average (20%). The low prevalence rate of opisthorchiasis in this population indicated that the Opisthorchiasis Control Program was effective, and the continuing of that program is suggested. However, the high prevalence of hookworm infection compared to the national average compiled in 1996[1] suggests that the active control program should also expand to cover hookworm infections.

Hookworm infection has been one of the major diseases of mankind in warm moist climates since prehistoric times, only exceeded by malnutrition and malaria in the production of human misery and economic loss.[7] One of major health problems caused by hookworms is anemia. Hookworm anemia constitutes one-third of all global iron deficiency anemia.[8] To accurately determine the nature of anemia, careful hematological examination of the

cause of anemias in hookworm endemic areas is recommended.[5,9] Besides anemia, hookworm infections influence behavior and learning as well as problem-solving capacites.[9,10,11] Generally, any survey that focuses only on the prevalence of hookworm infection has limited value in designing a control program, since it will not respond to the real burden of the disease. To quantify the burden of hookworm infection, more comprehensive field studies are required. Hookworm anemia depends on worm load, iron reserves and iron intake, and therefore the clinical outcome develops some time after the initial heavy infection. The worm load associated with hookworm anemia differs locally depending on the species of hookworm and the age, sex, occupation and iron intake of the individual host.

Definite actions for hookworm infected cases should include anthelmintic and iron therapy, improvement of sanitation, health education and encouraging the wearing of shoes.[4,5,12] National or local campaigns are required in areas with high mortality and morbidity due to hookworm disease. However, only a few countries have hookworm control programs. Hookworm disease remains neglected in many affected countries. The World Health Organization (1987) set up 3 major objectives for control of hookworm infection and disease. These are 1) reduction of mortality due to hookworm anemia, 2) reduction of morbidity, and 3) reduction of the prevalence of hookworm infection.[13]

For Thailand, a large scale control program is necessary. According to the eighth 5-year National Public Health Development Plan (1997-2001), the focus of hookworm-infection control is in the south while for opisthorchiasis it is in the north, northeast and central portions of Thailand. The increasing prevalence of hookworm infection in this northeastern population suggests that the control program should cover all age groups in this region of Thailand in as well. For Thailand, the majority of people still conduct agriculture as their main walk of life. Soil-transmitted parasitic diseases should receive attention. The program should pay attention not just to particular parasites of a region since the neglected ones can re-emerge later. Health education on a wide scale which, requires cooperation from NGO, the press, and local leaders as well as villagers, is necessary. However, to serve this purpose, the information system to evaluate, control, and follow up the control-program activities and local health units needs to be improved.[1]

Besides the above mentioned program, environmental interventions appropriate to hookworm control are necessary and they are extremely simple.[14] Humanity has built toilets for the sanitary disposal of excreta for thousands of years. However, it is still an innovative challenge to select and adapt the available technology for those people who need it most, and in finding the ways to promote its widespread use. Those who suffer from hookworm disease are generally poor people in developing countires, and who cannot afford the expensive sewered sanitation systems of the industralized world. Most of them live in rural areas, and may not even see the point to own and use toilet. However, the options for low-cost sanitation technology have been considered as well as some issues regarding the implementation of sanitation and other eneviron-mental interventions for hookworm control.[14]

To control hookworm, as well as other parasitic infections, active health education activities and treat-ment need to continuously be carried out with effective

strategies. Furthermore, to strengthen the national program, planning, monitoring and supervision for all operational elements has to be seriously considered.[3]

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