Home Healthcare Program for Soil-Transmitted Helminthiasis in Schoolchildren along the Mekong River Basin

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Background: *Soil-transmitted helminths (STH) are among the most important groups of infectious agents responsible for physical and intellectual growth retardation in children worldwide. Current status is need required for the development of control programs.*
Objective: *To determine the STH infections among the schoolchildren in the Mekong River basin near rural Ubon Ratchathani, Thailand and Champassak, Laos PDR, including their caregiver's knowledge and attitude concerning prevention of STH infections.*
Material and Method: *A cross sectional survey was designed as a home healthcare program from October 2009 to April 2012. 1,957 fecal samples were collected from children aged 5-12 years in five districts of Ubon Ratchathani province (1,012 fecal samples; Khong Chiam, Si Mueang Mai, Phibun Mangsahan, Sirindhorn, and Pho Sai), Thailand, and one district of Champassak Province (945 fecal samples; Pakse), Lao PDR. Fecal samples were prepared by the modified formalin ethyl-acetate concentration technique, and determined by light microscope. The knowledge and attitude of children's caregivers concerning prevention of soil-transmitted helminth infections were completed interviewed by semi-structured questionnaires.*
Results: *The overall intestinal helminth prevalence rate was 11.88%. Classified by species the STHs were as follows: Ascaris lumbricoides (30.9%), Trichuris trichiura (21.7%), and hookworm (20.5%). The highest prevalence was recorded in children aged 9 years and above. The highest prevalence of STH infection was found in the Pakse district of Laos PDR (16.08%). The intensities of infection with A. lumbricoides, T. trichiura, and Hookworm were 1.82±0.36, 1.32±0.30, and 1.29±0.32, respectively. 1,077 of caregivers were completed interviewed and found that the caregivers had fair levels of knowledge and attitude regarding soil-transmitted helminthiasis.*
Conclusions: *These results suggest that priority should be given to STH eradication, the development of control programs in the Mekong River Basin, and the provision of education about STH to caregivers to reduce the risk of STH infection in their schoolchildren.*

Keywords: *Soil-transmitted helminthiases, Schoolchildren, Mekong River basin*

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Soil-transmitted helminths (STH) are among the most important groups of infectious agents responsible for physical and intellectual growth retardation in children worldwide[1]. Children living in poverty are vulnerable to repeated infections by multiple STHs, which significantly impacts educational attainment and future economic productivity[1-3]. Four species of soil-transmitted helminths, the hookworms (*Ancylostoma duodenale* and *Necator americanus*), *Ascaris lumbricoides*, and *Trichuris trichiura* are responsible for most STH infections[4]. STHs are more important among children and in poor or malnourished populations in influencing morbidity and mortality. It has been speculated that 15% of host populations harbor 70% of STH worm burdens[5]. Inadequate hygiene, poor health care systems and facilities, social

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indifference, social instability, civil war, and natural disasters make these situations worse. STH and poverty are intimately linked in a vicious cycle in most developing countries. The DALY (disability-adjusted life year) score of STH is around 4.65 million worldwide[6]. However, priority for STH control is often neglected even in wormy countries. A high prevalence of STH, combined with poor hygiene and malnutrition, foretells future problems in burdened countries and suggests that priority should be given to the eradication of STHs worldwide. In this context, the World Health Assembly agreed to a strong recommendation for developing countries to conduct STH control programs in 2001[7].

In Southeast Asia prevalence data can provide valuable information for nationwide, school-based prevention and treatment programs[2]. Because there is a lack of data on STHs along the Mekong River Basin, especially in the rural communities of Thailand and Laos, this home healthcare program was conducted to determine the prevalence of soil-transmitted helminthic infections among schoolchildren in rural areas of Ubon Ratchathani, Thailand and Champassak, Laos PDR in the Mekong River basin, and also to assess the knowledge and attitudes of children's caregivers concerning prevention of soil-transmitted helminth infections.

Material and Method

Study areas and study population

A home healthcare program was designed as a cross sectional survey. The study was carried out from October 2009 to April 2012, in the Ubon Ratchathani province which is 630 km northeast of Bangkok, Thailand and the Champassak province, Lao People's Democratic Republic; both of these provinces are located along the Mekong River basin. The populations of this study are closely related and have historically immigrated between the 2 counties for socio-economic and health care reasons. Primary schools from both countries were selected: 40 primary schools in Thailand and 10 primary schools in Lao PDR. The study protocol was approved by the Ubon Ratchathani University Review Committee (2008).

Subjects

Before the start of the study, permission and collaboration of the head of each public health center and/or sub-district was obtained. In cooperation with local health workers we dealt directly with the community leaders who assisted us in maximizing community participation. A Laotian translator was also used. Primary schools from both countries were selected by probability proportionate to size cluster sampling including 40 clusters (20 cases/cluster). 40 primary schools in Thailand and 10 primary schools in Lao PDR, with 1957 fecal samples (1,012 fecal samples; Khong Chiam, Si Mueang Mai, Phibun Mangsahan, Sirindhorn, and Pho Sai), Thailand, and one district of Champassak Province (945 fecal samples; Pakse), Lao PDR were collected.

The sample group was drawn from children between the ages of 5 and 12 years who attended these primary schools. Verbal informed consent was obtained from each child's parents. The schoolchildren had to carry the questionnaire to their parents or caregivers to be filled out. Questionnaires emphasizing their knowledge and attitudes concerning STH disease, transmission, signs and symptoms, and prevention and control were collected and filled out by the parents or caregivers at their homes. All questions related to knowledge and attitudes were true-false and checklist questions, respectively.

Stool examination

Simple smear and the modified formalin-ethyl acetate concentration technique (FEACT) were performed. Specimens were collected by well-trained research assistants. The stool samples were kept at room temperatures overnight (for checking *Strongyloides* sp. and hookworm) at the Research and Diagnostic Center for Parasitic Disease, College of Medicine and public Health, Ubon Ratchathani University, Thailand, and the Parasitic Disease Research Unit, Suranaree University of Technology, Nakhon Ratchasima, Thailand. To obtain quantitative data, the FEACT technique was used to examine for parasitic infections. Briefly, 2 grams of stool were measured and transferred into a centrifuge tube (15 cc). The stool was fixed with 10 ml of 10% formalin buffer and then the mixture was filtered by passing through 2 layers of grazes. The mixture was centrifuged at 1,500 rpm at room temperature for 2 minutes, the supernatant was discarded and then the remaining pellet was solubilised with 6-7 mL of normal saline and 3 mL ethyl-acetate were added. The mixture was shaken well and then centrifuged with the same rpm above. The mixture was thus separated into 3 levels: upper, middle, and lower which were composed of ethyl-acetate, fat, and pellet (parasitic egg was mixed in this level), respectively. The fat level was aspirated with a speculum and then gently discard all soluble. The pellet

was then dissolved with 1-2 ml of 10% formalin buffer and the number of solute drops counted using pasture pipette and recorded (this is used to calculate epg). 1 drop was then used to examine for helminths by parasitologists.

Data analysis

The intensity of infection was classified according to the number of eggs per gram (EPG). Overall and specific prevalence rates were calculated using the formula [(number of infection)/(number of total cases)] x 100. Data from questionnaires were analyzed using a computer program. Knowledge variables were summed up into a composite score and ranked as poor, fair and good scores with a range of less than 5, 6-15, and more than 15 of 20 points, respectively. Attitude questions were structured in a 3 point scale with responses comprising poor, fair and good scores with a range of less than 5, 6-15, and more than 15 of 20 points, respectively.

Results

The overall response rate was 95.84%. In total responses and fecal samples from 1,957 schoolchildren, ages ranging from 5 to 12, were collected from the five districts of Ubon Ratchathani province (1,012 fecal samples; Khong Chiam, Si Mueang Mai, Phibun Mangsahan, Sirindhorn, and Pho Sai), Thailand, and one district of Champassak province (945 fecal samples; Pakse), Lao PDR, with a majority in the 10-12 years-old group; 56% were male and 44% were female (Table 1). Overall, the intestinal helminth prevalence rate was 11.88%, divided by species for STHs as follows: *Ascaris lumbricoides* (30.9%), *Trichuris trichiura* (21.7%), *hookworm* (20.5%). For other intestinal helminths, the rates were as follows: *Strongyloides stercoralis* 13.2%, *Opisthorchis viverrini* 8.9%, *Taenia* spp. 4.6% and *Hymenolepis* spp. 0.2%, respectively. The lowest prevalence was recorded in the 5-8 years-old age group, and the highest prevalence was recorded in children aged 9 years and above. Thus the prevalence of STHs rose with increasing age. 12.96% of males tested positive for infection compared to 10.57% of females. The most common mixed infection was *A. lumbricoides* with *T. trichiura* (6.51% of infected samples) and 3.59% of infected samples were mixed infections of all three: *A. lumbricoides, T. trichiura,* and *Hookworm*. The intensities of *A. lumbricoides*, *T. trichiura,* and *Hookworm* were 1.82$\pm$0.36, 1.32$\pm$0.30, and 1.29$\pm$0.32, respectively (Table 2). The highest prevalence of STH infection was found in the Pakse district of Laos PDR (16.08%) and the lowest in the Si Mueang Mai district of Thailand (6.2%) (Table2).

Table 1. The prevalence of intestinal helminthic infection in school children in the Mekong River basin, classified by sex, age, and place

Characteristic	No. of samples (infection)	Prevalence
Sex	1,957 (233)	11.88
Male	1,096 (142)	12.96
Female	861 (91)	10.57
Age (years old)	1,957 (233)	11.88
5	12 (1)	8.33
6	36 (3)	8.33
7	211 (12)	5.69
8	292 (25)	8.56
9	282 (54)	19.15
10	435 (49)	11.26
11	341 (45)	13.20
12	347 (44)	12.68
Place	1,957 (233)	11.88
Laos PDR	945	
Pakse	945 (152)	16.08
Thailand	1,012	
Khong Chiam	191 (15)	7.85
Pho Sai	185 (17)	9.19
Phibun Mangsahan	236 (21)	8.90
Sirindhorn	200 (16)	8.00
Si Mueang Mai	190 (12)	6.32

The overall response rate of completed the questionnaire was 53.85% (1,077 caregivers). Caregivers ages ranged from 15 to above 60 years-old with the majority in the 21-30 years-old group (37.23%). 78.46% of caregivers were female and 30.83% were male. The most common occupation was farmer (56.92%) and the most common knowledge skill level was the ability read and writes at the primary school level (52.37%) (Table 3).

The questionnaire revealed that informational resources available to the caregivers on soil transmitted helminthiasis included public health personnel (42.34%), television (20.33%), the health care centre (18.20%), the head of the sub-district (13.28%), and newspapers (5.85%) (Table 4).

Of the caregivers, 59.6% had a fair level of knowledge on soil-transmitted helminthiasis. A good level of knowledge was found about soil-transmitted helminthiasis prevention and control. A poor level was found about the soil-transmitted helminthiasis disease, transmission, signs and symptoms. Generally, the

Table 2. The prevalence rates and intensities of STH and other helminth infections in schoolchildren classified by sex, age, and place

Intestinal infection	Overall prevalence (%)	Mean EPG ± SE
Overall infection	233 (11.88)	
STH		
A. lumbricoides	71 (30.90)	1.82±0.36
T. trichiura	50 (21.70)	1.32±0.30
Hookworm	48 (20.50)	1.29±0.32
Mixed infection of STH		
A. lumbricoides + T. trichiura + Hookworm	6 (3.59)	1.45±0.31
A. lumbricoides + T. trichiura	11 (6.51)	1.57±0.33
A. lumbricoides + Hookworm	9 (5.32)	1.56±0.34
T. trichiura + Hookworm	8 (4.73)	1.31±0.31
Other infections		
S. stercoralis	31 (13.20)	0.71±0.19
O. viverrini	21 (8.90)	0.63±0.11
Taenia sp.	11 (4.60)	0.60±0.24
Hymenolepis sp.	1 (0.20)	0.23±0.13

Table 3. Classification of caregiver characteristics in the Mekong River Basin by sex, age, and place

Characteristic	n	%
Sex		
Male	332	30.83
Female	845	78.46
Age		
15-20	127	11.79
21-30	401	37.23
31-40	166	15.41
41-50	129	11.98
51-60	133	12.35
>60	121	11.23
Occupation		
Farmer	613	56.92
Trader	54	5.01
Housewife	314	29.16
Employee	47	4.36
Other	49	4.55
Knowledge skill		
Illiterate	467	43.36
Can read and write primary	564	52.37
Middle and high	46	4.27

Table 4. Caregiver information resources about soil-transmitted helminthiasis

Information resources	n	%
Head of sub-district	143	13.28
Health care canter	196	18.20
Public health personnel	456	42.34
Television	219	20.33
Newspaper	63	5.85
Internet	-	-
Others	-	-
Total	1,077	100

majority of the caregivers studied had a fair attitude (55.15%) towards soil-transmitted helminthiasis. A good attitude was found concerning soil-transmitted helminthiasis prevention and control. A poor level was found concerning soil-transmitted helminthiasis disease, transmission, signs and symptoms (Table 5).

Discussion

STHs have been recognized as a public health problem in Thailand and Lao PDR. STH are more important among children and in poor or malnourished populations in terms of morbidity and mortality. It has been speculated that 15% of host populations harbour 70% of STH worm burdens[8]. Inadequate hygiene, poor health care systems and facilities, social indifference, social instability, civil war, and natural disasters make situations worse. STH and poverty are intimately linked in a vicious cycle in most developing countries. The DALY (disability-adjusted life year) score of STH is around 4.65 million worldwide[9]. However, the priority of STH control is often neglected even in wormy

Table 5. Knowledge and attitude level of the caregiver about disease, transmission, prevention and control of soil-transmitted helminthiasis

Level	n	%
Knowledge		
Good	177	16.43
Fair	594	55.15
Poor	306	28.41
Attitude		
Good	89	8.26
Fair	777	72.14
Poor	211	19.59

countries. A high prevalence of STH combined with poor hygiene and malnutrition foretells future problems in affected countries, and suggests that priority should be given to eradicate STH worldwide. In this context, the World Health Assembly agreed to a strong recommendation for developing countries to conduct STH control programs in 2001[9]. STHs are among the most important groups of infectious agents responsible for physical and intellectual growth retardation in children worldwide. Consistent with the prevalence literature, the most common infectious agents in this study were the STHs; *A. lumbricoides, T. trichiura,* and *hookworm*[1,2,8-10]. In Thailand, school-based helminthiases control programs were constructed for a long time in some rural areas[11,12]. Nerveless, there was lack of STH data in the Mekong River Basin on the Thailand Laos border, therefore we purposed to survey the STH infections in this areas.

Our study confirms that STH infection rates were higher in older children. This may reflect behavioural differences by age and/or the accumulation of infection over time. The intestinal helminth prevalence rate was 11.88%, with stool samples containing *A. lumbricoides*, *T. trichiura*, *hookworm*, *S. stercoralis*, *O. viverrini*, *Taenia* spp. and *Hymenolepis* spp. This figure demonstrates that STHs are still a problem with rates similar to that found by other researchers. Rim et al[13] reported the prevalence of intestinal parasite infections on a national scale among primary schoolchildren in Laos. The infections found were *A. lumbricoidess*, *Hookworm*, *T. trichiura*, *O. viverrini*, *Taenia* spp. and *Hymenolepis* spp. Moreover, Sayasone et al[15] have investigated multiparasitism in the Mekong River basin. They assessed helminth (trematode, nematode, and cestode), and intestinal protozoa infections, and multiparasitism in random population samples from three different eco-epidemiological settings in the Champasack province, southern Lao People's Democratic Republic, and determined underlying risk factors. In their study of nematode infections hookworm was the most prevalent species followed by *A. lumbricoides* and *T. trichiura.* Regarding trematodes, *O. viverrini* and *Schistosoma mekongi* infections were also found in the participants. Infections with intestinal protozoa were rare. In Thailand Tungtronchitr et al[17] collected 479 stool specimens from rural communities in Ubon Ratchathani province and found *O. viverrini*, hookworm, *Taenia* spp, *S. stercoralis*, *A. lumbricoides*, The lowest prevalence of STH was recorded in the 5-8 years-old age group, and the highest prevalence was recorded in children aged 9 years and above. The prevalence of STHs rose with age. Montresor et al[18] reviewed large-scale preventive chemotherapy for helminth control in Western Pacific countries and found that STHs are still a problem in Mekong areas especially in the schoolchildren of Laos PDR and Cambodia. Mixed infections of STHs were found in the studied area with the most common mixed infection being *A. lumbricoides* with *T. trichiura*. Their results also showed the lowest intensities of *A. lumbricoides*, *T. trichiura*, and *Hookworm*, respectively. Our study results were similar to Sayasone et al[15] which assessed multiparasitism in Champasack province, southern Lao PDR. They also found mixed infections including hookworm, *A. lumbricoides* and *T. trichiura*, and other known parasites such as *O. viverrini*. Present study showed that of all areas studied the prevalence of STH was highest in the Pakse district of Laos PDR and the lowest in the Si Mueang Mai district of Thailand. Our results showed that priority should be given to the eradication of STH and contribution to STH control programs in the Mekong River Basin. This finding is related to previous studies[13,15] and suggests that populations should be surveyed and explored yearly. Caregivers completed the questionnaires that measured their knowledge and attitude toward STH disease, transmission, sign, symptom, prevention and control. In regards to age, the majority of caregivers were in the 21-30 years-old group. Most of them were female and were farmers who could read and write at the primary school level. The sources of STH information were public health personnel, television, health care centres, heads of the sub-districts, and newspapers. This indicates that public health personnel have been the most important source of knowledge and may indicate how best to plan health education campaigns for

improvement of caregiver knowledge in the future. These results are also similar to previous studies showing that public health personnel were the most influential educational factor for the eradication of STH and other parasitic diseases[13]. In our study the caregivers' had a fair level of knowledge about STH. In the details of their knowledge, a good level was found about prevention and control while a poor level was found about the disease, transmission, signs and symptoms. The majority of caregivers were farmers and had a primary school reading level in the studied areas of Ubon Ratchathani, Thailand and Champasak, Laos PDR. This finding raises the possibility of a relationship between knowledge on STH disease and a low level of education.

Moreover, the majority of the caregivers had a fair attitude towards STH. A good attitude was also found concerning STH prevention and control and a poor level was found concerning the disease, transmission, signs and symptoms. This poor knowledge and attitude level correlated to STH infection in both districts. This finding is similar to Kaewpitoon et al[10] and Sayasone et al[15] that a poor level of knowledge and attitude correlated to parasitic infection and suggested that further education of caregivers is required to reduce the risk of STH infection in their schoolchildren

Conclusion

Present study results show that STHs are still a major health problem in schoolchildren in the Mekong River Basin and also suggest that priority be given to STH eradicate and the development of STH control programs in that area, moreover, that caregivers require further health education to reduce the risk of STH infection in their schoolchildren.

What is already known on this topic ?

The most common infectious agents in this study were the STHs; *A. lumbricoides*, *T. trichiura*, and *hookworm*[1,2,8-10]. In Thailand, school-based helminthiases control programs were constructed for a long time in some rural areas[11,12]. Nerveless, there was lack of STH data in the Mekong River Basin on the Thailand Laos border.

What this study adds ?

Present study results show that STHs are still a major health problem in schoolchildren in the Mekong River Basin. the priority be given to STH eradicate and the development of STH control programs in that area, moreover, that caregivers require further health education to reduce the risk of STH infection in their schoolchildren.

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Potential conflicts of interest

None.

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โปรแกรมการดูแลสุขภาพที่บ้านสำหรับโรคพยาธิที่ติดจากดินในเด็กวัยเรียนพื้นที่ลุ่มแม่น้ำโขง

สรญา แก้วพิทูลย์, ไรอัน เอ ลอยด์, ณัฏฐวุฒิ แก้วพิทูลย์

ภูมิหลัง: โรคหนอนพยาธิที่ติดต่อผ่านดิน เป็นปัญหาที่สำคัญส่งผลต่อการเจริญเติบโตทั้งทางกายภาพและทางสติปัญญาของเด็กทั่วโลก

วัตถุประสงค์: งานวิจัยเชิงพรรณนาแบบภาคตัดขวางนี้มุ่งศึกษาปัญหาของการติดเชื้อโรคหนอนพยาธิที่ติดต่อผ่านดินในเด็กวัยเรียนและผู้ดูแลโดยใช้โปรแกรมการดูแลสุขภาพที่บ้านในพื้นที่ลุ่มน้ำแม่โขง ตามชนบทของจังหวัดอุบลราชธานีของประเทศไทยและแขวงจำปาสัก ประเทศลาว

วัสดุและวิธีการ: เก็บตัวอย่างอุจจาระของนักเรียนอายุ 5-12 ปี จำนวน 1,957 ราย จาก 5 อำเภอในจังหวัดอุบลราชธานี ประเทศไทย (1,012 ราย จากอำเภอโขงเจียม ศรีเมืองใหม่ พิบูลมังสาหาร สิรินธร และโพธิ์ตาล) และ 1 อำเภอในแขวงจำปาสัก ประเทศลาว (ปากเซ จำนวน 945 ราย) เก็บตัวอย่างตั้งแต่เดือนตุลาคม พ.ศ. 2552 ถึงมิถุนายน พ.ศ. 2555 ตัวอย่างอุจจาระเตรียมด้วยวิธีเข้มข้นชนิด formalin ethyl-acetate และตรวจด้วยกล้องจุลทรรศน์แบบธรรมดา ความรู้และทัศนคติของพี่เลี้ยงเด็กต่อการป้องกันโรคหนอนพยาธิที่ติดต่อผ่านดินเก็บข้อมูลด้วยแบบสัมภาษณ์

ผลการศึกษา: ความชุกหนอนพยาธิในลำไส้ 11.88% แบ่งออกเป็นโรคหนอนพยาธิที่ติดต่อผ่านดินชนิดต่างๆ ดังนี้ พยาธิไส้เดือน (30.9%) แส้ม้า (21.7%) ปากขอ (20.5%) พบความชุกสูงในกลุ่มอายุ 9 ปีขึ้นไป พบมากในอำเภอปากเซ ประเทศลาว (16.08%) ความหนาแน่นของพยาธิไส้เดือน แส้ม้า และเข็มหมุดเท่ากับ 1.82±0.36, 1.32±0.30 และ 1.29±0.32 ตามลำดับ ผลการสัมภาษณ์ผู้ดูแลเด็กวัยเรียนจำนวน 1,077 ราย พบว่ามีความรู้และทัศนคติเกี่ยวกับการโรคหนอนพยาธิที่ติดต่อผ่านดินอยู่ระดับปานกลาง

สรุป: ผลการศึกษาชี้ให้เห็นว่าลำดับแรกควรกำจัดโรคหนอนพยาธิที่ติดต่อผ่านดิน พัฒนาโปรแกรมควบคุมในพื้นที่ลุ่มแม่น้ำโขงและให้สุขศึกษาแก่ผู้ดูแลเด็กเพื่อลดความเสี่ยงต่อการติดเชื้อหนอนพยาธิที่ติดต่อผ่านดินในเด็กวัยเรียน