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Prevalence and risk factors of intestinal parasitic infections among hill tribe schoolchildren, Northern Thailand

Tawatchai Apidechkul*

School of Health Science, Mae Fah Luang University, Muang District, Chiang Rai 57100, Thailand

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ABSTRACT

Objective: To study the prevalence and risk factors of intestinal parasitic infections among hill tribe schoolchildren who attended 10 border patrol police schools in 2012, Chiang Rai, Thailand.
Methods: A total of 339 subjects were recruited into the study from 2 194 children. Questionnaire was tested for validity and reliability before use. About 5 g stool specimens were collected and investigated for intestinal parasite infections by using cellophane-covered thick smear technique. Logistic regression at $\alpha = 0.05$ was used to test the associations between variables to find risk factors.
Results: There were 339 subjects of whom 51.9% were males and 66.1% were Buddhist; racially 31.2% were Akha and 30.4% were Kmong; mean age was 10.3 years old (minimum = 6, maximum = 16). The prevalence of parasitic infection was 9.7%. After controlling for age, sex, religion, parents' education levels and parents' occupations, the only factor that showed a statistically significant association with intestinal parasitic infection was the source of drinking water. The group of drinking mountain piped water had a greater risk of 8.22 times (adjusted odds ratio = 8.22, 95%; confidence interval: 1.07–63.18) compared to the drinking commercially bottled water group, while the group of drinking underground water had a greater risk of 9.83 times (adjusted odds ratio = 9.83, 95%; confidence interval: 0.93–104.12) compared to the drinking commercially bottled water group.
Conclusions: Drinking water contaminated by soil was shown to be an important risk factor for intestinal parasitic infection in hill tribe schoolchildren living in mountainous border areas in the northern part of Thailand. Safer alternative drinking water source should be provided along with health education for schools and villagers to be aware of the risk of intestinal parasites from drinking water sources such as mountain piped or underground wells. Such sources are likely to contain higher soil contents.

1. Introduction

Soil-transmitted helminth infections are among the most common infections worldwide and affect the poorest and most deprived communities particularly among children in developing countries[1]. The main species that infect people are the roundworm [*Ascaris lumbricoides* (*A. lumbricoides*)], whipworm (*Trichuris trichiura*) and hookworms (*Necator americanus* and *Ancylostoma duodenale*) [2]. In 2012, World Health Organization reported that almost 2 billion people were infected with these parasites. The highest prevalence occurs in areas where sanitation is inadequate and water supplies are unsafe and at least 75% and up to 100% of all school-age children are at risk of morbidity from the disease[3].

The burden of disease from soil-transmitted helminth is mainly attributed to their chronic and insidious impact on the health and quality of life of those infected people rather than to the mortality they cause. Infections of heavy intensity impair physical growth and cognitive development and are a cause of micronutrient deficiencies including iron-deficiency anaemia leading to poor school performance and absenteeism in children, reduced work productivity in adults and adverse pregnancy outcomes[4].

There are six main groups of hill tribes in Thailand: Lahu, Akha, Lisu, Karen, Yao, and Hmong[5]. They have migrated from the south of China to Thailand over the last several decades. Approximately 800 000 people were living in Thailand in 2013[6]. Each group

*Corresponding author: Dr. Tawatchai Apidechkul, School of Health Science, Mae Fah Luang University, Muang District, Chiang Rai 57100, Thailand.
Tel: +66 053 916826
E-mails: tk2516ms@gmail.com, Tawatchai.api@mfu.ac.th
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has their own language, culture and beliefs which are different from those of Thai indigenous people. Most of them live in the mountainous border areas in 16 northern provinces of Thailand. In 2012, there were 180 214 people living in 652 villages in Chiang Rai Province[5]. Their villages are in remote areas far from the city with health service facilities and approximately 35 km away with poor road access and public transport[7]. Many of them do not qualify for, or have failed to obtain, a Thai ID card which generally is required for free or subsidized by government medical and educational services. Most hill tribe people work in low-paid manual jobs. They have limited opportunity to have access to afford healthcare or receive health information. They are a population vulnerable to many infectious diseases particularly among young children[8]. Many still lack basic rights such as the rights of land use, ready access to the justice system, education and health care services[7].

In very remote areas, the Border Patrol Police Department of the Royal Thai Police sponsored the village schools and provided qualified teachers for them[9,10]. In 2013, there were 172 schools under the Border Patrol Police Department[9]. In 2014, approximately 100 000 hill tribe children were studying in schools[6].

This study aimed to investigate the prevalence and risk factors of intestinal parasite infection among young hill tribe children who were attending 10 border patrol police primary schools in Chiang Rai Province. There is no record of a previously similar study.

2. Materials and methods

2.1. Study design

A cross-sectional study design was used to find the prevalence of intestinal parasite infection. Infection was identified by stool microscopy for parasites and eggs at Mae Chan Hospital Medical Laboratory. Questionnaires were administered by face-to-face interview and analyzed for associations between the presence of parasitic infection and possible risk factors. Statistics used to identify the associations was unconditional logistic regression.

2.2. Study sites

Study sites were 10 primary schools under the Border Patrol Police Department in Chiang Rai Province. They were Ar Chee Wa Chiang Rai Border Patrol Police School, Dan Cha Nut Pi Ya Aui Border Patrol Police School, Som Ta Win Chin Ta Mai Border Patrol Police School, Na To Border Patrol Police School, Chao Paw Luang U-Patum 3 Border Patrol Police School, Technique Du Sit Border Patrol Police School, Sri Som Wong Border Patrol Police School, Bam Rung no. 87 Border Patrol Police School, San Wang Vit 8 Border Patrol Police School and Bam Rung no.112 Border Patrol Police School.

2.3. Study population

The study population was 2 194 students of primary school, grade one to grade six, who were attending 10 above named Border Patrol Police schools, in the academic year 2012.

2.4. Sample size and sampling technique

Sample size was calculated by the Epi-Info, version 6.04d (US Centers for Disease Control and Prevention, Atlanta, GA). Rate of infection was estimated based on the previous study of Nuchprayoon *et al*. who found parasitic infection prevalence among Myanmar migrant workers to be 62.3% at 95% confidence intervals (*CI*) and 80% power of test, in a population of 1 848 persons[11]. Our calculated sample size plus 10% for errors was 370. Subjects who were unable to speak Thai, or could not provide stool specimen were excluded from the study.

2.5. Research instruments

The research instruments were a questionnaire and a stool sample (5 mL). The questionnaire had three parts: general information, risk behavior profile and questions on subject's knowledge, attitude and practice on the prevention of intestinal parasitic infection. The subject's knowledge, attitude and practice part consisted of 20 questions on the prevention of intestinal parasitic infection which was suitable for students' grade 4–6. Three external experts tested the questions for content validity according to the item objective congruence index technique. The questionnaire was also tested before use for validity and reliability in a group of subjects of similar characteristics. The cutoff point was set at 70% of correct answers as a good score for knowledge, attitude, and practice. Five grams of stool was obtained in the morning and transferred under cold chain conditions. The specimens were tested by the Kato's thick smear technique at Mae Chan Hospital.

2.6. Data collection procedure

Permission for the study was obtained from the 10 school directors. Teachers who were responsible for school health were asked to manage the appointments. Simple random sampling technique was applied for recruiting subjects from a complete list of all students from the 10 schools. If a selected child was not in school for interview, the next child on the list would be chosen instead. Selected students were asked if they would volunteer to be subjects in the study. Project information was explained by the researcher to all subjects and school staff. Participating students took the consent forms back to home to sign (or fingerprint) by their parents or guardians if permission for their children to participate was given. After getting the completed consent form back, the questionnaire was administered by face-to-face interviewing method in a private room. At the end of the interview, each subject was instructed on how to collect 5 g of stool into a small specimen container provided for them. Students handed the stool specimens in the next morning to a responsible health teacher who stored them in a provided ice-pack box to be transported to the laboratory. Only subjects who had completed both questionnaire and stool collection were included into the analysis.

2.7. Data management and data analysis

Data were double entered and validated using Microsoft Excel. Data analyses were performed using SPSS (version 11.5; 2006 SPSS, Chicago, Illinois), Stata (version 8.2; Stata Corp, College Station, TX) and Epi-Info (version 6.04d; US Centers for Disease Control and Prevention, Atlanta, GA). All the data were secured with a specific password accessible only by the researchers.

2.8. Descriptive statistics

Frequency, percentage, mean, and SD were used to explain the characteristics of the subjects.

2.9. Inferential statistics

The unconditional logistic regression was performed to explain the associations between the independent variables and dependent variable. Univariate analysis of associations was determined at $\alpha = 0.10$. Multiple logistic regression was used to find associations between a group of independent variables and a dependent variable, controlling for possible confounding factors at $\alpha = 0.05$. Odds ratio (OR) and adjusted odds ratio (OR_{adj}) and their 95% *CI* were calculated.

2.10. Ethical considerations

All study forms and procedures were approved by the Committee for the Protection of Human Subjects of Mae Fah Luang University, Thailand. Consent for every subject participation was obtained from their parents or guardians.

3. Results

A total of 339 subjects from 10 schools were recruited into the study. Most subjects were in the 1st grade (18.6%), followed by the 3rd grade (17.7%) and 5th grade (17.1%). A total of 176 were male (51.9%) and the mean age was 10.3 with maximum age of 16, and minimum of 6. According to the living areas of the students, 15 subjects (4.4%) lived in Muang District, 208 (61.4%) in Mae Fah Luang District, 73 (21.5%) in Wiang Ken District and 43 (12.7%) in Chiang Khon District. A total of 42 subjects (12.4%) out of 231 students were recruited from Ar Chee Wa Chiang Rai Border Patrol Police School, 48 (14.2%) out of 190 from Dan Cha Nut Pi Ya Aui Border Patrol Police School, 25 (7.4%) out of 127 from Som Ta Win Chin Ta Mai Border Patrol Police School, 44 (13.0%) out of 299 from Na To Border Patrol Police School, 80 (23.6%) out of 495 from Chao Paw Luang U-Patum 3 Border Patrol Police School, 16 (4.7%) out of 82 from Technique Du Sit Border Patrol Police School, 17 (5%) out of 83 from Sri Som Wong Border Patrol Police School, 17 (5%) out of 82 from Bam Rung no. 87 Border Patrol Police School, 16 (4.7%) out of 80 from San Wang Vit 8 Border Patrol Police School, and 34 (10%) out of 179 from Bam Rung no. 112 Border Patrol Police School.

One hundred and nine subjects (32.2%) were Akha, 30.4% were Kmong and 13.6% were Lahu. Two hundred and twenty-four subjects (66.1%) were Buddhist and 33.9% were Christian. Two hundred and thirteen subjects (62.8%) had family members of 5–8 persons, 21.5% of ⩽ 4 persons. Thirty-seven subjects (10.9%) had medical conditions and 54.6% had body mass index score ⩽ 18.50.

Two hundred and eighty-one subjects (82.9%) had both father and mother and lived together and 8.0% had a single parent. Two hundred and four subjects (61.1%) parents' occupation were farmer, followed by employee (15.4%). Regarding parents' education: 82.6% of fathers were illiterate and 93.4% of mothers were illiterate. One hundred and twenty-three subjects (36.3%) family income were 10 000 baht per year and 9.7% family income were 15 000–20 000 baht per year.

Table 1

Univariate analysis of risk factors of parasite infection among the subjects.

Factors		*n*	Results		OR	90% *CI*
			Positive	Negative		
Sex	Male	176	20 (11.4)	156 (88.6)	1.00	0.37–1.25
	Female	163	12 (7.4)	151 (92.6)	0.68	
Age (years old)	⩽ 8	85	6 (7.1)	79 (92.9)	1.00	
	9–11	143	17 (11.9)	126 (88.1)	1.89	0.84–4.27
	⩾ 12	111	9 (8.1)	102 (91.9)	1.16	0.47–2.86
Level of education	1st grade	63	10 (15.9)	53 (84.3)	1.00	
	2nd grade	49	4 (8.2)	45 (91.8)	0.6	0.23–1.58
	3rd grade	60	4 (6.7)	56 (93.3)	0.38	1.34–1.05
	4th grade	57	5 (8.7)	52 (91.3)	0.51	0.19–1.33
	5th grade	58	2 (3.5)	56 (96.5)	0.19	0.05–0.70*
	6th grade	52	7 (13.5)	45 (86.5)	0.82	0.34–1.98
Student characteristics	Boarding students	57	8 (14.1)	49 (85.9)	1.00	
	Non-boarding students	282	24 (8.5)	258 (91.5)	0.49	0.25–0.99*
Religion	Buddhist	224	19 (8.5)	205 (91.5)	1.00	
	Christian	115	13 (11.3)	102 (88.7)	1.49	0.81–2.76
Parent relationships	Live with parents	281	28 (9.9)	53 (90.1)	1.00	
	Other	58	4 (6.9)	54 (93.1)	0.65	0.26–1.60
Family member	⩽ 4	73	4 (5.5)	69 (94.5)	1.00	
	5–8	213	25 (11.7)	188 (88.1)	2.29	0.92–5.73
	⩾ 9	43	1 (2.3)	42 (97.7)	0.84	0.19–3.63
	Missing	10	2 (20.0)	8 (80.0)	4.31	0.91–20.35
Family income (baht)	10 000	123	14 (11.4)	109 (88.6)	1.60	0.81–3.19
	10 001–15 000	32	3 (9.4)	29 (90.6)	1.19	0.39–3.67
	15 001–20 000	33	2 (6.1)	31 (93.9)	0.75	0.20–2.75
	20 001	13	2 (15.4)	11 (84.6)	2.09	0.54–8.23
	Unknown	138	11 (7.9)	127 (92.1)	1.00	
Source of drinking water	Mountain piped water	255	28 (10.9)	227 (89.1)	7.69	1.45–43.09*
	Underground water	21	3 (14.3)	18 (85.7)	10.33	1.47–72.61*
	Commercially bottled water	63	1 (1.6)	62 (98.4)	1.00	
Smoking	Yes	25	2 (8.0)	23 (82.0)	1.26	
	No	314	30 (9.5)	284 (90.5)	1.00	0.36–4.41
Eating uncooked food	Yes	97	9 (9.3)	88 (90.7)	0.93	0.47–1.83
	No	242	23 (9.5)	219 (90.5)	1.00	
Frequency of wearing shoes	Always	225	23 (10.2)	202 (89.8)	1.00	
	Not often	114	9 (7.9)	105 (82.1)	0.18	0.37–1.41
Eating fresh vegetables	Often	124	10 (8.1)	114 (91.9)	1.00	
	Sometimes	175	15 (8.6)	160 (91.4)	1.07	0.53–2.16
	Non	40	7 (17.5)	33 (82.5)	2.38	0.89–6.29
Toilet use	Always	207	19 (9.2)	188 (90.8)	1.00	
	Sometimes	115	9 (7.8)	106 (92.2)	0.58	0.17–2.03
	None	3	1 (33.3)	2 (66.7)	3.39	0.60–36.36
	Missing	14	3 (21.4)	11 (78.6)	2.55	0.82–7.97
Washing hands	Often	290	28 (9.7)	262 (90.3)	1.00	
	Not often	49	4 (8.2)	45 (91.8)	0.45	0.13–1.55

*: Significant level at $\alpha = 0.10$.

Sources of drinking water at the school: 65.5% drank mountain piped water and 32.7% drank underground water. Sources of household drinking water: 75.2% drank mountain piped water and 18.6% drank underground water. None of the schools provided soap in school toilets. Forty subjects reported that at least one of their family members had been diagnosed as having parasitic infection from medical doctor in the year before.

Ninety-seven subjects (28.6%) ate uncooked food, 33.6% did not often wear shoes, 51.6% ate fresh vegetables, 5% used hands for eating, 11.5% did not wash hands before eating, 72.9% washed hands by water without soap and 14.5% washed kitchen's tools by water without any dishwashing liquid. At home, 132 subjects (38.9%) did not always defecate in the toilets. Twenty-five (7.7%) smoked, 5.9% drank alcohol and 4.2% used methamphetamine.

Assessing the knowledge, attitude and practice of 146 subjects from grade 4–6 found that 78.1% had a low level of knowledge, 67.5% had wrong attitude and practice of prevention and control of intestinal parasitic infection.

The laboratory results found that 33 cases (9.7%) had been infected by various types of intestinal parasites: *A. lumbricoides* (27 cases: 84.4% had $\leqslant$ 500 eggs and 15.6% had $\geqslant$ 501 eggs per low magnification field), *Trichuris trichiura* (1 case: 9 eggs per low magnification field), *Enterobius vermicularis* (1 case: 72 eggs per low magnification field), *Taenia* spp. (1 case: 36 eggs per low magnification filed) and hookworms (3 cases: 7, 45 and 147 eggs per low magnification field).

Univariate analysis of risk factors at $\alpha = 0.10$ showed that there were 3 variables with a statistically significant association with intestinal parasitic infections. The risk of parasitic infection among the subjects was decreased with the increasing education level. The 5th grade presented as a protective factor compared to the first grade (OR = 0.19, 90% *CI* = 0.05–0.70). Subjects who drank mountain piped water (OR = 7.69, 90% *CI* = 1.45–43.09) and underground water (OR = 10.33, 90% *CI* = 1.47–72.61) groups had a greater risk than the commercially bottled water group (Table 1).

Multiple logistic regression analysis was applied for controlling confounders and for evaluating the effects of risk factors on parasitic infection. After controlling for age, sex, religion, parents' education and parents' occupation, there was only the source of drinking water which showed statistically significant association: drinking mountain piped water increased the risk of intestinal parasite infection by a factor of 8.22 times ($OR_{adj} = 8.22$) and drinking underground water increased the risk of intestinal parasite infection by a factor of 9.83 times ($OR_{adj} = 9.83$, 95% *CI* = 0.93–104.12) (Table 2).

Table 2

Multivariate analysis of intestinal parasite infection among the subjects.

Sources of drinking water	OR	95% *CI*	*P* value
Commercially bottled water	1.00		
Underground water	9.83	0.93–104.12	0.071
Mountain piped water (Grounded water)	8.22	1.07–63.18	0.046*

*: Significant at $\alpha = 0.05$.

4. Discussion

The prevalence rates of parasitic infection were different from one study to another and depended on the different characteristics of the subjects. The results of this study agree with those of Arnat *et al*.[12], Kitvatanachai and Rhongbutsri[13] and Okpala *et al*.[14] who found the overall prevalence of parasitic infection among students were 9.05%, 13.9%, and 11.8% respectively. Niamnuy found that the overall prevalence of parasitic infection among Thai people in Dhonburi, Bangkok and Park-tho District, Ratchaburi Province was 3% which was less than the result of this study[15].

Tefera reported that the overall prevalence of parasitic infection among the rural community was 16.6%[16]. Many studies had found a greater prevalence than this study such as the study of Anuar *et al*.[17] which found that the prevalence of parasitic infections among the Asli tribes in Malaysia was 43% and the studies of Nuchprayoon *et al*.[11] and Ngrenngarmlert *et al*.[18] which reported that the prevalence of parasitic infection among the Myanma migrant workers in Thailand was 62.3%.

In this study, no multiple infections was found, whereas, Fusi-Ngwa *et al*. reported that the study of parasitic infection among 18 years old children in Cameroon, had 7% multiple infection[19]. In this study, the most common parasite infection among the hill tribe children was *A. lumbricoides*. This is not similar with that of Yasri and Wiwanitkit[20] who found that hookworm infection was the most common parasitic infection among underweight school age children in rural Thailand.

The type of parasitic infection among the children from the south of Thailand was different from the north of Thailand. In the south of Thailand, hookworm was the most predominant helminth among the children whereas according to study conducted in the north of Thailand, we found that the major parasitic infection among the children was *A. lumbricoides*[21].

Some studies reported that differences in sex and age were associated with the risk of intestinal parasitic infection. However, in this study, sex and age were not found to be the association factors with intestinal parasitic infection[14].

Our findings coincide with the studies of Boonjaraspinyo *et al*.[22], Okpala *et al*.[14] and Amuta *et al*.[23] who found that drinking water from the river and well, and drinking fresh water were associated with intestinal parasitic infection.

While Anuar *et al*.[17], Ashok *et al*.[24], Tefera[16], Torgerson and Macpherson[25] reported that economic status and poor living condition were the main risk factors of parasitic infection among schoolchildren. Boonjaraspinyo *et al*.[22], Niamnuy[15] and Petney[26] reported that the risk factors of intestinal parasitic infection were poor sanitation and eating uncooked food. In our study, personal hygiene, wearing shoes and sanitation were not associated with intestinal parasitic infection.

In the study of Petney, the changes of environment, culture and social patterns such as eating raw food had a direct impact on the infection rate of intestinal parasite infection[26]. These changes have had and will continue to have a major influence on a broad range of intestinal parasitic infection and on the diseases they cause. Utaaker and Robertson showed that climate change was associated with the number of infected patients in the hospitals[27].

Our study showed that the cultural tradition of using ground water for drinking in Northern Thailand particularly among the hill tribe people increased infection rate of intestinal parasitic infection particularly in young children.

Conflict of interest statement

I declare that I have no conflict of interest.

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