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# Taeniasis and Other Helminthic Infections in the Northern and Northeastern Border Provinces of Thailand

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## Abstract

Microscopic stool examinations to diagnose taeniasis and other helminthic infections were performed in three provinces: Nan in the north, and Ubon Ratchathani and Khon Kaen in the northeast. In Nan, lowland communities and hill-tribe communities were treated separately. By Kato thick-smear technique, the results indicated similar prevalence (13-15%) of helminthic infections in all three provinces. In Nan, higher infection rates were found among lowland (34.9%) than hill-tribe inhabitants (13.0%). The most significant contributors to the high infection rate were minute intestinal flukes (29.4%) in lowland Nan, whereas in the hill-tribe community, prevalence was very low (0.5%). Infections in the two northeastern provinces were mainly caused by *Opisthorchis* liver flukes (6-7%). Hookworm infection rates were 4-6% in all study areas. *Taenia* eggs were found in 2% of both Nan groups, 3.7% in Ubon Ratchathani and 0.9% in Khon Kaen. Other helminths found included *Ascaris lumbricoides* (4%), *Enterobius vermicularis* (0.5%) in Nan hill-tribe communities, *Strongyloides stercoralis* (about 1-2%), *Trichuris trichiura* in both northeastern provinces (< 1%), and *A. lumbricoides* in Ubon Ratchathani (< 1%).

Thirteen cases positive for *Taenia* eggs were treated with 2 g niclosamide, and five bowel movements were observed immediately following cathartic administration. Eleven of these 13 cases had *Taenia* segments in their stool. Long-chain strobilae were commonly expelled in the first two bowel movements. The head portion, or scolex, was released in five cases during any of the five bowel movements. One case expelled two separate long-chain strobilae with two scolices. All *Taenia* worms found were identified morphologically as *T. saginata*, either by scolex or gravid proglottids.

**Keywords:** stool examination, helminths, treatment, *Taenia* expulsion, bordering provinces, Thailand

## Introduction

Helminth infections remain a serious public-health problem in Thailand. The Helminthiasis Control Program of the Thai Ministry of Public Health reported that, in 2001, 25-70% of people

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living in certain provinces of Thailand (especially border provinces) were infected with intestinal helminths or opisthorchiasis liver flukes. The highest infection rates (43.3-73.5%) were in the three southernmost provinces (Pattani, Yala, and Narathiwat) and were caused by soil-transmitted helminthes (STH), a group which includes hookworms, *Ascaris* and *Trichuris*. Equally significant, the three northernmost provinces of Thailand (Chiang Mai, Chiang Rai, and Nan) have a very high rate of *Opisthorchis* liver-fluke infection (24.6-54.0%). Taeniasis occurs most frequently in the northern border provinces of Mae Hong Son (8.9%) and Nan (4.2%), and the northeastern border provinces of Mukdahan (5.4%) and Yasothorn (3.6%). The overall rates of helminthic infections in the western border provinces are comparatively low [1], although recent reports suggest high prevalence rates of STH (35%) and taeniasis (0.7%) in some villages in Kanchanaburi Province [2], which is in this area.

In general, populations in remote, border communities have low hygiene standards, especially those communities in high-elevation, semi-forested areas. It is also common practice to prepare raw or partially raw dishes of fish, pork, or beef, which puts communities at risk of food-borne parasitic infections. This study aimed to investigate the prevalence of helminth infections, through the detection of eggs in stool samples, among remote communities along the northern and northeastern borders. Subjects who tested positive for taeniasis were treated to induce worm expulsion and enable species identification. For comparative purposes, one location remote from the border, in Khon Kaen Province, was also included.

## Materials and methods

### Study areas

The study was conducted in three provinces in northern and northeastern Thailand, chosen for their geographical locations: Nan lies on the northern border, close to Lao PDR; Ubon Ratchathani lies on the eastern border, near southern Lao PDR and northern Cambodia; and

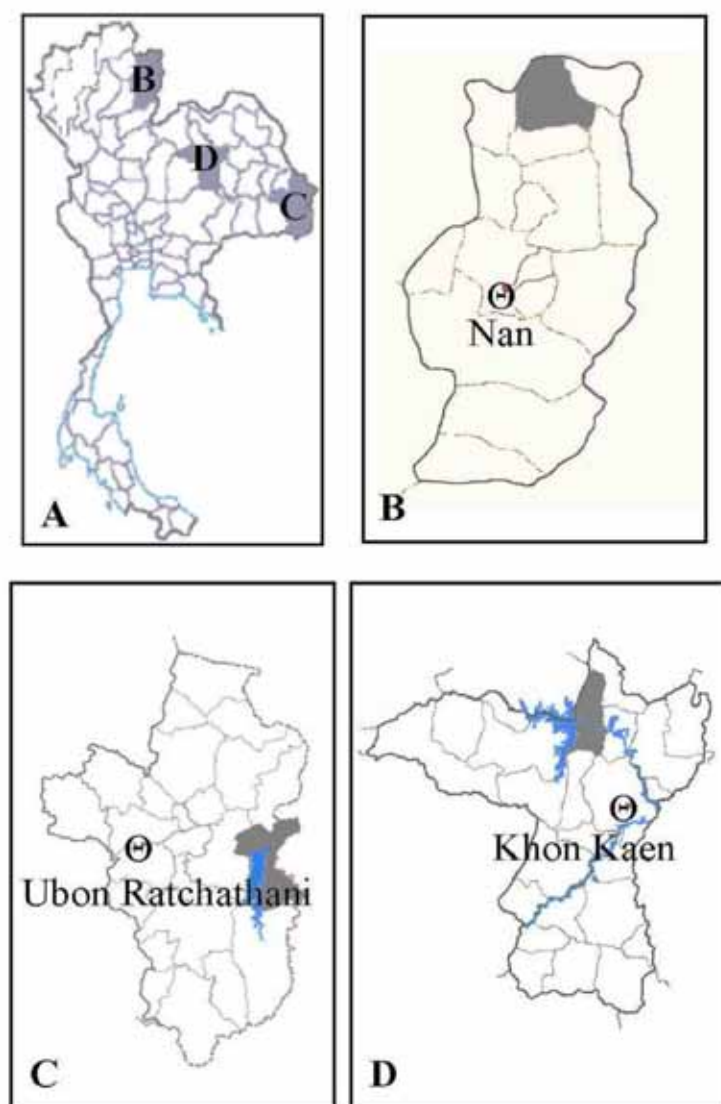
Khon Kaen is in a more central location, far from the border (Fig 1).

Nan is composed largely of mountainous areas. Within Nan, two highland sites (Pangkae and Maneepruk) and two lowland sites (Tungsun and Hauypan), in the border district of Thung Chang, were chosen as study areas. Hauypan is a border village close to the neighboring district of Chiang Klang. Both Tungsun and Hauypan are relatively near the main district city. Pangkae and Maneepruk, located farther away from the city, serve as the residence of the Hmong hill-tribes that still practice a traditional lifestyle. In these communities, pork is the most frequently consumed meat and domesticated pigs are free to wander freely around households.

Study sites in Ubon Ratchathani and Khon Kaen were chosen for their close proximity to dams supervised by the Electric Generating Authority of Thailand (EGAT). In Ubon Ratchathani, the study sites were in the border district of Sirindhorn, near Sirindhorn Dam. Patients from two separate health centers, Kanrai and Kanpeuy, were subjects of study. In Khon Kaen, Ubolratana District, where Ubolratana Dam is situated, served as the study site. Here, patients of the Khoksung and Sapsomboon health centers were subjects of study.

### Stool examination and treatment

Stool sample collection boxes were distributed by volunteers to villagers aged > 15 years in each study site. Collected stool samples were examined under a microscope for helminth eggs using the Kato-Katz technique [3]. Subjects positive for *Taenia* eggs, and willing to participate in further study, were treated with a 2 g dose of niclosamide (Yomesan, Bayer, Turkey). Two hours after drug administration, each patient was given 60-90 ml of magnesium salts. Samples from the subsequent 4-5 bowel movements of each individual patient were collected separately, and washed until clear. If present, *Taenia* worms and scolices were collected and identified morphologically. Subjects testing positive for other helminthiasis were treated according to WHO guidelines. All subjects were required to provide written informed consent



**Fig 1 A: Map of Thailand showing 3 studied provinces (shaded areas). B: Nan, C: Ubun ratchathani, D: Khon Kaen; shaded areas indicated district studied, ⊕ Indicated province city.**

before participation. The study was approved by the Ethics Committee of the Faculty of Tropical Medicine, Mahidol University, and the Ethics Committee of the Ministry of Public Health, Thailand.

## Results

The results from stool examinations are shown in Tables 1 and 2 for each of the study areas.

Among a population sample of 109 males and 143 females in lowland Nan, with ages ranging between 15-85 years, 88 (34.9%) tested positive for the presence of helminth eggs in their stool. Only three distinct parasite species were found: *Opisthorchis*-like eggs in 74 subjects (29.4%); *Taenia* eggs in 6 subjects (2.4%); and hookworm eggs in 14 subjects (5.6%). The results of the study in highland Nan were very different: *Opisthorchis*-

**Table 1 Results of fecal examinations for the presence of helminth eggs in lowland and hill-tribe communities (age ≥ 15 years) in Thung Chang District, Nan Province, northern Thailand.**

Village	Age (years)	Sex		No. examined	No. positive (%)	Parasites species (%)*				
		M	F			Taenia	Ov-like	Hookworm	Ascaris	Enterobius
Lowland										
Thungsun	15-81	69	99	168	59 (35.2)	2 (1.2)	57 (33.9)	0	0	0
Hauypan	17-85	40	44	84	29 (34.5)	4 (4.8)	17 (20.2)	14 (16.7)	0	0
Total	15-85	109	143	252	88 (34.9)	6 (2.4)	74 (29.4)	14 (5.6)	0	0
Hill-tribe										
Pangkae	15-85	74	82	156	10 (6.4)	4 (2.6)	0	5 (3.2)	0	1 (0.6)
Maneepruk	15-73	39	28	67	19 (28.4)	1 (1.5)	1 (1.5)	9 (13.4)	9 (13.4)	0
Total	15-85	113	110	223	29 (13.0)	5 (2.2)	1 (0.5)	14 (6.3)	9 (4.0)	1 (0.5)

M: male, F: female, Ov: *Opisthorchis viverrini*; \*some cases have multiple infections

**Table 2 Results of fecal examinations for the presence of helminth eggs among people aged ≥ 15-years living in northeastern Thailand: Ubon Ratchathani and Khon Kaen provinces.**

Village	Age		Sex	No. examined	No. positive (%)	Parasites species (%)*					
	(years)					M	F	Taenia	Ov-like	Hookworm	Strongyloides
Ubon Ratchathani, Sirindhorn District											
Khanrai	15-81	93	93	186	30 (16.1)	8 (4.3)	12 (6.5)	9 (4.8)	6 (3.2)	1 (0.5)	0
Khan Peuy	21-82	51	59	110	16 (14.5)	3 (2.7)	7 (6.4)	4 (3.6)	1 (0.9)	0	1 (0.9)
Total	15-82	144	152	296	46 (15.5)	11 (3.7)	19 (6.4)	13 (4.4)	7 (2.4)	1 (0.3)	1 (0.3)
Khon Kaen, Ubolratana District											
Sapsombon	15-76	62	60	122	12 (9.8)	0	7 (5.7)	4 (5.3)	1 (0.8)	0	0
Khoksung	15-68	46	53	99	16 (16.2)	2 (2.0)	9 (9.1)	9 (9.1)	1 (1.0)	0	1 (1.0)
Total	15-76	108	113	221	28 (12.7)	2 (0.9)	16 (7.2)	13 (5.9)	2 (0.9)	0	1 (0.5)

M: male; F: female, Ov: *Opisthorchis viverrini*; \*some cases have multiple infections

like eggs were only found in one subject (0.5%) out of the 223 hill-tribe members. Other species of helminthes found include 14 subjects with hookworm (6.3%), 9 subjects with *Ascaris* (4.0%), 5 with *Taenia* (2.2%), and 1 with *Enterobius* (0.5%). The total helminthiasis prevalence rate in the hill-tribe community of 129 males, 94 females, with ages ranging between 15-85-years-old, was 13.0% (29/223). Mixed infection was noted in some cases (data not shown).

Similarly low prevalence rates were found in the two northeastern provinces. Overall helminthiasis prevalence in Ubon Ratchathani was 15.5%, where the sample size was 296 people (144 males and 152 females, aged 15-82). In Khon Kaen, the prevalence rate was 12.7% in 221 subjects (108 males and 113 females, aged 15-76 years). More cases of taeniasis were found in Ubon Ratchathani (11 subjects, or 3.7%) than in Khon Kaen (two subjects, or 0.9%). Unlike those communities in Nan, strongyloidiasis was found at a prevalence rate of 2.4% in Ubon Ratchathani and 0.9% in Khon Kaen. Other parasite eggs found include *Opisthorchis*-like eggs (6-7%) as well as hookworm eggs (4-5%) in both provinces. Low-prevalence helminthic infections found were *Ascaris* and *Trichuris*, with one case each in Ubon Ratchathani and only one *Trichuris* case in Khon Kaen.

A total of 24 cases of taeniasis were found, with 10 of those occurring in males and 14 in females: 11 were reported in Nan, 11 in Ubon Ratchathani and two in Khon Kaen. Thirteen (5 males; 8 females; age range 29-68 years) of these patients agreed to participate in further study. Observation of each subject's first five bowel movements immediately following treatment revealed that 11 subjects expelled worms in their stool (Table 3). The worms were mostly separated gravid proglottids, short-chain gravid proglottids, and short-chain immature proglottids. One subject discharged two long-chain strobilae with an approximate length 3.5-4.0 meters, containing immature, mature and gravid proglottids. Five subjects each expelled one chain strobila, with approximate lengths ranging from 2.5-5.0 meters.

The chain strobilae were primarily found in the first two bowel movements. Stool samples of five patients contained scolices. Although these were most commonly found in the first two bowel movements, they were also found in the final collected movement of one subject. The subject who discharged two chain strobilae also expelled two scolices in the second and fourth bowel movements.

All *Taenia* worms were identified as *T. saginata* based on the morphology of the scolex, gravid proglottids or both. Two patients did not expel any worms. One patient exhibited a co-infection of *Taenia* worms and the pin worm *Enterobius vermicularis*, which were both found in his excreta in spite of having no *E. vermicularis* eggs present in his initial fecal sample.

## Discussion

The highest prevalence (34.9%) of helminthic infection occurred in lowland Nan, which was primarily caused by *Opisthorchis*-like eggs. However, since the *Opisthorchis* liver fluke produces morphologically similar eggs to several species of intestinal flukes, it left open the question of which of these was actually present. While *Opisthorchis viverrini* is the most common helminth in northeastern provinces, regions to the north have higher infection rates of intestinal flukes. Radomyos *et al* [4] determined that 92.2% (628/681) of confirmed infections with *Opisthorchis*-like eggs in 16 northeastern provinces could be identified conclusively as *O. viverrini*. In a similar study across 16 provinces in the north, Radomyos *et al* [5] showed that 63.1% (272/431) of *Opisthorchis*-like egg infections were caused by *Haplorchis taichui*, a species of minute intestinal flukes, while only 11.6% (50/431) were *O. viverrini*. Maipanich *et al* [6] reported 593 positive cases of *Opisthorchis*-like eggs among 2,540 stool samples (23.3%) taken from the hill-tribes of the Chalermprakiat District in northeastern Nan. Through worm identification, all of these infected cases proved to be *H. taichui*. In the study of Radomyos *et al* [5] in Nan, species of *Haplorchis*, *H. taichui*, *H. yokogawai* and *H. pumilio*, but no *O.*

**Table 3 Summary of worm expulsion characteristics for *Taenia* egg-positive cases, obtained from five bowel movements immediately after niclosamide treatment and subsequent catharsis. The 13 subjects lived in the lowlands or uplands of Nan, Ubon Ratchathani or Khon Kaen in Thailand.**

No.	Age (years)	Sex	Worm recovered in bowel movements					Number of worm(s) expelled			
			1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	5 <sup>th</sup>	Scolex	Proglottids		
Nan, lowland											
1	63	F	2 chains 3.5 m, 4.0 m segments	scolex	segments	scolex	segments	2	2		
2	29	F	segments	segments scolex, chain 3.0 m	N	N	N	0	1		
3	34	F	segments		segments	N	N	1	1		
Nan, upland											
4	58	M	chain 5.0 m	segments	N	N	N	0	1		
5	36	F	segments	segments	segments	chain 4.0 m	scolex	1	1		
6	47	M	segments	segments	segments	segments	segments	0	1		
Ubon Ratchathani											
7	55	M	segments	segments	segments	segments	segments	0	1		
8	35	F	N	N	N	N	N	0	0		
9	40	F	segments	chain 3.0 m	segments	segments	segments	0	1		
10	36	F	N	N	N	N	N	0	0		
11	68	M	segments	segments	segments	N	N	0	1		
12	42	F	scolex	segments	segments	N	N	1	1		
Khon Kaen											
13	50	M	scolex, chain 2.5 m	segments Ev	Ev	N	N	1	1		

Age: 29-68 years, M: male, F: female, Sex: 5M:8F, N: negative, Ev: *Enterobius vermicularis*; segments may indicate either gravid or immature segments.

*viverrini*, were identified in the 11 patients that tested positive for *Opisthorchis*-like eggs.

In our study, *Opisthorchis*-like eggs were found in approximately 30% of all human subjects. Worms were collected from a small number of the cases testing positive for *Opisthorchis*-like eggs. Minute intestinal flukes were found without the presence of *O. viverrini* worms, but no attempt was made to identify their species. Therefore, the infections in the Nan study were tentatively diagnosed as minute intestinal flukes. Interestingly, the minute intestinal fluke infection rate was much higher in the lowland populations than that which was found upland (29.4:0.5). This could be because eating raw fish, which is the main transmission mode of intestinal fluke infection, is not a common practice of the Hmong hill-tribe population in this area. Another possibility is that water sources which contain the fish host species are scarce in the higher mountain region that is home for the hill-tribes.

Although the highest rate of helminthic infections (34.9%) was found in lowland Nan in our study, significantly higher rates of 64.0% for all helminthiasis – and 54.0% specifically for *Opisthorchis* liver fluke infections – were reported as the average prevalence in Nan [1]. This discrepancy in data could be due to several factors. The high *Opisthorchis* liver fluke prevalence reported by the Ministry of Public Health in 2001 might be due to incorrect diagnoses, due to the morphological similarities between liver fluke and intestinal fluke eggs. It is also possible that an increased awareness of the risks of raw fish consumption have decreased the prevalence of *Opisthorchis*-like eggs in the residents of Nan.

In the northeastern provinces of Ubon Ratchathani and Khon Kaen, similar prevalence rates and distributions of species of helminthic infections were found. Our study observed a higher prevalence of helminths in Khon Kaen than the previous study of Muennoo *et al* [7]. Specifically, we found the prevalence of hookworm infection to be 4.4-5.9% as compared to the previous study's 0.9%. *Opisthorchis* liver fluke infection rates were a consistent 7% in our study at both Khon Kaen

and Ubon Ratchathani, similar to the Muennoo *et al* study in Khon Kaen [7]. Even though study sites were chosen based on their being in the vicinity of the water reservoirs of dams, and, consequently, their close proximity to its populations of various host species of cyprinid fish, *O. viverrini* infection rates did not occur in more than 10% of the population. This is indicative of the success of the helminthiasis control program coordinated by the Ministry of Public Health, Thailand [8]. However, other border provinces still have high prevalence rates. Nakhon Phanom is located close to Mekong River in northeast Thailand, where it was reported *O. viverrini* has a 66.4% prevalence rate [9].

*Taenia* infections were found to be relatively uncommon. About 2% of the subjects in Nan were found to have *Taenia* eggs in their stool samples. A similar rate of 1.9% was reported in a different district of Nan in 2004 [6]. Ubon Ratchathani had a slightly higher rate of 3.7% while Khon Kaen had a lower one of 0.9%, something which was found both by this study and by Muennoo *et al* [7].

Niclosamide has proven effective in the treatment of taeniasis. 84% (11/13) of the subjects successfully discharged *Taenia* worms after treatment. Only 38% (5/13) expelled a scolex, and all scolices found were separated from strobilae. Pieces of young immature segments were usually found in each bowel movement. It is possible that the expelled scolices were digested by niclosamide and decomposed by washing, so that the scolices were not found. The scolex and long-chain strobila were frequently expelled in the first two bowel movements, but lesser in the others after catharsis. Jaroonvesama and Harinasuta [10] reported only 3% (1/32) of patients treated with 2 g of niclosamide expelled a scolex in the stool collected on the same day as treatment. However, follow-up showed that 78% of the treated cases showed neither presence of eggs nor segments in stool after treatment for three months.

In summary, the helminthiasis situation did not differ substantially in northeastern Thailand, between Ubon Ratchathani at the border and the more centrally located Khon Kaen. However, different communities within the single northern



border province of Nan displayed variations in the prevalence of helminthiasis, with the hill-tribe populations displaying less helminthiasis burden than the lowland community.

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