

HEALTH BEHAVIOR ASSOCIATED WITH *OPISTHORCHIS VIVERRINI* INFECTION IN KHUKAN DISTRICT, SI SA KET PROVINCE, THAILAND

Choosak Nithikethkul^{1,6}, Ole Wichmann⁷, Panida Polseela⁵, Chalobol Wongsawad⁶, Noppamas Akarachantachote³, Supaporn Wanapinyosheep² and Manat Boonprakob⁴

¹Department of Biological Science, ²Department of Basic Medical Science, ³Department of Mathematics and Statistics, Faculty of Science and Technology, Huachiew Chalermprakiet University, Samut Prakan; ⁴Behavioral Science Research Institute, Srinakharinwirot University, Bangkok; ⁵Department of Microbiology and Parasitology, Faculty of Medical Science, Naresuan University, Phitsanulok; ⁶Department of Biology, Faculty of Science, Chiang Mai University, Chiang Mai, Thailand; ⁷Institute of Tropical Medicine, Charité, Humboldt University, Berlin, Germany

Abstract. Food-borne trematode infections, such as opisthorchiasis, are major causes of morbidity in Asia. This present study was performed to determine the prevalence of infection with *Opisthorchis viverrini* and other intestinal parasites in five areas of Khukan District, Si Sa Ket Province, Thailand. Data regarding socioeconomic characteristics and the health behavior of the population were thought to be useful in the development of a strategy to control and eradicate parasitic infections in a cost-effective manner. Stool samples were collected from 774 subjects, including all age-groups, from below 10 years of age to more than 60 years. The prevalence of infection varied in the 5 investigated areas and ranged from 7 to 13.6%. The majority of detected parasites (61 cases, 7.9%) were *Opisthorchis viverrini*. Males were significantly more often infected than females ($p=0.03$), and the prevalence of infection significantly increased with age ($p=0.003$) and lower educational level ($p=0.03$). Hand cleaning behavior was not significantly associated with the prevalence of infection ($p=0.44$). Subjects who claimed to wash their hands always tended to be even more often infected than subjects who only washed their hands sometimes (10.1 and 7.7%, respectively). These results indicate that opisthorchiasis is still a public health problem in Khukan District is more restricted to populations of lower education. However, hand cleaning behavior and personal hygiene do not seem to play as crucial a role in the transmission of the disease as previously thought. Further studies on social habits are required and might offer the possibility of targeted treatment and education of predisposed groups or communities.

INTRODUCTION

Opisthorchiasis caused by *Opisthorchis viverrini* remains a major public health problem in many parts of Southeast Asia, including Thailand, Lao PDR, Vietnam, and Cambodia. The epicenter of this disease is located in north-eastern Thailand, where high prevalence coexists with a high incidence of cholangiocarcinoma, major primary carcinoma of the liver with a very poor prognosis (Okuda *et al*, 2002). An acute infection with *O. viverrini* usually has no, or few, clinical manifestations. However, a case-control study was performed with 103 cases of cholangiocarcinoma and showed that at least two-thirds were attributable to *O. viverrini* (Parkin *et al*, 1991). Further studies in endemic regions led to the suggestion that besides the fluke, chemical carcinogens are involved

as a cofactor. For example, increased intake of dimethylnitrosamine produced by bacteria in salted fish, consequent upon fluke infestation, is thought to contribute to carcinogenesis (Srivatanakul *et al*, 1991).

Many factors influence the survival and transmission rates of parasites. In the case of opisthorchiasis, the consumption of raw or undercooked fish is the primary vector of infection (Nithikathkul and Puapairoj, 2002). Unsanitary latrines and the prevalence of both intermediate hosts, freshwater snails and fish, are further factors that contribute to high rates of infection, especially in northeast and northern Thailand (Jongsuksuntigul and Imsomboon, 1997; Radomyos *et al*, 1998). In the northeast, several preparations contain uncooked fish (Nithikathkul, 2000). Of those, *koi pla* (raw fish flesh chopped with garlic, lemon juice, fish sauce, chilly, roasted ground rice, and vegetables) is probably the most infective, followed by fish preserved for less than seven days, then *pla ra* and *jaew bhong*, in which viable metacercariae are rare (Upatham *et al*, 1988; Sithithaworn and Haswell-Elkins, 2003).

Correspondence: Choosak Nithikathkul, Department of Biological Science, Huachiew Chalermprakiet University, Samut Prakan 10540, Thailand.
Tel: 66 (0) 2312-6300 ext 1208; Fax: 66 (0) 2312-6458
E-mail: Choosak@chaba.hcu.ac.th

Based on a regional survey in 1981, the overall prevalence of opisthorchiasis in northeastern Thailand was as high as 34.6% (Jongsuksuntigul and Imsomboon, 1997). As a consequence, in 1984, the Ministry of Public Health started a liver fluke control program, which was expanded in 1988 to cover all 19 northeastern provinces. The main strategies for control comprise 3 interrelated approaches: stool examinations and treatment of positive cases with praziquantel for eliminating the human host reservoir; health education promoting consumption of cooked fish to prevent infection; and improvement of hygienic defecation to interrupt disease transmission. As a result, the annual positive rates subsequently decreased to 9.4% in the year 2001 (Jongsuksuntigul and Imsomboon, 2003).

However, studies on post-treatment re-infection in the northeast demonstrated that populations with high pre-treatment intensity tended to have the highest intensity of re-infection (Sornmani *et al*, 1984; Upatham *et al*, 1988). Rapid re-infection despite treatment might suggest the absence of protective immunity and that some communities are predisposed to heavy infection, probably due to their unchanged social habits. Besides consumption of raw or undercooked fish, contaminated utensils, unwashed hands and food preparation surfaces are believed to have an important impact on the transmission of *O. viverrini*. However, most published descriptions of social habits regarding consumption of raw fish are anecdotal and careful sociological investigations are required (Sithithaworn and Haswell-Elkins, 2003).

The present study was performed to determine if health behaviors other than eating raw fish might be associated with *Opisthorchis viverrini* infection in Khukhan District, Si Sa Ket Province, Thailand. This study was thought to provide useful data about the health status and the risk behaviors that might be addressed by targeted treatment and or education as a strategy for parasite control in the future.

MATERIALS AND METHODS

This cross-sectional survey was conducted in Khukan District, Si Sa Ket Province, during May 2003. Investigators visited five randomly selected areas of Khukan District, accompanied by local Public Health Department officials. Subjects of all age-groups were assigned to the study population after informed consent was given.

All subjects were interviewed and stool specimens were collected. Stool specimens were fixed with formalin and carefully stored before examination in a

laboratory at the Department of Microbiology and Parasitology, Faculty of Medical Science, Naresuan University. The formalin-ether concentration technique was used to process all specimens. The presence of intestinal parasite eggs, larvae, and protozoa was determined microscopically.

Statistical data were analyzed using the software EPI-INFO (Version 2, Centers for Disease Control and Prevention, Atlanta, USA). Descriptive statistics were used to describe the distribution of the demographic and socio-economic characteristics of the subjects. The chi-square test was used to compare differences in the distribution of categorical variables, or the chi-square test for trend when appropriate. A statistically significant difference was determined when a p-value was <0.05.

RESULTS

Overall, 774 subjects were recruited, including all age-groups, from below 10 to over 60 years. Of these, 347 were males and 427 were females (male to female ratio 1:1.23). Microscopy revealed parasites in 72 stool samples (9.3%). The majority of detected parasites (61 cases, 7.9%) were *Opisthorchis viverrini*. Other intestinal parasites included *Ascaris lumbricoides*, *Trichuris trichiura*, *Strongyloides stercoralis*, hookworms, *Taenia* spp and *Giardia lamblia*. The prevalence of parasitic infection varied in the 5 investigated areas and ranged from 7 to 13.6% (Table 1). Overall, males were significantly more often infected than females (11.8 vs 7.3%, p=0.03). However, this association varied strongly between the different communities. The infection rate increased significantly (p=0.003) by age with the highest prevalence (14.8%) in villagers aged 51 to 60 years (Table 2).

Most of the included subjects had lower educational levels (illiterate or elementary level), and the infection rate was significantly associated with lower education level (p=0.031). In respect of the subjects' health behavior, hand cleaning was not significantly associated with prevalence of infection (p=0.44). There was a trend that individuals who claimed to wash their hands 'always' (n=406) were more frequently infected than individuals who claimed to wash their hands 'usually' (n=212), or even only 'sometimes' (n=104) (10.1 vs 9% vs 7.7%, respectively).

DISCUSSION

'Population health' is a public health approach that targets individuals at high risk and might offer a cost-

Table 1
Parasite infection rates in five areas of Khukan District, Si Sa Ket Province.

Sub-district	Male		Female		Total	
	No. examined	No. infected (%)	No. examined	No. infected (%)	No. examined	No. infected (%)
Noon	93	12 (12.9)	113	3 (2.7)	206	15 (7.3)
Ta Ken Bang In	25	3 (12.0)	41	5 (12.2)	66	8 (12.1)
Hua Saew	56	5 (8.9)	81	6 (7.4)	137	11 (8.0)
Jai Dee	62	10 (16.1)	63	7 (11.1)	125	17 (13.6)
Sa Noon	111	11 (9.9)	129	10 (7.8)	240	21 (8.8)
Total	347	41 (11.8)	427	31 (7.3)	774	72 (9.3)

Table 2
Potential factors associated with infection.

Factors	Examined	Total infected (%)	p-value
Sex	774	72 (9.3)	0.03
Male	347	41 (11.8)	
Female	427	31 (7.3)	
Status	748	72 (9.6)	0.01
Family head	204	29 (14.2)	
House-wife	258	25 (9.7)	
Child	277	16 (5.8)	
Relative	9	2 (22.2)	
Age	738	72 (9.8)	0.003 ^a
< 10	111	5 (4.5)	
10 – 20	113	3 (2.7)	
21 – 30	62	9 (14.5)	
31 – 40	170	21 (12.4)	
41 – 50	139	13 (9.4)	
51 – 60	81	12 (14.8)	
> 60	62	9 (14.5)	
Education	687	70 (10.2)	0.031 ^a
Illiterate	74	9 (12.2)	
Elementary	516	58 (11.2)	
Secondary	82	3 (3.7)	
Diploma	2	0 (0.0)	
Bachelor degree	13	0 (0.0)	
Occupation	626	59 (9.4)	0.984
Agriculture	576	55 (9.5)	
Farmer	4	3 (75.0)	
Private business	4	0 (0.0)	
Labor	8	0 (0.0)	
Government employee	10	1 (10.0)	
Unknown	24	0 (0.0)	
Hand cleaning behavior	722	68 (9.4)	0.44 ^a
Always	406	41 (10.1)	
Usually	212	19 (9.0)	
Sometimes	104	8 (7.7)	

^aChi-square test for trend

effective way to allocate limited funds. The present study demonstrated that there is still a need for further control programs regarding *O. viverrini* infections in rural areas. *Opisthorchis viverrini*, a well-described etiologic factor for cholangiocarcinoma, was found in more than 9% of all subjects.

Infection rates showed significant differences in sex distribution, and between the five investigated areas of Khukhan District. The prevalence ranged from 2.7% in females of one area to 16.1% in males of another area. Overall, males were more often infected than females. Similar findings were observed in other endemic communities. Within the northeast itself, there is large variability at the provincial, district, and village levels with a prevalence of infection slightly higher among males (Upatham *et al*, 1984; Jongsuksuntigul and Imsomboon, 1997; Sithithaworn and Haswell-Elkins, 2003). Differences in the prevalence of infection presumably reflect variations in environmental conditions, as well as social behaviors.

The crude overall prevalence of infection in our study population was lower than the overall prevalence rate of 15.7% for northeast Thailand observed in 2001 (Jongsuksuntigul and Imsomboon, 2003). The variability between different geographic regions, as described above, and seasonal variations, might serve as an explanation for this discrepancy (Sithithaworn *et al*, 1997).

However, when compared with numbers from 1981, where 34.6% of all observed people in the Northeast were infected with *O. viverrini*, the success of the implemented liver fluke control program was impressively demonstrated (Jongsuksuntigul and Imsomboon, 1997). Nevertheless, data derived from our study demonstrated that there are still groups predisposed to higher infection rates. It was found that lower education was associated with higher prevalence rates, which might reflect inequity of access to information.

In our study population, hand-cleaning behavior was not correlated with prevalence of the disease, as has been suggested by other authors (Sithithaworn and Haswell-Elkins, 2003). To our surprise, individuals who only washed their hands sometimes were even less frequently infected with *O. viverrini* than people who claimed to wash their hands always. Education about eating and cooking behaviors remains, therefore, a crucial tool in the control of liver fluke infections. These educational programs should target individuals and communities at risk, and further sociological studies are recommended to elucidate risk behaviors in the transmission of opisthorchiasis and other intestinal parasites.

Further studies are required to 'up-date' the current health status of populations in specific endemic areas of Thailand, and to investigate the impact of socioeconomic backgrounds on their health behavior. Perhaps, this type of approach might offer a comprehensive and cost-effective strategy for the helminth dilemma.

ACKNOWLEDGEMENTS

The authors greatly appreciate the assistance provided by Si Sa Ket public health officials. We would like to thank the Director of the Public Health Institute Si Sa Ket, Associate Professor Dr Pramote Thongkrajai (Dean of Public Health, Huachiew Chalermprakiet University), Associate Professor Dr Samarn Tesana Faculty of Medicine, Khon Kaen University, for giving us the opportunity to do this research. Our thanks are also extended to the volunteers from the villages, and to Khun Sasithorn of Si Sa Ket Public Health Office for her kind cooperation and assistance with this research project.

REFERENCES

Jongsuksuntigul P, Imsomboon T. The impact of a decade long opisthorchiasis control program in

northeastern Thailand. *Southeast Asian J Trop Med Public Health* 1997;28:551-7.

Jongsuksuntigul P, Imsomboon T. Opisthorchiasis control in Thailand. *Acta Trop* 2003;88:229-32.

Nithikathkul C. Liver flukes. *Commun Dis J* 2000; 26:274-8.

Nithikathkul C, Puapairoj A. Opisthorchiasis. *APHEIT* 2002;1:49-53.

Okuda K, Nakanuma Y, Miyazaki M. Cholangiocarcinoma: recent progress. Part 1: epidemiology and etiology. *J Gastroenterol Hepatol* 2002;17: 1049-55.

Parkin DM, Srivatanakul P, Khlat M, *et al.* Liver cancer in Thailand. 1. A case-control study of cholangiocarcinoma. *Int J Cancer* 1991;48:323-8.

Radomyos B, Wongsaroj T, Wilairatana P, *et al.* Opisthorchiasis and intestinal fluke infections in northern Thailand. *Southeast Asian J Trop Med Public Health* 1998;29:123-7.

Sithithaworn P, Pipitgool V, Srisawangwong T, Elkins DB, Haswell-Elkins MR. Seasonal variation of *Opisthorchis viverrini* infection in cyprinoid fish in north-east Thailand: implications for parasite control and food safety. *Bull WHO* 1997;75:125-31.

Sithithaworn P, Haswell-Elkins M. Epidemiology of *Opisthorchis viverrini*. *Acta Trop* 2003;88:187-94.

Srivatanakul P, Ohshima H, Khlat M, *et al.* *Opisthorchis viverrini* infestation and endogenous nitrosamines as risk factors for cholangiocarcinoma in Thailand. *Int J Cancer* 1991;48:821-5.

Sornmani S, Schelp FP, Vivatanasesth P, *et al.* A pilot project for controlling *O. viverrini* infection in Nong Wai, Northeast Thailand, by applying praziquantel and other measures. *Arzneimittelforschung* 1984;34:1231-4.

Upatham ES, Viyanant V, Brockelman WY, Kurathong S, Lee P, Kraengraeng R. Rate of re-infection by *Opisthorchis viverrini* in an endemic northeast Thai community after chemotherapy. *Int J Parasitol* 1988;18:643-9.

Upatham ES, Viyanant V, Kurathong S, *et al.* Relationship between prevalence and intensity of *Opisthorchis viverrini* infection, and clinical symptoms and signs in a rural community in north-east Thailand. *Bull WHO* 1984;62:451-61.