OVERVIEW OF HUMAN CLONORCHIASIS SINENSIS IN CHINA

Li Xue-ming[1], Chen Ying-dan[2], Ouyang YI[1], Zhang Hong-man[1], Lin Rui[1] and Mao Wei[1]

[1]Guangxi Regional Center for Disease Control and Prevention, Nanning;
[2]Institute of Parasitic Diseases, Chinese Center for Disease Control and Prevention, Shanghai, PR China

Abstract. The objective of the survey was to determine the current status, trends and transmission factors for *Clonorchis sinensis* infection in China and to provide updated information for development control strategies. This was part of a nationwide survey of major human parasitic diseases carried out during 2000-2002 sampled by the stratified randomized cluster sampling method. Fecal examination was conducted using the Kato-Katz thick smear method and egg count per gram of feces (EPG) was determined for the egg-positive patients. A questionnaire and a case-control study were applied to analyze the transmission factors for *C. sinensis* infection. The overall prevalence rate of *C. sinensis* infection was 0.58% in 356,629 residents from 688 sampled pilot sites in 31 provinces, autonomous regions and municipalities (PAM) of China. The infection rates of *C. sinensis* in Guangdong, Jilin, Guangxi Zhuang autonomous region, Anhui and Heilongjiang were higher than the other PAM, they were 5.35, 4.77, 3.71, 0.67 and 0.48%, respectively. In Guangxi, moderate and heavy infections were found in 29.14% and 11.52%, respectively, of the total infected. Heavy infections were not found in any of the other provinces except for 2 heavily infected cases in Heilongjiang. The prevalence rate increased with age for residents aged <35 years and remained at high levels in those aged 25-60 years. The infection rate in males was 1.64 times that of females. The *C. sinensis* egg positivity rates in fishermen, businessmen, physicians and teachers were higher than others. Among the 38 ethnic groups, the prevalences in the Han (3.20%) and the Zhuang (3.15%) were the highest; no cases were found among the Zang, Miao, Man and other 29 ethnic groups. Significant differences in prevalences were also found among counties of different economic levels. *C. sinensis* infection is prevalent in hilly and plains regions of northeast and southcentral China, representing two highly endemic areas in the North and the South. An increasing trend in prevalence was seen in endemic areas. The infection was mainly detected in young and middle aged males. A higher prevalence was observed in those with a better education and a higher income. Consumption of raw (or under-cooked) fresh water fish or shrimp were the main risk factors responsible for transmission of the parasite.

Keywords: *Clonorchis sinensis*, prevalence, risk factor, PR China

Correspondence: Li Xue-ming, Guangxi Regional Center for Disease Control and Prevention, 18 Jin Zhou Road, Nanning, Guangxi 530028, PR China.
Tel: +86 771 2518688; Fax: +86 771 2518688,
E-mail: gxnnxm@sohu.com

INTRODUCTION

With the rapid economic growth of China large numbers of domestic migrants with diverse dietary habits from different parts of the country have been mingled. Fisheries have flourished dramatically and the number of fish consumed has increased greatly. The prevalence of *Clonorchis sinensis* has increased and has become an important issue in food safety and public health. *C. sinensis* has become one of the most serious food-borne parasitic diseases in China. It can cause acute or chronic cholecystitis, obstructive jaundice and gallstones of the bile duct. Severe cases can lead to liver cirrhosis, cholangiocarcinoma and dysplasia in children, which can cause a serious financial burden to families and society (Fang, 2008). In underdeveloped areas in China, *C. sinensis* has become a leading cause of disease leading farmers to poverty (Xu *et al*, 2000). Clonorchiasis is found mostly in Asia, such as China, Japan, Korea, Vietnam and Southeast Asian countries (Cao, 2007). Currently, 35 million people are infected with *C. sinensis* worldwide, 15 million China alone (Lun *et al*, 2005). Following the first national survey carried out a decade ago (1988-1992), the survey reported in this paper was conducted in 31 provinces, municipalities and autonomic regions (not surveyed in Taiwan, Hong Kong or Macao) in 2002-2004 to understand the current status, trends and transmission factors for *Clonorchiasis sinensis*.

MATERIALS AND METHODS

Survey sites and sample size

According to national protocol (Coordinating Office of the National Survey on Important Human Parasitic Diseases, 2005), a two-step stratified random sampling method was applied to survey for *C. sinensis*. The sample sites were randomly selected based on geographic position (North, South, East and West) and economic rank (high, medium and low). The sampled counties were selected from sites where the first national survey had been carried out. The nationwide sample size was determined according to the estimated overall prevalence rate, and the sample size, number of sample counties and number of survey sites in provinces according to the proportion of the population infected. About 500 residents per site were surveyed.

Parasitological examination

Fecal examination was carried out using the Kato-Katz smear method with three smear slides per sample for *C. sinensis* eggs; the infection intensity was determined by egg count and expressed as eggs/gram of feces (EPG). The intensity of infection was categorized (Yu *et al*, 2003) as light, moderate, and heavy infections when the EPG were <1,000, 1,000 to 9,999, and >10,000, respectively.

Survey of transmission factors

Questionnaires were filled out to collect information regarding economic level, dietary customs, education level, living environment, occupation, production patterns and floating population. At the same time, a comparative case study was conducted to analyze correlative factors.

Data analysis

All the data were entered into Epidata 2.0 and analyzed by SAS software.

RESULTS

Prevalence and intensity of *C. sinensis* infections

A total of 356,629 residents from 688 survey sites were investigated; of these 2,065 were found to be infected, giving a prevalence rate of 0.58%, a significant increase compared to the first national survey of 0.31% (Xu *et al*, 2000) (χ^2=566.6813, p=0.0000). *C. sinensis* infection was found

Table 1
Prevalence of *C. sinensis* infection in China.

PRM[a]	No. examined	No. infected	Prevalence (%)	Standardized prevalence (%)
Guangdong	17,014	911	5.35	6.20
Jilin	7,589	362	4.77	4.63
Guangxi	15,455	573	3.71	4.01
Anhui	14,873	100	0.67	0.65
Heilongjiang	7,505	36	0.48	0.46
Hainan	7,924	11	0.14	0.16
Jiangsu	15,331	19	0.12	0.13
Shandong	15,152	13	0.09	0.09
Xinjiang	6,750	4	0.06	0.05
Jiangxi	15,578	7	0.05	0.05
Henan	15,244	7	0.05	0.04
Chongqing	10,575	4	0.04	0.03
Hunan	15,223	5	0.03	0.03
Sichuan	15,653	5	0.03	0.03
Zhejiang	15,863	5	0.03	0.03
Hubei	15,524	2	0.01	0.01
Tianjin	7,500	1	0.01	0.01
Other Provinces	127,876	0	0.00	0.00
Total	356,629	2,065	0.58	0.58

[a] Province, Autonomous Region, Municipality

Table 2
Distribution and intensity of *C. sinensis* infection.

PRM	No. examined	No. infected	Intensity of infection (%) [a]		
			Light	Moderate	Heavy
Guangdong	17,014	912	850 (93.20)	61 (6.69)	0 (0.00)
Guangxi	15,455	573	340 (59.34)	167 (29.14)	66 (11.52)
Jilin	7,589	362	333 (91.98)	29 (8.01)	0 (0.00)
Anhui	14,873	100	97 (97.00)	3 (3.00)	0 (0.00)
Heilongjiang	7,505	36	27 (75.00)	7 (19.44)	2 (5.56)
12 other Provinces	156,317	82	77 (93.90)	5 (6.10)	0 (0.00)
Total	218,753	2,065	1,724 (83.49)	273 (13.22)	68 (3.29)

[a] light, EPG $< 1,000$; moderate, $1,000 \geq$ EPG $< 10,000$; heavy, EPG $\geq 10,000$

in 17 provinces, but not in 14 provinces. The highest standardized prevalence rate was observed in Guangdong Province followed by Jilin, Guangxi, Anhui and Heilongjiang Provinces. There were 1,982 cases in these 5 provinces, accounting for 95.98% of the total cases in this study (Table 1). The number with moderate and

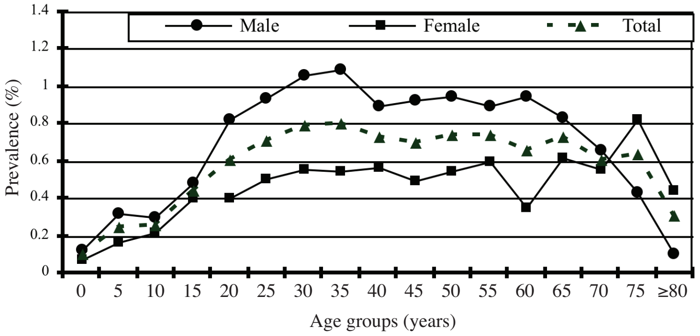

Fig 1–Prevalence of *C. sinensis* infection by age and sex.

heavy infections accounted for 40.0% of the total cases in Guangxi Province, 25.0% in Heilongjiang, and 6.0% in the other provinces (Table 2).

Age and sex distribution of *C. sinensis* infection

Infection prevalence reached a plateau at ages 25 to 60. The prevalence increased with increasing age in those under age 35. There was no significant difference in age distribution in the groups aged 25 to 75 years ($\chi^2<2.7746$, $p>0.05$). The prevalence in men (0.72%) was 1.6 times greater than in women (0.44%) ($\chi^2=123.2953$, $p=0.0000$) (Fig 1).

Distribution of *C. sinensis* infection by ethnic groups

Of the 38 ethnic groups surveyed, *C. sinensis* infection was found in 6, no infections were found in the other 32 ethnic groups. Statistical analysis was performed for Guangdong, Guangxi, Jilin, Anhui and Heilongjiang Provinces, where highest prevalence was seen in the Han ethnic group (3.20%, 1,850/57,779), followed by the Zhuang (3.15%, 130/4,123), the Man (2.17%, 1/46)and the other groups (0.20%, 1/488), showing a significant difference among ethnic groups ($\chi^2=14.2979$, $p=0.0000$).

Occupation of infected subjects

The highest prevalence by occupation was among fishermen, followed by businessmen, doctors and teachers ($\chi^2=602.5665$, $p=0.0000$) (Table 3).

Education and *C. sinensis* infection

Prevalence and intensity of infection were significantly different among subject with different education levels (Table 4). A higher prevalence was found among people with a higher level of education: people with a senior high school or higher education level had the highest infection rates ($\chi^2=259.9451$, $p=0.0000$), however people with a junior high school education level had the highest infection rate, followed by senior high school ($\chi^2=27.4138$, $p=0.0006$) and elementary school.

Economic level and prevalence of *C. sinensis* infection

Among 340,441 residents surveyed, 1,181 of the 100,604 from affluent counties and 696 of the 136,992 from middle economic counties were infected; the remainder were from poor counties. The prevalence in rich counties (1.17%) was 2.29 and 6.50 times higher than that in middle-income counties (0.51%) and poor counties (0.18%), respectively, while the prevalence in middle-income counties was 2.83 times higher than in poor counties.

Multifactor analysis

There were 16 factors that might affect the prevalence of *C. sinensis*: eating raw or under cooked fish or raw shrimp, feeding their cat with raw fish, contaminated chopping block or bowl, eating food with hand contaminated with raw fish, fertilizing with unprocessed feces,

Table 3
Occupation of *C. sinensis* infected participants in Guangdong, Guangxi, Jilin, Anhui and Heilongjiang.

Occupation	No. examined	No. infected	Prevalence (%)
Fisherman	57	16	28.07
Businessman	234	21	8.97
Civil servant, doctor, teacher	1,014	61	6.02
Factory worker	1,336	59	4.42
Farmer	36,166	1,525	4.22
Private sector	519	19	3.67
Housewife	1,193	26	2.18
Student	14,799	184	1.24
Unemployed	548	5	0.91
Pre-school children	5,928	50	0.84
Retiree	393	13	3.30
Others	249	3	1.20
Total	62,436	1,982	3.20

Table 4
Education level, prevalence and intensity of *C. sinensis* infection.

Education	No. examined	No. infected	Prevalence (%)	No. persons in different intensities (ratio, %)		
				Light	Moderate	Heavy
Pre-school children	5,928	50	0.84	49 (98.00)	1 (2.00)	0 (0.00)
Illiterates	3,899	116	2.98	101 (87.07)	15 (12.93)	0 (0.00)
Elementary school	25,269	654	2.59	549 (83.94)	94 (14.37)	11 (1.68)
Junior high school	22,421	899	4.01	730 (81.20)	122 (13.57)	47 (5.23)
Senior high school and above	4,919	263	5.35	218 (82.89)	35 (13.31)	10 (3.80)
Total	62,436	1,982	3.17	1,647 (83.10)	267 (13.47)	68 (3.43)

occupation, education, income, lavatory style, feeding fish with unprocessed feces, lavatory built over or beside a fish pond, holding fish alive in the mouth, etc. On logistic regression analysis of the factors, using $\alpha = 0.05$, the first eight factors had statistical significance. On multivariate analysis (conditional logistic regression) on case-controls, the first 6 were found as risk factors (OR>2); eating raw or under cooked fish were the highest risks, with the OR being 5.850 and 5.222, respectively (Table 5).

DISCUSSION

C. sinensis is the causative agent of human clonorchiasis. This survey revealed clonorchiasis is widely prevalent (17 provinces) with a large population infected. In some areas, such as Guangdong, Jilin, Guangxi, Anhui and Heilongjiang,

Table 5
Multivariate analysis (conditional logistic regression) on the case-control study.

Variable	Parameter estimate	Standard error	p-value	OR	OR 95% CI	
Eating raw or undercooked fish	1.7665	0.1640	<0.0001	5.850	4.242	8.069
Eating underbaked fish	1.6530	0.2271	<0.0001	5.222	3.346	8.150
Eating raw or undercooked shrimp	0.9562	0.1699	<0.0001	2.602	1.865	3.630
Feeding cat (dog or pig) with fresh fish viscera	1.0406	0.1769	<0.0001	2.831	2.001	4.004
Processing cooked food with contaminated chopping block and knife	0.7543	0.2227	0.0007	2.126	1.374	3.290
Using contaminated containers for cooked food	0.8488	0.2268	0.0002	2.337	1.498	3.645

The logistic regression model was verified using maximum likelihood, Score and Wald test. All the tests showed was $p<0.0001$.

it was highly endemic. The prevalence increased by 87.10% compared with the first national survey carried out in 1990 with prevalence of 0.31% (Li *et al*, 2006). Of the 31 provinces surveyed, Jilin, Guangxi and Guangdong had an increase by 7.20, 2.09 and 1.94 fold, respectively. Eating raw fish or raw fish congee, poor knowledge, unhealthy behavior, poor environmental hygiene and inappropriate farming/fishery practices are possible reasons for the increase of clonorchis in humans (Li *et al*, 2006; Fang *et al*, 2008).

The number of infected people recorded from this survey in Guangdong and Guangxi in the south and Jilin and Heilongjiang in the north accounted for 91.14 (1,882/2,065) of the nationwide total, which is a significant increase from 57.60% (2,653/4,606) in 1990. This indicates the above mentioned areas are two heavy endemic areas for clonorchiasis in China.

Data analysis showed the infection rate was higher in the Han and Zhuang minorities, and the more heavily infected cases were found in Guangxi. This may be attributed to the local habit of eating raw fish in Guangxi, where the ethnic Zhuang live, while Han living in the same region was affected by their own food preferences.

The gender and age distribution of those infected with *C. sinensis* reveal the prevalence of infection was higher in men than in women, and the highest infection rate was seen in young and middle age people. This may be explained by the fact that middle age males are usually the breadwinners and have more social activities than females. As the migrating population increases, people move from non-endemic to endemic areas (*eg*, Guangdong), where they become exposed to infection.

Infection rates were higher in those with a higher education and a higher income. The fishermen, businessmen, doctors and teachers had higher infection rates than other occupations, since these people had a greater chance of joining social activities and consuming raw fish. Many educated people, who were aware of the risk of *C. sinensis* infection, still kept eating raw fish, continuing the infected cycle, described as the "knowledge-based self-initiated infection (Zuo *et al*, 1999)". Consequently, these people became a high risk population.

The case-control study showed eating raw or under cooked fish or shrimp were the highest risk factors (OR value is 5.139), but feeding cats with raw fish or using contaminated containers were also high risk behaviors (2.263<OR<5.139). *C. sinensis* transmission in highly endemic in Guangdong, Guangxi, Jilin and Heilongjiang and is closely related to the local habit of consuming "raw fish porridge", sliced raw fish or under cooked fish.

C. sinensis is a food-borne parasitic disease. Changing unhealthy dietary behavior is the most critical measure for prevention. Some authorities believe when a new practice or product is introduced into a social system, educating people may cause them to restrain their behavior. The more a population becomes aware of a practice, the more difficult it is to change behavior (Yang, 2006). In endemic areas, eating raw or undercooked fish has long been a part of dietary customs; therefore, health education regarding clonorchiasis cannot simply inform people about the risk of infection. Changing unhealthy food habits and ensuring safe and healthy food become important topics for development in nutrition hygiene.

REFERENCES

Cao GZ. Prevalent status of clonorchiasis and its control in China. *China Trop Med* 2007; 7: 1455-7.

Coordinating Office of the National Survey on the Important Human Parasitic Diseases. A national survey on current status of the important parasitic diseases in human population. 2005; 23 (suppl): 332-40.

Fang RY,Cheng YD, Li XM, *et al*. Current prevalence of *Clonorchis sinensis* infection in endemic areas of China. *Chin J Parasitol Parasit Dis* 2008; 26: 99-109.

Fang RY, Wu J, Liu Q, *et al*. Investigation and analysis on epidemic status of clonorchiasis in Guangdong Province , China. *Chin J Parasit Dis Control* 2007; 2: 54-56.

Li Xm, Tang YG, Zhang HM, *et al*. The prevailing status and risk factors analysis of the clonorchiasis in Guangxi Autonomous Region. *J Appl Prev Med* 2006; 12: 334-7.

Lin R, Li XM, Lan CG, *et al*. Investigation on the epidemiological factors of *Clonorchis sinensis* infection in an area of south China. *Southeast Asian J Trop Med Public Health* 2005; 36: 1114-7.

Lun ZR, Gasser RB, Lai DH, *et al*. Clonorchiasis: a key foodborne zoonosis in China. *Lancet Infect Dis* 2005; 5: 31-41.

Xu LQ, Yu SH, Xu SH. Distribution and pathogenic impact of human parasites in China. Beijing: People's Medical Publishing House, 2000; 3: 146.

Yang TZ. Study on the dissemination of human immunodeficiency virus risk behaviors in a floating workers coming from the countryside in China. *Chin J Epidemiol* 2006; 27: 264-9.

Yu SH, Kawanaka M, Li XM, Xu LQ, Lan CG, Rui L. Epidemiological investigation on *Clonorchis sinensis* in human population in an area of South China. *Jpn J Infect Dis* 2003; 56: 168-71.

Zuo SL, Gui AF, Yang LD. The transmission status and countermeasure of *C. sinensis*. *Chin J Zoonos* 1999; 15: 92-3.