

Analysis of the Results of Two Nationwide Surveys on *Clonorchis sinensis* Infection in China

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Abstract

Objective To examine *Clonorchis sinensis* infection in China and evaluate the effectiveness of efforts to prevent and control it, two nationwide surveys were undertaken in 31 provinces, autonomous regions, and municipalities (PAMs) during 1988-92 (the 1990 survey) and during 2001-04 (the 2003 survey).

Methods During the period 2001-04, two sampling methods were applied. The first method repeated the stratified cluster random sampling used in the 1990 survey; the second method applied two-characteristic stratified cluster random sampling in 27 PAMs—the 2003 endemic area (EA) survey. The Kato-Katz thick smear method was used for the nationwide survey.

Results The infection rates of *Clonorchis sinensis* in the 1990 and 2003 surveys were 0.311% and 0.579%, respectively. The infection rate was 2.40% in the 2003 EA survey, and it was estimated that 12.49 million people in China were infected with *Clonorchis sinensis*.

Conclusion The 2003 survey showed that the standardized infection rate of *Clonorchis sinensis* increased by 74.85% compared with the 1990 survey. The infection rate in males was higher than in females; the infection rate among people eating raw fish or eating out frequently was higher than among those who did not.

Key words: *Clonorchis sinensis*; Two nationwide surveys; The status of infection in China

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INTRODUCTION

As a foodborne disease resulting from eating raw or undercooked freshwater fish or shrimp, *Clonorchis sinensis* infection presents a serious health threat. To examine the status of *Clonorchis sinensis* infection in China and evaluate efforts to prevent and control it—and thereby provide a scientific basis for formulating strategies against this infection—two nationwide surveys were undertaken in 31 provinces, autonomous regions, and municipalities (PAMs; excluding Taiwan, Hong Kong, and Macao) in 1990 and 2003. A comparison of the findings of these two

surveys throws considerable light on the status of *Clonorchis sinensis* infection in China.

MATERIALS AND METHODS

Sampling Method and Sample Size

During the period 1988-92, when the distribution of *Clonorchis sinensis* infection in China was unclear, the stratified cluster random sampling method was used, taking the provincial level as the principal stratum. For the first substratum, the provinces were divided into several districts according to topographic features

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or location. For the second substratum, the first substratum was divided into three different types of counties according to the level of economic, sanitary, and cultural development. For the third substratum, the randomly selected second substratum was again divided into three different types of townships according to their economic, sanitary, and cultural development status. The sampling spots were randomly selected from these townships^[1].

In the first survey, 30 PAMs (Chongqing was then part of Sichuan Province), 726 counties (cities), 2 848 sampling spots, and 1 477 742 people. were investigated. Since most of the field surveys were conducted in 1990, this survey is termed the 1990 survey^[2].

During the second investigation period of 2001-04, two sampling methods were used. The first method was used for comparison with the 1990 survey, and it repeated the stratified cluster random sampling based on the level of economic development and topographic features; 356 629 individuals from 687 sampling spots in 229 counties (cities) involved in the 1990 survey were again investigated. Since most of the field surveys were carried out in 2003, this is termed the 2003 survey^[1-2].

The second method was the two-characteristic stratified cluster random sampling based on the water system and epidemic situation in 27 PAMs used in the 1990 survey so as to assess the endemic situation of *Clonorchis sinensis* infection in recent years. A total of 217 829 people from 423 sampling spots in 141 counties (cities) in the 27 provinces were investigated. Since most of the field survey was completed in 2003, this is termed the 2003 endemic area (EA) survey.

Survey Method

The Kato-Katz (one stool specimen-one slide) method was used for the nationwide survey; for the EA survey, the method used was one stool specimen-three slides. The control group was set up in the ratio of 1:4, namely 1 infected person detected to 4 uninfected healthy persons from the same sex and age groups (age difference not over 5 years).

Statistical Analysis

Epidata 2.0 was used to establish the database, and SAS 8.2 software was used for statistical analysis. Taking the age and sex constituents of the whole country in 2001 as a standard, the weighted infection rate was calculated by taking the

proportion of the population of each PAM to the total population of all PAMs investigated as the weighting.

RESULTS

Infection Rate and Standardized Infection Rate of *Clonorchis sinensis* in China

The infection rate and standardized rate in 1990 and 2003 are listed in Table 1.

Table 1. Infection Rate and Standardized Infection rate of *Clonorchis sinensis* According to the Two Nationwide Surveys

Year		Number of Persons Investigated	Infection Rate (%)	Standardized Infection Rate (%)
1990		1 477 742	0.311	0.334
2003	Nationwide Survey	356 629	0.579	0.584
	Endemic Area Survey	217 829	2.401	2.387

Geographic Distribution

Among the 30 PAMs investigated in the 1990 survey, 22 had individuals infected with *Clonorchis sinensis*, and 12 had standardized infection rates of over 0.1%. The rate was highest in Guangdong (2.089%), followed by Guangxi (1.390%), Anhui (1.368%), Heilongjiang (1.187%), and Jilin (0.565%); these were all higher than the average level in China for that year (0.344%)^[2].

Among the 31 provinces investigated in the 2003 survey, 17 had individuals infected with *Clonorchis sinensis*, and seven had standardized infection rates of over 0.1%. The rate was highest in Guangdong (6.198%), followed by Jilin (4.631%), Guangxi (4.006%), and Anhui (1.368%); they were all higher than the average level in China in that survey (0.584%)^[3] (Table 2).

Among the 27 provinces investigated in the 2003 EA survey, 19 had individuals infected with *Clonorchis sinensis*, and 14 had standardized infection rates of over 0.1%. The highest rate was in Guangdong (17.477%), followed by Guangxi (9.443%), Heilongjiang (4.539%), and Jilin (2.794%); these were all higher than the average level in China in that survey (2.387%)^[3] (Table 2).

Population Distribution

Both surveys revealed that *Clonorchis sinensis* infection was higher in males than in females (Table 3).

Table 2. Standardized Infection Rate and Infection Rate in the Two Surveys

Province	Standardized Infection Rate (Infection Rate) %		
	1990 Nationwide Survey	2003 Nationwide Survey	2003 EA Survey
Guangdong	2.089 (1.824)	6.198 (5.354)	17.477 (16.417)
Guangxi	1.390 (1.201)	4.006 (3.708)	9.443 (9.757)
Anhui	1.368 (1.441)	0.647 (0.672)	0.695 (0.722)
Heilongjiang	1.187 (1.184)	0.456 (0.480)	4.539 (4.726)
Jilin	0.565 (0.582)	4.631 (4.770)	2.794 (2.899)
Hainan	0.421 (0.402)	0.155 (0.139)	0.374 (0.383)
Sichuan	0.388 (0.396)	0.031 (0.032)	0.179 (0.205)
Jiangsu	0.302 (0.301)	0.134 (0.124)	0.716 (0.741)
Tianjin	0.187 (0.190)	0.009 (0.013)	0.412 (0.400)
Henan	0.160 (0.157)	0.044 (0.046)	0.131 (0.124)
Shandong	0.122 (0.123)	0.086 (0.086)	0.044 (0.044)
Liaoning	0.108 (0.113)	0 (0)	0.728 (0.799)
Hubei	0.098 (0.094)	0.013 (0.013)	0.041 (0.043)
Gansu	0.095 (0.098)	0 (0)	0 (0)
Fujian	0.068 (0.077)	0 (0)	0.608 (0.605)
Hunan	0.055 (0.052)	0.033 (0.033)	1.272 (1.328)
Jiangxi	0.055 (0.056)	0.048 (0.045)	0 (0)
Beijing	0.052 (0.055)	0 (0)	0 (0)
Xinjiang	0.039 (0.034)	0.054 (0.059)	0.038 (0.042)
Shanghai	0.003 (0.003)	0 (0)	0 (0)
Hebei	0.003 (0.003)	0 (0)	0.019 (0.023)
Shanxi	0.002 (0.002)	0 (0)	0 (0)
Zhejiang	0 (0)	0.031 (0.032)	0 (0)
Chongqing	(Not Separated from Sichuan)	0.033 (0.038)	1.162 (1.176)
Guizhou	0 (0)	0 (0)	0.036 (0.038)
Inner Mongolia	0 (0)	0 (0)	0 (0)
Yunnan	0 (0)	0 (0)	0 (0)
Shaanxi	0 (0)	0 (0)	0 (0)
Qinghai	0 (0)	0 (0)	0 (0)
Ningxia	0 (0)	0 (0)	0 (0)
Tibet	0 (0)	0 (0)	0 (0)

Table 3. *Clonorchis sinensis* Infection Rate by Sex according to the Two Surveys

Year	Sex	Number of Persons Investigated	Number of Persons Infected	Infection Rate (%)	
1990	Male	733 143	2 758	0.376	
	Female	744 599	1 848	0.248	
2003	Nationwide Survey	Male	1 290	0.719	
		Female	177 288	775	0.437
	Survey in Endemic Areas	Male	111 262	3 267	2.936
		Female	106 567	1 963	1.842

According to the 1990 survey, the highest infection rate was in the age group of 30-34 years (0.440%), followed by the group aged 45-49 years (0.426%), the group aged 35-39 years (0.0414); the lowest infection rates were in the group aged 0-4 years (0.066%) and that aged 5-9 years (0.147%).

In the 2003 nationwide survey, the highest infection rate was in the age group of 35-39 years (0.802%), followed by the group aged 30-34 years (0.795%). The lowest infection rates were in the group aged 0-4 years (0.103%) and that aged 5-9 years (0.246%).

In the 2003 EA survey, the highest infection rate was in the age group of 50-54 years (3.164%), followed by the group aged 45-49 years (3.113%). The lowest infection rates were in the group aged 0-4 years (0.807%) and that aged 5-9 years (0.954%) (Table 4).

Table 4. *Clonorchis sinensis* Infection Rate in Different Age Groups according to the Two Surveys

Age Group	1990 Survey		2003 Nationwide Survey		2003 EA Survey	
	Number of Persons Investigated	Infection Rate (%)	Number of Persons Investigated	Infection Rate (%)	Number of Persons Investigated	Infection Rate (%)
0-	128 980	0.066	18 517	0.103	9 295	0.807
5-	169 420	0.147	31 346	0.246	17 288	0.954
10-	165 817	0.203	40 463	0.257	24 238	1.234
15-	142 303	0.339	23 171	0.445	14 586	1.803
20-	129 498	0.400	17 915	0.608	11 462	2.678
25-	123 196	0.387	24 931	0.710	15 297	2.948
30-	125 050	0.440	35 471	0.795	22 575	2.870
35-	123 921	0.414	35 913	0.802	22 518	2.851
40-	88 886	0.399	24 585	0.728	15 300	3.052
45-	63 594	0.426	27 424	0.704	17 442	3.113
50-	60 075	0.395	23 547	0.743	15 424	3.164
55-	51 104	0.366	16 373	0.745	10 438	2.960
60-	43 481	0.380	13 145	0.654	8 016	2.769
65-	29 119	0.289	10 316	0.727	6 120	2.631
70-	18 786	0.277	7 290	0.604	4 284	2.218
75-	9 405	0.351	3 929	0.636	2 211	2.849
80-	5 107	0.196	2 293	0.305	1 335	2.397
Total	1 477 742	0.312	356 629	0.579	217 829	2.401

Preschool Children, Students, and People with Various Occupations

According to the 1990 survey among preschool children, students, and people with various occupations (farmers, factoryworkers, herdsman, fishermen, businessmen, part-time farmers/part-time businessmen, government employees, teachers, and retirees), the highest *Clonorchis sinensis* infection rate was in the

part-time farmers/part-time businessman (2.407%), followed by businessmen (0.0787%), teachers (0.593%), and government employees (0.500%); the lowest infection rate was in herdsmen (0%).

In the 2003 nationwide survey, the highest infection rate was in fishermen (2.279%), followed by teachers (1.728%), part-time farmers/part-time businessmen (1.373%), and government employees (0.891%). The lowest infection rate was in preschool children (0.189%).

In the 2003 EA survey, the highest infection rate was in businessmen (13.420%), followed by workers (7.898%), retirees (5.275%), and teachers (4.884%). The lowest infection rate was in preschool children (0.916%).

DISCUSSION

The results of the 2003 survey regarding the geographic and demographic distribution were essentially similar to those of the 1990 survey. In China, epidemic rates of *Clonorchis sinensis* infection were found to occur only in a few PAMs. In both the 1990 and 2003 surveys, the six provinces with high infection rates were Guangdong, Guangxi, Jilin, Heilongjiang, Anhui, and Hainan. The proportion of infected individuals in these six provinces and autonomous regions was 75.315% (3 469/4 606), while the overall national proportion of infected individuals was 96.513% (1 993/2 065). In the 2003 EA survey, the six provinces with the highest infection rates were Guangdong, Guangxi, Heilongjiang, Jilin, Hunan, and Chongqing. These six PAMs accounted for 91.472% (4 784/5 230) of all infected individuals in the entire survey.

In the two nationwide surveys and the 2003 EA survey, the infection rate in males was higher than in females (Table 3). Further, the infection rates in individuals aged 0-14 years was lower than in those older than 15 years. Within the age ranges of 0-34 years (1990 survey), 0-39 years (2003 survey), and 0-54 years (2003 EA survey), the infection rates increased with age. The two nationwide surveys and the 2003 EA survey of preschool children, students,

and people with various occupations indicated that the infection rate among individuals who ate raw fish or ate out more frequently, e.g., businessmen, part-time farmers/part-time businessmen, fishermen, government employees, and teachers, was higher than among preschool children and herdsmen.

In some areas in China the *Clonorchis sinensis* infection rate increased significantly. In 31 PAMs, the standardized infection rate of *Clonorchis sinensis* was 0.584% in the 2003 survey. This represents an increase of 74.85% compared with the results of the 1990 survey (0.334%). The infection rates in Guangdong, Guangxi, and Jilin increased more significantly than in other provinces-by 182.712%, 164.248%, and 630.442%, respectively. From the results of the EA survey among 27 PAMs, it was estimated that 12.49 million individuals in China were infected with *Clonorchis sinensis*. Thus, controlling the spread of *Clonorchis sinensis* infection is a matter of urgency. The most effective way to prevent such infections is to persuade people to stop consuming raw or undercooked freshwater fish. This, however, is no small task since the eating of such fish is part of the dietary culture in endemic areas of China. Therefore, health education with regard to *Clonorchis sinensis* has to be properly implemented. Convincing people to give up unhealthy dietary habits so as to ensure safety and raise the sanitary standard of food is the most pressing problem in dietary culture^[4].

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