



ORIGINAL ARTICLE

Prevalence and Risk Factors of Clonorchiasis among the Populations Served by Primary Healthcare Posts along Five Major Rivers in South Korea

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Abstract

Objectives: Clonorchiasis is an infectious disease caused by the Chinese liver fluke *Clonorchis sinensis*. In this study, we investigated the prevalence and risk factors of clonorchiasis among the populations served by primary healthcare posts along five major rivers in South Korea.

Methods: Forty primary healthcare posts that are located less than 5 km from one of the five rivers were selected from 26 counties. For the purpose of the survey, community health practitioners selected the nearest villages from the riversides in their own catchment area. From January to May 2009, a total of 2788 stool samples were collected and examined using the formalin–ether sedimentation technique. Village inhabitants were also interviewed by means of questionnaires in order to obtain information on potential risk factors.

Results: The prevalence rates of clonorchiasis at various river basins were as follows: Seomjin River, 21.3%; Nakdong River, 13.5%; Geum River, 9.2%; Han River, 7.6%; and Yeongsan River, 4.9%. The total number of people infected with *C. sinensis* was 329 (11.3%). By gender, 14.3% of males and 7.6% of females were infected. In case of both males and females, the prevalence rate was highest in those in their 40s. Consumption of raw freshwater fish was confirmed as a risk factor based on a logistic regression analysis.

Conclusion: The present findings suggest that clonorchiasis is still highly prevalent among the inhabitants of riverside areas in southern Korea, and, accordingly, it is necessary to implement a systematic control program in the endemic areas.

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1. Introduction

Korea is considered to be a successful country with regard to the parasite control programs that it has implemented during the country's period of rapid economic growth over the last 50 years. National surveys and group medication programs have been conducted periodically, and health education and campaigns have been executed widely for the prevention of parasite infection. As a consequence of these measures, the intestinal parasite infection rate decreased to 3.7% in 2004 [1]. However, the prevalence of *Clonorchis sinensis* has not decreased since the 1990s and has been endemic, particularly in riverside areas. According to the results of a national survey conducted using a stratified sample, the prevalence rate was 2.9% in 2004; however, a survey of endemic areas conducted in 2007 indicated that the rate was as high as 9.5% on average in the riverside areas surveyed [2].

In order to lower the *C. sinensis* positive rate, it is necessary to manage riverside endemic areas continuously. In the 1990s, medication was made available to 100 rural residents in Korea for 3.5 years at 6-month intervals and, as a result, the *C. sinensis* positive rate decreased [3]. For example, as a consequence of 6 years' continuous management at Gokseong-gun in the Seomjin River basin, the positive rate decreased from 26.9% to 13.1% [4]. Similarly, in China, the positive rate has decreased as a consequence of annual examinations and medication programs in areas showing an average *C. sinensis* positive rate. However, despite these measures, cases of reinfection and unsuccessful treatment have been reported and newly infected persons have also been identified [5].

According to the results of previous studies, the major risk factor of *C. sinensis* infection is the consumption of raw freshwater fish, and the risk of infection is highest in middle-aged men and higher in rural areas than in urban areas [6,7]. An obvious means of reducing infection would be to change such dietary habits; however, the habit of raw freshwater fish consumption cannot be changed in a short period of time. Moreover, successful administration of the drug praziquantel is difficult; it is also difficult to change the drinking habits of middle-aged men. Accordingly, accurate knowledge should be spread through health education, and control strategies should be developed continuously in order to manage drug administration for infected persons, prevent reinfection, and change community culture.

This study was conducted as a baseline survey with the aim of developing a program for continuous *C. sinensis* control, based on primary healthcare posts that provide primary healthcare services to residents in riverside areas where *C. sinensis* is endemic.

2. Materials and Methods

2.1. Survey areas

Among 26 counties in South Korea, we selected 40 primary healthcare posts that are located less than 5 km from one of the following five major rivers: Geum, Han, Nakdong, Seomjin, and Yeongsan. Community health practitioners selected the nearest villages from the riversides in their own catchment area. A total of 2788 participants were screened for *C. sinensis* and some were interviewed in selected localities. The study was undertaken from January to May 2009.

2.2. Stool collection and examination

Informed consent was obtained from all the participants, and the study protocol was approved by the IRB committee of Soonchunhyang University Hospital.

Stool specimens were collected in plastic containers and transferred to the laboratory of the National Institutes of Health. The formalin–ether sedimentation technique was used to identify the presence of the *C. sinensis* eggs. One gram of each fecal sample was fixed with 10% neutral formalin in a 10 mL test tube. The formalin-fixed stool specimen was further processed using the formalin–ether concentration technique and examined for parasites in the laboratory.

2.3. Questionnaire survey

We also conducted a questionnaire survey of the participants. The questionnaire included questions on sociodemographic characteristics, health behaviors, consumption of raw freshwater fish, and past history of *C. sinensis* infection. Each participant was interviewed by a community health practitioner working in his/her village.

2.4. Statistical analysis

Descriptive statistics were applied to determine the prevalence rates of clonorchiasis. Unconditional multiple logistic regression was used to evaluate odds ratios and 95% confidence intervals of being egg positive according to various characteristics (Table 1). Statistical analyses were performed using SPSS WIN 17.0 software.

3. Results

Among the 2,614 persons surveyed, 300 (11.4%) were found to be positive (Table 2). The positive rate was higher in men (14.8%) than in women (7.8%). Categorized according to riverside area, the rate was highest along the Seomjin River (21.5%), followed by the rivers Nakdong (13.8%), Geum (9.3%), Han (7.9%), and Yeongsan (4.8%). Of the primary healthcare posts, four along the Seomjin River and one by the Han River recorded a positive rate of greater than 30%, with the

Table 1. OR and corresponding 95% CI for the presence of *C. sinensis* in stools according to selected characteristics

Characteristic		OR	95% CI
Gender	Female	Reference	
	Male	1.501	0.838–2.691
Age (y)	≤49	Reference	
	50–59	0.698	0.336–1.450
	60–69	0.848	0.428–1.682
	≥70	1.120	0.555–2.261
Smoking	Never	Reference	
	Ex-smoker	0.885	0.490–1.599
	Current smoker	1.049	0.586–1.879
Alcohol drinking	Never	Reference	
	≤1/mo	0.621	0.316–1.219
	2–4/mo	1.352	0.728–2.511
	2–3/wk	1.097	0.594–2.026
	≥4/wk	1.353	0.725–2.527
Raw freshwater fish consumption	Never	Reference	
	Yes	2.581	1.175–5.672
Intent to change the habit of raw freshwater consumption	Yes	Reference	
	No	0.892	0.594–1.415
Past history of <i>C. sinensis</i> infection	Never	Reference	
	Yes	0.944	0.630–1.339

CI = confidence interval; OR = odds ratio.

Geumcheon Health Center by the Seomjin River showing the highest positive rate (38.4%).

Among men, the positive rate was highest among those in their 40s (17.6%), and was higher in those with smoking experience (16.6%) than in those without it (Table 3). In addition, the positive rate was higher in those drinking four or more times a week (17.8%) than in those drinking less frequently. The rate was also higher in those who had consumed raw freshwater fish (16.3%) than in those who had not, and was somewhat higher in those who replied that they would not change their habit of consuming raw fish (16.5%) than in those who intended to change the habit. It was also somewhat higher in those with a previous experience of infection. Drinking frequency and consumption of raw freshwater fish were found to be the factors contributing to a statistically significant difference in the positive rate.

In contrast, among women, the positive rate was higher in those in their 60s (9.3%) than in those in other age groups and in those with smoking experience (14.3%) than in those without it (Table 4). With respect to drinking frequency, the positive rate was highest in those drinking two to four times a month (12.2%). Further, the rate was as high as 12.5% in those with a previous experience of infection, and was significantly higher in those with the habit of raw freshwater fish consumption and in those who indicated that they would not change the habit.

Logistic regression analysis that included all the demographic characteristics and behavioral characteristics indicated that the risk of infection was 2.58 times higher in those with the habit of raw freshwater fish consumption than in those without the habit.

4. Discussion

The overall positive rate in the survey areas of the present study is similar to that recorded in a 2007 survey conducted in endemic areas in the basins of four major South Korean rivers [2]. As a result of continuous management at Gokseong-gun in the basin of the Seomjin River, the positive rate was reported to have decreased from 25.05% in 1999 to 10.4% in 2005 [4]; however, in the present study, the rate exceeded 30% at four of the primary healthcare posts along the Seomjin River. Moreover, although the positive rate was found to be 2.1% in Chuncheon by the Bukhan River and 7.8% in Chungju by the Namhan River [7], there was an area in the present study where the positive rate exceeded 30%. Thus, there were significant differences among different river basins and even among areas within the same river basin. This is probably because, in contrast to previous studies, our study sampled residents living close to the rivers and examined only a small number of individuals based on their proximity to primary healthcare posts [8]. Accordingly, in order to survey the current state of *C. sinensis* infection, it is considered more desirable to select high-risk areas showing a markedly high positive rate among the primary healthcare posts of cities, counties, and wards, and to monitor changes in the positive rate of the same areas continuously, than to compare the average positive rates of various river basins.

As in previous studies, the positive rate was higher in men than in women [8]. This may be related to the Korean culture, in which drinking alcohol and consumption of raw freshwater fish are more common

Table 2. Positive rates of *C. sinensis* eggs categorized by river, locality, and gender

River	Localities	No. examined.	No. (%) of positive cases			
			Males	Females	Total	
Guem-gang	1 Geumji	86	5 (6.4)	0 (0.0)	5 (5.8)	
	2 Dosam	70	0 (0.0)	0 (0.0)	0 (0.0)	
	3 Dudong	66	3 (7.3)	1 (4.0)	4 (6.0)	
	4 Dumo	65	1 (3.3)	0 (0.0)	1 (1.5)	
	5 Buri	75	17 (31.5)	1 (4.8)	18 (23.7)	
	6 Wondong	56	12 (46.2)	2 (6.7)	14 (24.6)	
	7 Jangsang	74	2 (5.9)	2 (5.0)	4 (5.4)	
	Subtotal	492	40 (13.7)	6 (3.0)	46 (9.3)	
Han-gang	8 Boktan	50	17 (38.6)	1 (16.7)	18 (36.0)	
	9 Geumkwan	46	7 (16.3)	1 (33.3)	8 (17.4)	
	10 Haho	47	4 (20.0)	1 (3.7)	5 (10.6)	
	11 Hwangsan	51	1 (4.5)	3 (10.3)	4 (7.8)	
	12 Danglim	100	4 (6.6)	1 (2.6)	5 (5.0)	
	13 Dukmok	50	2 (7.4)	0 (0.0)	2 (4.0)	
	14 Bobat	50	1 (2.9)	0 (0.0)	1 (2.0)	
	15 Kwangrak	54	0 (0.0)	1 (4.3)	1 (1.9)	
	16 Gumchun	57	0 (0.0)	0 (0.0)	0 (0.0)	
	17 Suhang	50	0 (0.0)	0 (0.0)	0 (0.0)	
		Subtotal	555	36 (10.7)	8 (3.6)	44 (7.9)
	Yeongsan-gang	18 Guemkang	50	3 (15.8)	4 (12.9)	7 (14.0)
		19 Walak	52	6 (12.8)	1 (20.0)	7 (13.5)
		20 Kwangam	71	3 (8.8)	1 (2.7)	4 (5.6)
		21 Sinhak	47	1 (4.5)	1 (4.0)	2 (4.3)
		22 Bongmyong	55	1 (5.0)	1 (2.9)	2 (3.6)
23 Juksan		93	2 (5.4)	1 (1.8)	3 (3.2)	
24 sinryong		49	0 (0.0)	0 (0.0)	0 (0.0)	
25 Sachang		50	0 (0.0)	0 (0.0)	0 (0.0)	
26 Eungok		50	0 (0.0)	0 (0.0)	0 (0.0)	
		Subtotal	517	16 (6.3)	9 (3.4)	25 (4.8)
Seomjin-gang	27 Geumchun	73	15 (50.0)	13 (30.2)	28 (38.4)	
	28 Kyesan	50	10 (37.0)	8 (34.8)	18 (36.0)	
	29 Dosa	57	14 (51.9)	7 (23.3)	21 (36.8)	
	30 Oegok	50	8 (38.1)	9 (31.0)	17 (34.0)	
	31 Hachun	52	5 (22.7)	7 (23.3)	12 (23.1)	
	32 Bumwang	100	5 (11.1)	2 (3.6)	7 (7.0)	
	33 Hapgang	80	3 (8.1)	2 (4.7)	5 (6.3)	
	34 Aprok	46	0 (0.0)	1 (3.4)	1 (2.2)	
		Subtotal	508	60 (26.5)	49 (17.4)	109 (21.5)
	Nakdong-gang	35 Gobong	129	5 (9.8)	3 (3.8)	8 (6.2)
36 Oryong		68	8 (21.1)	0 (0.0)	8 (11.8)	
37 Yulgok		50	8 (30.8)	3 (12.5)	11 (22.0)	
38 Doheung		90	3 (6.5)	0 (0.0)	3 (3.3)	
39 Sinsung		94	15 (33.3)	8 (16.3)	23 (24.5)	
40 Yangseo		121	11 (23.4)	12 (16.2)	23 (19.0)	
	Subtotal	552	50 (19.8)	26 (8.7)	76 (13.8)	
Total		2624	202 (14.8)	98 (7.8)	300 (11.4)	

among men than among women; men participate in social activities that involve drinking and raw freshwater fish consumption more frequently than women [6–8]. Differences among age groups were not significant; however, attention should be paid to the finding that those in their 40s showed a somewhat higher positive rate. Because the survival period of *C. sinensis* is over

30 years, if infected persons are not treated adequately, they are highly likely to experience reinfection or complications [2]. Those in their 70s also showed a high positive rate, probably because of unsuccessful treatment in the past or repeated reinfections. A positive rate of approximately 16% in those with a previous experience of infection indicates the possibility of reinfection.

Table 3. Differences in *C. sinensis* positive rates according to age and behavioral characteristics among males

Characteristic	Total	No. negative (%)	No. positive (%)	χ^2	<i>p</i>
Age (y)	≤49	204	168 (82.4)	2.773	0.428
	50–59	350	299 (85.4)		
	60–69	454	395 (87.0)		
	≥70	348	293 (84.2)		
Smoking	Never	330	292 (88.5)	4.154	0.125
	Ex-smoker	501	418 (83.4)		
	Current smoker	523	443 (84.7)		
Alcohol drinking	Never	116	105 (90.5)	10.880	0.028
	≤1/mo	91	85 (93.4)		
	2–4/mo	190	163 (85.8)		
	2–3/wk	336	280 (83.3)		
	≥4/wk	371	305 (82.2)		
Raw freshwater fish consumption	Never	219	201 (91.8)	9.325	0.002
	Yes	1119	937 (83.7)		
Intention to change the habit of raw freshwater consumption	Yes	807	694 (86.0)	1.440	0.253
	No	467	390 (83.5)		
Past history of <i>C. sinensis</i> infection	Never	359	297 (82.7)	0.164	0.735
	Yes	215	175 (81.4)		

Previous studies have also reported that the positive rate is higher among the aged and, as a result of treatment effect, highest among those in their 50s and 60s, but decreases thereafter [2,6]. In both men and women, the *C. sinensis* positive rate varies significantly among people depending on whether they have the habit of

consuming raw freshwater fish or not. This is consistent with previous reports and confirms that continuous efforts should be made to change the habit of raw freshwater fish consumption in order to prevent *C. sinensis* infection [2,6]. Consistently, the results of logistic analysis indicated that the habit of raw

Table 4. Differences in *C. sinensis* positive rates according to age and behavioral characteristics among females

Characteristic	Total	No. negative (%)	No. positive (%)	χ^2	<i>p</i>
Age (y)	≤49	156	143 (91.7)	2.580	0.461
	50–59	305	284 (93.1)		
	60–69	430	390 (90.7)		
	≥70	367	343 (93.5)		
Smoking	Never	1202	1110 (92.3)	1.345	0.510
	Ex-smoker	21	18 (85.7)		
	Current smoker	31	29 (93.5)		
Alcohol drinking	Never	639	593 (92.8)	5.109	0.276
	≤1/mo	342	320 (93.0)		
	2–4/mo	139	122 (87.8)		
	2–3/wk	91	84 (92.3)		
	≥4/wk	22	20 (90.9)		
Raw freshwater fish consumption	Never	445	425 (95.5)	10.367	0.001
	Yes	803	726 (90.4)		
Intention to change the habit of raw freshwater consumption	Yes	897	840 (93.6)	10.825	0.002
	No	322	283 (87.9)		
Past history of <i>C. sinensis</i> infection	Negative	272	248 (91.2)	1.203	0.266
	Positive	112	98 (87.5)		

freshwater fish consumption increased the risk of *C. sinensis* infection by approximately 2.5 times, which is higher than that previously reported [6]. Accordingly, in community health surveys, we need to consider using the habit of raw freshwater fish consumption as a screening tool to select high-risk areas or individuals susceptible to *C. sinensis* infection [9,10].

According to the results presented above, prevention of *C. sinensis* infection may be achieved by changing individuals' health behaviors and improving the awareness of communities. Specifically, because *C. sinensis* infection is closely related to the habits of drinking and raw fish consumption, it would be effective to adopt a comprehensive approach as part of the health promotion programs. Further, in order to reduce the chance of reinfection in *C. sinensis*-positive persons, it is necessary to enhance their compliance with treatment regimens and change their health behaviors through regular education and consultation after medication.

To date, *C. sinensis* control has been conducted through demonstration projects limited to some localities or nationwide centering on examination, medication, and campaigns by public health centers at the county level. However, these efforts have not succeeded in persuading residents in endemic areas to change their habit of raw fish consumption, and, consequently, they have not been successful in decreasing the *C. sinensis* positive rate continuously. On the basis of the results of this study, we suggest developing a program for primary healthcare posts in the high-risk areas of the five major rivers surveyed to control *C. sinensis* infection, execute such control programs continuously, and evaluate the effect.

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