

Prevalence of Clonorchiasis in Southern Endemic Areas of Korea in 2006

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Abstract: This study was performed to investigate prevalence of clonorchiasis among the inhabitants living in villages along the 4 major rivers, Nakdong-gang (= river), Seomjin-gang, Youngsan-gang, and Guem-gang in southern Korea. From January to December 2006, a total of 24,075 stool samples (1 sample per an inhabitant) were collected in 23 localities and examined by the formalin-ether sedimentation technique. Of the inhabitants examined, 3,441 (14.3%) were found to harbor various types of intestinal parasite eggs, cysts or larvae. Numbers of infected people were 2,661 (11.1%) for *Clonorchis sinensis*, 431 (1.8%) for heterophyids, 226 (0.9%) for *Entamoeba* spp., 57 (0.2%) for *Giardia lamblia*, 30 (0.1%) for *Trichuris trichiura*, and 18 (0.07%) for echinostomes. Prevalence rates of clonorchiasis according to the river basin were 17.1% in Nakdong-gang, 11.2% in Seomjin-gang, 5.5% in Youngsan-gang and 4.6% in Guem-gang. Of the 2,661 *C. sinensis* egg-positive cases, 57.7% was male. The present findings suggest that clonorchiasis is still highly prevalent among inhabitants in the riverside areas of southern Korea, and it is necessary to implement a systematic control program in the endemic areas.

Key words: *Clonorchis sinensis*, prevalence, fecal examination

INTRODUCTION

Human helminthiasis has been highly endemic in Korea for a long time. In the past, it was distributed along most major river basins over the country. A rapid decrease in the overall prevalence of intestinal parasites during the past decade is attributed by continuous efforts for nationwide control programs undertaken by the Korean government to reduce the prevalence of soil-transmitted nematode infections and to improve hygiene and sanitary conditions of Koreans. However, despite this remarkable control of soil-transmitted nematode infections, the prevalence of fish-borne trematode infections such as with *C. sinensis* and *Metagonimus* spp. has maintained at relatively high levels, particularly in riverside areas [1].

Clonorchiasis is endemic in East Asian countries with estimated infections of 35 million people [2]. National surveys revealed egg positive rates of *C. sinensis* in general population as 4.6% in

1971, 1.8% in 1976, 2.6% in 1981, 2.7% in 1986, 2.2% in 1992, 1.4% in 1997, and 2.9% in 2004 [3]. The infection of *C. sinensis* is contracted by eating undercooked fishes which harbor the metacercariae. Contaminated fishes are mainly found from streams and rivers where the freshwater snails, *Parafossarulus manchouricus* thrive. Especially, many endemic foci of *C. sinensis* were located along the 7 major rivers of South Korea. In 1981, the egg positive rates of people living in those river basins differed considerably; 40.2% in Nakdong-gang (= river), 30.8% in Yeongsan-gang, 17.3% in Seomjin-gang, 15.7% in Han-gang, 15.9% in Tamjin-gang, 12.0% in Geum-gang, and 8.0% in Mangyeong-gang [4]. The liver fluke in the biliary passage provokes severe pathological changes therein, such as bile duct dilatation, ductal wall thickening, ductal inflammation, biliary mucosal hyperplasia, and biliary cirrhosis [1]. *C. sinensis* was found to induce cholangiocarcinoma in experimental hamsters as a promoter [5]. Clonorchiasis has been recognized as one of risk factors of development of cholangiocarcinoma in humans [6-8].

The present survey on the prevalence and distribution of human clonorchiasis endemic in Korea is one of the prerequi-

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sites for the government to implement its national control measures. Although some local data are previously available on this issue, no nationwide surveys have been conducted to determine the breadth of the problem. In this study, we evaluated the prevalence and distribution of clonorchiasis in a large scale survey and compared the endemicity among the endemic areas scattered in the southern part of Korean Peninsula.

MATERIALS AND METHODS

Surveyed area

Twenty-three counties were selected in 4 river basins which were located near or alongside the major rivers of Korea, for this study with reference to the nationwide survey in 2004 [3] (Fig. 1). A total of 24,075 inhabitants (male 11,090 and female 12,985) were screened of their intestinal parasites in the selected localities (Table 1). This study was undertaken for 1 yr from January to December, 2006.

Stool collection and examination

Stool specimens were collected in plastic containers and transferred to the laboratory of National Institute of Health (NIH). The subjects for stool sampling were recruited from villages by

a random household sampling method to assess the prevalence of parasitic infection. The formalin-ether sedimentation technique was used to examine helminth eggs, larvae, and protozoan cysts. 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 by the formalin-ether concentration technique and examined for parasites in the laboratory. Parasite positive individuals were treated with praziquantel and other appropriate anti-parasitic drugs at the end of the study.

Statistical analysis

Comparisons of the prevalence parameters were assessed by the Student's *t*-test. Due to the distribution of the data for statistical significance by variation of intensity of infection was analyzed using the non-parametric analysis of variance. *P* < 0.05 was considered significant.

Table 1. The subject of investigation by the riverside, locality and sex

Riversides	Locality ^a	No. of residents examined		
		Total	Male	Female
Nakdong-gang (River)	1	1,761	853	908
	2	863	377	486
	3	549	232	317
	4	1,001	308	693
	5	397	142	255
	6	1,081	453	628
	7	967	420	547
	8	1,526	815	711
	9	1,032	512	520
	Subtotal	9,177	4,112	5,065
Seomjin-gang (River)	10	1,506	726	780
	11	1,150	563	587
	12	872	387	485
	13	1,046	523	523
	14	981	396	585
	Subtotal	5,555	2,595	2,960
Youngsan-gang (River)	15	1,202	485	717
	16	1,478	671	807
	17	1,277	541	736
	18	1,001	523	478
	Subtotal	4,958	2,220	2,738
Guem-gang (River)	19	921	471	450
	20	811	409	402
	21	692	421	271
	22	849	378	471
	23	1,112	484	628
	Subtotal	4,385	2,163	2,222
Total		24,075	11,090	12,985

^aLocality designated in Fig. 1.

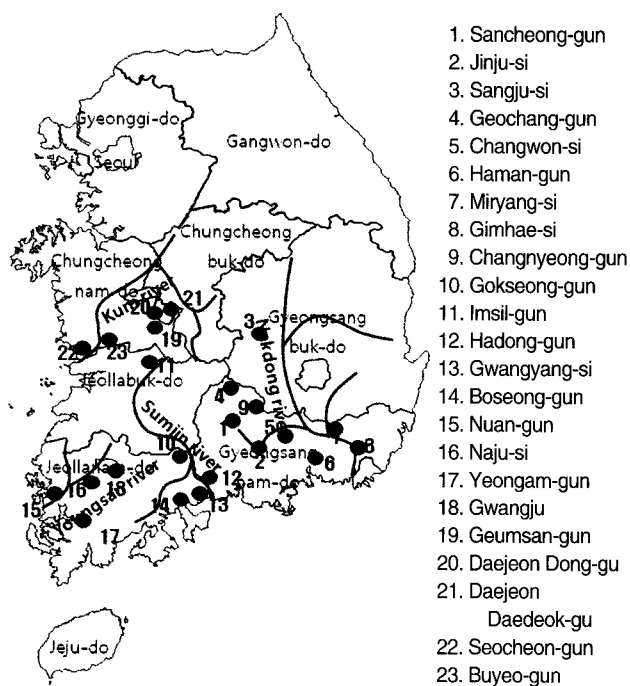


Fig. 1. The surveyed areas (●) and 4 major rivers located in southern parts of Korea.

RESULTS

Positive rate of intestinal parasites

Of 24,075 examined stool samples, 3,441 (14.3%) were found to contain various intestinal parasite eggs, cysts or larvae. The helminth eggs detected were *C. sinensis* 2,661 (11.05%), heterophyids 431 (1.79%), echinostomes 18 (0.075%), *Trichuris trichiura* 30 (0.125%), Hookworms 5 (0.021%), *Ascaris lumbricoides* 4 (0.017%), *Trichostrongylus orientalis* 3 (0.012%), *Taenia* sp. 3 (0.012%), and *Diphyllobothrium latum* 1. Protozoan cysts were observed, *Giardia lamblia* from 57 (0.237%) and *Entamoeba* spp. from 221 (0.918%) individuals (Table 2).

Prevalence of *C. sinensis* by river basin

The positive rates of *C. sinensis* eggs by rivers, localities and sexes were summarized in Table 3. The overall egg positive rate of *C. sinensis* was 11.1%. The highest rate was observed in river basin of Nakdong-gang 17.1%, from 7.4% to 30.6% by counties: 30.6% in Sancheong-gun, 27.9% in Jinju-si, 26.7% in

Changwon-si, 17.3% in Sangju-si, 13.5% in Miryang-si, 13.0% in Haman-gun, and 7.4% in Changnyong-gun (Table 3). In river basin of Seomjin-gang, the egg positive rate varied from 6.5% to 15.3%. In river basin of Youngsan-gang, the egg positive rate varied from 3.6% to 7.5%, and the rate varied from 0.4% to 13.9% in the river basin of Guem-gang. The overall egg positive rate of male inhabitants was 13.6% ranging from 0.4% to 36.5% by river basin, and that of females was 8.9% in average with a range from 0.5% to 25.0% ($P < 0.05$).

Positive rate of *C. sinensis* eggs by age group

To evaluate the prevalence of *C. sinensis* by age group, a total of 23,979 cases of the 24,075 whole examined individuals were subjected to analysis. The positive rate of *C. sinensis* was highest in 50-59 yr group (12.8%), followed by the order of 60-69 (12.6%), 40-49 (11.5%) and 70-79 (9.9%), whereas it decreased in those aged below 40 yr (Table 4).

Table 2. Results of stool examination according to administrative regions

Locality ^a	No. of exam.	No. of positive cases by parasite								Total no. (%) of positive
		Cs	Hetero- phyids	Echino- stomes	Tt	Al	Gl	E sp.	Others	
1	1,761	538	100	6	3	0	3	3	8	661 (37.5)
2	863	241	56	0	1	0	3	4	0	305 (35.3)
3	549	95	0	1	0	0	9	2	3	110 (19.9)
4	1,001	81	14	0	0	0	0	0	0	95 (9.5)
5	397	106	0	0	4	0	0	1	0	111 (28.0)
6	1,081	140	21	0	2	0	0	9	1	173 (16.0)
7	967	131	8	0	1	0	4	2	1	147 (15.2)
8	1,526	158	8	0	4	0	6	7	0	183 (12.0)
9	1,032	76	10	0	0	0	0	6	0	92 (8.9)
10	1,506	159	15	1	1	1	8	21	1	207 (13.7)
11	1,150	75	4	3	0	0	0	9	2	93 (8.1)
12	872	99	85	0	0	1	3	13	0	201 (23.1)
13	1,046	160	24	4	3	1	2	16	1	211 (20.2)
14	981	130	12	1	0	0	3	8	0	154 (15.7)
15	1,202	43	43	0	0	0	2	66	0	159 (13.2)
16	1,478	111	5	0	5	0	4	10	0	135 (9.1)
17	1,277	63	4	2	3	1	3	10	2	88 (6.9)
18	1,001	54	1	0	0	0	1	11	0	67 (6.7)
19	921	128	14	0	1	0	1	3	0	147 (16.0)
20	811	26	3	0	1	0	3	7	0	40 (4.9)
21	692	22	1	0	0	0	1	4	0	28 (4.0)
22	849	20	3	0	1	0	1	4	0	29 (3.4)
23	1,112	5	0	0	0	0	0	5	0	10 (0.9)
Total	24,075	2,661	431	18	30	4	57	221	19	3,441 (14.3)

Cs, *Clonorchis sinensis*; Tt, *Trichuris trichiura*; Al, *Ascaris lumbricoides*; Gl, *Giardia lamblia*; E sp, *Entamoeba*.

^aLocality designated in Fig. 1.

DISCUSSION

The present study recognized that the overall prevalence of intestinal parasites was 14.3%, and 3,117 individuals were infected with trematodes, 42 with nematodes, 4 with cestodes and 283 with protozoa. This result is considerably higher than

Table 3. Positive rates of *Clonorchis sinensis* eggs according to riversides, localities, and sexes

Riversides	Locality ^a	No. of exam.	No. (%) of positive cases in		
			Male	Female	Total
Nakdong-gang	1	1,761	311	227	538 (30.6)
	2	863	134	107	241 (27.9)
	3	549	47	48	95 (17.3)
	4	1,001	39	42	81 (8.1)
	5	397	49	57	106 (26.7)
	6	1,081	70	70	140 (13.0)
	7	967	63	68	131 (13.5)
	8	1,526	105	53	158 (10.4)
	9	1,032	47	29	76 (7.4)
	Subtotal	9,177	865	701	1,566 (17.1)
Seomjin-gang	10	1,506	80	79	159 (10.6)
	11	1,150	52	23	75 (6.5)
	12	872	48	51	99 (11.4)
	13	1,046	81	79	160 (15.3)
	14	981	76	54	130 (13.3)
	Subtotal	5,555	337	286	623 (11.2)
Youngsan-gang	15	1,202	21	22	43 (3.6)
	16	1,478	73	38	111 (7.5)
	17	1,277	35	28	63 (4.9)
	18	1,001	32	22	54 (5.4)
	Subtotal	4,958	161	110	271 (5.5)
Guem-gang	19	921	98	30	128 (13.9)
	20	811	18	8	26 (3.2)
	21	692	14	8	22 (3.2)
	22	849	15	5	20 (2.4)
	23	1,112	2	3	5 (0.4)
	Subtotal	4,385	147	54	201 (4.6)
Total		24,075	1,510 (13.6)	1,151 (8.9)	2,661 (11.1)

^aLocality designated in Fig. 1.

Table 4. Number of egg positive cases of *Clonorchis sinensis* according to riversides and age groups

Riversides	No. of exam.	No. (%) of egg positive cases by age group									Total (%)
		< 19	20-29	30-39	40-49	50-59	60-69	70-79	Over 80	NK ^a	
Nakdong-gang	9,177	6	12	38	195	384	543	286	37	65	1,566 (17.1)
Seomjin-gang	5,555	11	10	15	78	141	186	128	23	30	622 (11.2)
Youngsan-gang	4,958	2	5	12	45	53	87	56	10	1	271 (5.5)
Guem-gang	4,385	1	2	3	14	42	75	55	9	1	202 (4.6)
Total (%)	24,075	20 (2.4)	29 (5.1)	68 (6.3)	332 (11.5)	620 (12.8)	891 (12.6)	525 (9.9)	79 (8.0)	97 (17.8)	2,661 (11.1)

^aNot exactly known.

that of a previous nationwide survey previously performed in 2004 [3]. KCDC and KAHP (2004) surveyed intestinal helminth infections nationwide, and observed a 4.3% egg positive rate [3]. The nationwide survey in 2004 included subjects according to a statistical stratified sampling method upon population census, however, the present study subjected all available residents in villages where clonorchiasis is endemic or suspected. That is the main reason of the higher egg positive rate (11.1%) of *C. sinensis* of the present study than that (2.9%) of the nationwide survey in 2004. In this context, it is more reasonable to compare the present results with those of Seo et al. (1981). That is because Seo et al. (1981) recovered helminth eggs from residents along the major rivers in Korea.

In 1981, the egg positive rate of *C. sinensis* was 15.7% at the river basin of Han-gang, 12.0% at the Geum-gang river basin, 8.0% at the Mangyeong-gang river basin, 30.8% at the Yeongsan-gang river basin, 17.3% at the Seomjin-gang river basin, and 40.2% at the Nakdong-gang river basin [4]. The egg positive rate of the present study was 4.6% at the Geum-gang river basin, 5.5% at the Yeongsan-gang river basin, 11.2% at the Seomjin-gang river basin, and 17.1% at the Nakdong-gang river basin. The egg positive rates at the individual river basins decreased remarkably compared with those at the same river basins in 1981 [4]. However, clonorchiasis is regarded as a persisting helminthiasis in Korea because almost all of other past prevalent helminthiasis have disappeared throughout the country [1]. Especially the river basins of Nakdong-gang and Seomjin-gang are still endemic.

The average egg positive rate of *C. sinensis* among males was 13.6% which ranged from 0.4% to 36.5% by riverside areas, and that among females was 8.9% with a range from 0.5% to 25.0%. The age-specific egg positive rate increased as age increased, reaching a maximum of 12.8% in the 50-59 yr group. The egg positive rate of *C. sinensis* in men was more remarkable than that of whole population, highest in 50-59 yr (12.8%), fol-

lowed in order by 60-69 (12.6%), 40-49 (11.5%), and 70-79 (9.9%). The prevalence of *C. sinensis* by age showed one peak at the age of 40-49 or 50-59 yr in the past [9]. In every endemic area under natural equilibrium of clonorchiasis, the egg positive rate and the infection intensity increase linearly by age up to the 50s or 60s and make a peak, and then rapidly decrease afterwards. Since the life span of *C. sinensis* is known 30 yr or more, the peak is explained as an accumulation effect of life-long re- or super-infection with age. Human body develops no protective impact to re- or super-infection. However, the egg positive rate decreases after the peak in spite of the cumulative effect in the aged groups of 60s or more. This decreasing phenomenon in senior groups may suggest the possibility of shorter life span of residents with clonorchiasis than that of uninfected ones at the endemic areas [10]. Our data updated recent status of clonorchiasis in endemic areas of Korea as reduced egg positive rate and lower intensity of infection compared with those of previous reports [4,9,11,12]. Whole and age-specific egg positive rates have decreased, and the age-specific peak moves to 60s from 40s or 50s. This movement is an outcome of low endemicity by praziquantel medication. In other words, clonorchiasis in the endemic area in Korea is under continuous anthelmintic intervention, and the intervention makes the peak movement. The intervention has reduced also frequencies of complications of clonorchiasis as well as egg positive rate and intensity of infection [13].

Our findings reveal several other helminth eggs than *C. sinensis*, such as heterophyids, *Gymnophalloides seoi*, *Echinostoma* spp., *Fasciola hepatica*, *A. lumbricoides*, *T. trichiura*, hookworms, *T. orientalis* and *D. latum*. These various helminths have been prevalent in whole Korea in the past but most of them are now rapidly disappearing. In most of the southern parts of Korea, however, especially the fish-mediated helminths are still remaining as well as *C. sinensis* [14]. The localities of the helminthic infections are agricultural areas and the environment is well-preserved with minimum pollution.

In conclusion, we confirmed the presence of light to moderate endemicity of clonorchiasis and also observed other intestinal helminths in southern localities of Korea in 2006. Continuous and repeated praziquantel medication is necessary in the endemic areas in Korea.

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