

## Epidemiological studies of *Clonorchis sinensis* in the vicinity of River Ahnseong, Kyungpook Province, Korea

CHONG YOON JOO AND YOUNG AE HONG

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### Abstract

Three snail habitats were found in River Ahnseong, Kyungpook Province, Korea.

The population density of the snails per square meter of the habitats ranged from 5 to 150, with an average of 40. Of the three habitats, Jisan area had snails infected with the cercaria of *C. sinensis*, but the proportion of infected snails was very low, the average being 0.05%.

Seventeen species of fresh-water fish caught in the river were examined for the encysted larvae of *C. sinensis*. Of these, 10 species were infested with the metacercariae of *C. sinensis*. Infection rates varied greatly by fish species and ranged from 12.5% in *Acanthorhodeus taenianalis* to 85.4% in *Pseudorasbora parva*.

In the intensity of infection with *C. sinensis*, *G. atromaculatus* was the most heavily infected species, the average number of metacercariae per gram of the fish flesh being 35.1, followed by *P. parva* with 21.9, and *S. dabryi* with 11.9 cysts. *P. rhombea*, *H. longirostris* and *P. herzi* were moderately infested, with an average number varying from 9.0 to 8.3 cysts.

The infection rate for *C. sinensis* among the residents in the vicinity of River Ahnseong was 11.0% (13.2% in males and 8.5% in females). The difference of infection rate between males and females is found to be statistically significant ( $t > 2$ ). In the age-specific rate of infections, the rate was 2.8% in the 0–9 year age group and 2.5% in the 10–19 year age group. The rate progressively increased by age group, reaching a maximum of 35.4% in the 50–59 year age group, followed by a decrease. In the intensity of *Clonorchis* infections, approximately 80.0% of residents infected with *Clonorchis* had less than 10,000 eggs per gram of feces.

This study indicate that endemic foci of *C. sinensis* exist in the vicinity of River Ahnseong and the prevalence of the liver fluke among the residents is still high.

**Key Words:** *Clonorchis sinensis*, metacercaria, prevalence, fresh-water fish, River Ahnseong

### Introduction

Human clonorchiasis is widely distributed in the middle and southern parts of Korea, chiefly in villages and towns in the vicinity of main rivers and their tributaries such as the Naktong, Yeongsan, Hungsan, Taehwa, Kum, and Han Rivers, lakes and small ponds, and is still recognized as a major public health problem in various parts of Korea. Epidemiological studies on *C. sinensis* in Korea have been carried out by many investigators since Matsumoto's first report on the liver fluke among the residents in Taegu and Yeongcheon districts in 1915.

Nishimura (1943) studied the incidence of *C. sinensis* infection and other intestinal parasites among residents in Taegu and Yeongcheon and reported that an endemic focus of the fluke exists in the vicinity of Yeongcheon. He also found fresh-water fishes from the River Kumho where contained the vector snails with *C. sinensis* cercariae. Hunter *et al.* (1949) reported finding the liver fluke with a 37.0% positive rate among the residents in Taegu City, and Walton and Chyu (1959) estimated that about 4.5 million residents in south Korea were infected by *C. sinensis*, posing a public health problem of considerable magnitude. After the establishment of the first "Five-year economic development plan" in 1962, the results of comprehensive

studies on *C.sinensis* have been reported by Joo and Choi (1974) in Wiseong county; by Joo (1984a) in Taegu City; by Kim *et al.* (1971) in Kyungsan county; by Choi (1978) in Seongju county; by Choi *et al.* (1976), and Joo and Baik (1986) on in several counties of Kyungpook Province, Korea.

Quite recently, Joo (1988) reported that the infection rate of larval trematodes in fresh-water fishes in River Taewha was relatively high, and the total number of metacercariae in the fishes varied greatly by different individuals in 1980 and 1988, and also suggested that clonorchiasis among residents is still wide-spread in Korea.

River Ahnseong running through Kolyung county is situated in the southwestern part of Kyungpook Province, and many small streams drain into the river. There are many unusual eating-houses that sell raw fresh-water fishes to local residents and visitors. However, no epidemiological studies on *C.sinensis* have so far been undertaken in the vicinity of the River Ahnseong.

This report deals with the infection rates for *Clonorchis* larvae in the snail and fish hosts, and the prevalence of the liver fluke among the residents in the vicinity of River Ahnseong.

### Materials and Methods

1. Geographical features of surveyed area: The River Ahnseong, about 40 kilometers in length, has its origin in the South range of the Mt. Odo. The main stream of the river runs through Kolyung county, and then joins with the River Taega in the southern part of Kolyung town, and then it joins the River Naktong in the Kaeki of Ugok myun. There are 10 rivulets in the basin.

Three places in the River Ahnseong, Maechon (1), Anrim (2) in Shangrim myun, and Jisan (3) in Kolyung town were selected as the study areas because of the abundance of the snail, *P.manhouricus* (Fig. 1). The localities are from 50 to 60 meters above sea level and the soil is mainly composed of sand, pebble and rock with mud. The water in the river is fairly constant except 2–3 days after heavy rain. Many types of marsh plants and grasses cover the entire area,

and many kinds of fresh-water fishes and snails live in the water.

2. The snail host survey: The collection of snails were made from late in June to early in September in 1990. The density of the snail population was measured by the approximate number of snails collected per square meter of the river bed.

In order to determine the infection with *Clonorchis* cercariae, the snails were examined using both natural emerging and crushing methods. In the former method 10 snails were put into Petri-dishes containing about 40 ml of tap water for 48 hours, and observations were made on the liberation of cercariae. All the snails in a dish revealing the cercariae were crushed to determine the total percentage of infection.

3. The fish host survey: Fresh-water fishes were caught in the River Ahnseong by netting and fishing. The specific name of the fishes was determined by the keys described by Chung (1977).

The flesh, scales, all fins and tail of the fishes were separated from each fish using a knife, after removal of their intestinal contents, and each material was compressed between two large slides (50×90mm) and examined for the metacercariae of *C.sinensis* under a binocular dissecting microscope.

In order to isolate the metacercariae and to estimate the average number of cysts per gram of flesh, the digestion technique was applied: 1 gram of flesh was mixed with artificial gastric juice (0.2ml of diluted hydrochloric acid and 0.3g of pepsin per 100 ml of distilled water), and the mixture were incubated under the temperature 37–38°C for 30–40 minutes.

4. Survey of *C.sinensis* infection in residents: During the period from October, 1989 to September, 1990, the fecal examination was made in order to the discovery of *Clonorchis* eggs among residents located near the snail habitats.

Stool samples were collected from Shangrim and Baiksan primary school children, Shangrim middle school boys and girls, and the residents in Shangrim myun and Kolyung town, Kyungpook Province. The feces were examined by the MGL technique, and then the Stoll's egg

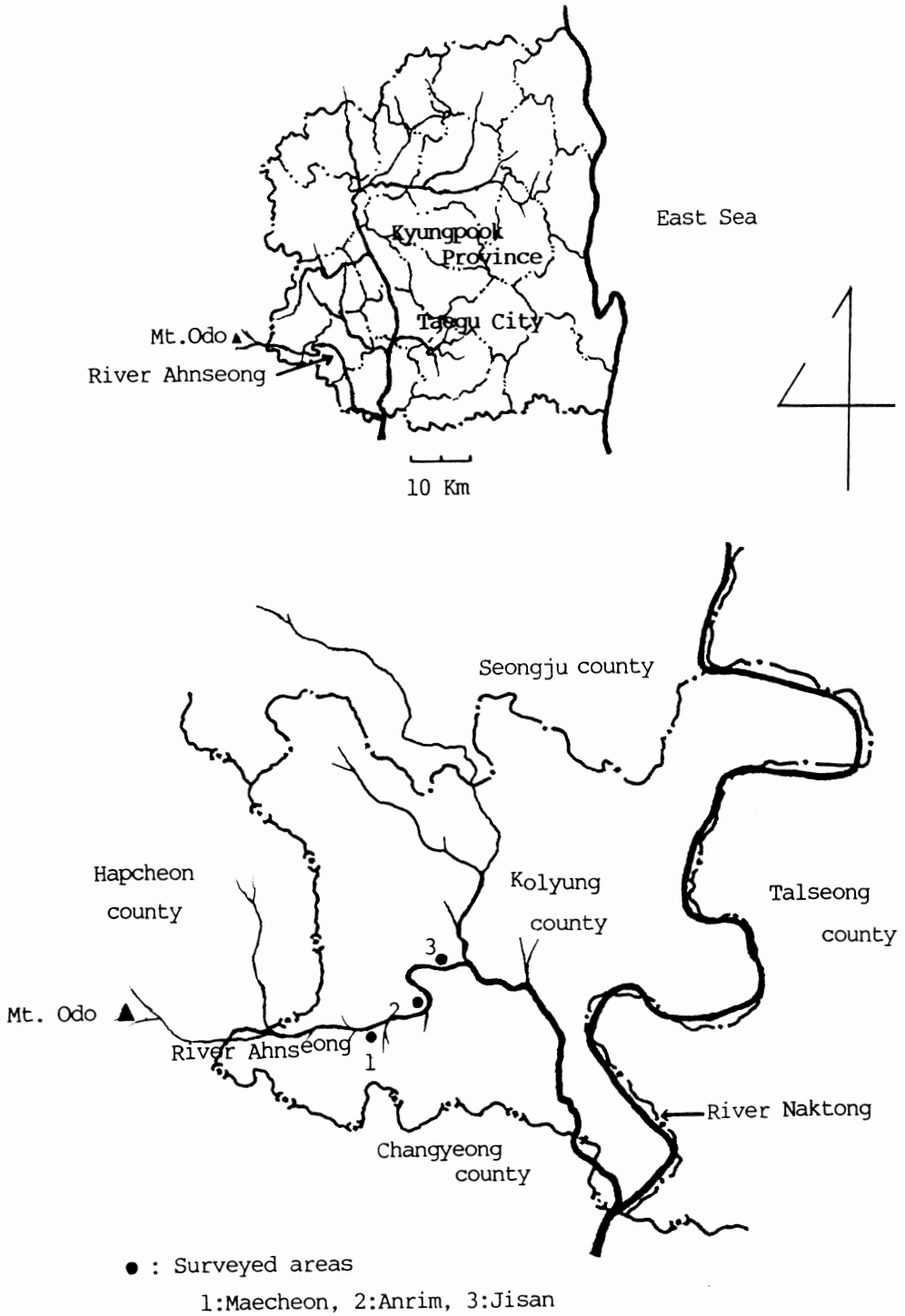


Fig. 1 Map showing the surveyed area in the vicinity of the River Ahnseong, Kyungpook Province, Korea.

count technique was applied.

## Results

The habitats and population density of the snails, *P.manhouricus*, in the vicinity of River Ahnseong, Kyungpook Province is presented in Table 1 and Fig. 1. The black dots in Fig. 1 indicate the snail habitats.

The snails in the river were found on the surface of mud, sand and pebbles in water bed with the water grass, where the water was abundant with sluggish flow. The approximate range of snail habitats was from 500 to 800 meters, and the number of snails collected in the habitats ranged from 5 to 150, with an average of 40 per square meter of river-bed.

Table 2 shows the infection rates of *Clonorchis* cercaria in the snails collected from 3 habitats in the River Ahnseong. The infection rates for *Clonorchis* cercaria were very low. A total of 2,070 snails were examined, of which

only 1 or 0.05% were infected with *C.sinensis* cercaria, while no infection was found in Maechon and Anrim habitats.

Table 3 shows the infection rates and intensity for metacercariae of *C.sinensis* in fishes caught in the River Ahnseong.

Of 17 fish species, 10 kinds were infected with the encysted larvae of *C.sinensis*. The most frequently infected fish was *P.parva*, being found to be 85.4%, followed by *P.herzi*, 77.3%, *P.esocinus*, 72.5%, *G.atromaculatus*, 64.8% and *H.longirostris*, 57.1%. The less frequently infected fishes were *A.taenianalis* and *C.brevicarpus*, 12.5% and 23.1%, respectively. No *Clonorchis* metacercaria was found in flesh, scale, fins and tail of remaining 7 species of fish. The average number of encysted larvae per gram of the fish flesh was few as a whole. Of these, *G.atromaculatus* was the most heavily infected with the larvae and the average number of cysts was 35.1, and *P.parva* was next infected with an average of 21.9 cysts. *H.longirostris*, *P.rhombea*,

Table 1 Habitats and population density of *Parafossarulus manchouricus* in River Ahnseong, Korea

Locality of snail hosts		Approximate range of snail habitats(m)	No. of snails per m <sup>2</sup> of river bed		
Village	Myun* or Town		Maximum	Minimum	Mean
Maechon	Shangrim	500	50	5	25
Anrim	Shangrim	800	100	5	50
Jisan	Kolyung	700	150	10	50

\*Myun means administration unit in a Province

Table 2 Infection rates of *Parafossarulus manchouricus* with *Clonorchis* cercaria in River Ahnseong, Korea

Habitat	No. of snails examined	No. infected	Percent positive
Maechon	594	0	0
Anrim	648	0	0
Jisan	828	1	0.12
Total	2,070	1	0.05

Table 3 Infection rates and intensity of *Clonorchis sinensis* metacercariae from fresh-water fish caught in 5 localities of River Ahnseong, Korea

Scientific name	Length (Cm)	No. of fishes examined	Infection rate (%)	No. of metacercariae per gram of flesh (ea)
Family Cyprinidae				
<i>Acanthorhodeus taenianalis</i> Gunter	5.0–11.0	24	12.5	1.7 (1– 2)†
<i>Carassius carassius</i> Linnaeus	3.8–20.0	57	–	–
<i>Coreoleucicus splendidus</i> Mori	9.5–10.5	2	–	–
<i>Gnathopogon atromaculatus</i> Nichols et Pope	5.5– 7.5	105	64.8	35.1 (1–224)
<i>Hemibarbus longirostris</i> (Regan)	7.0–15.5	21	57.1	8.5 (1– 17)
<i>Moroco oxycephalus</i> (Bleeker)	6.0–11.5	7	–	–
<i>Paracheilognathus rhombea</i> (T et S*)	6.0–11.5	115	37.4	9.0 (2– 89)
<i>Pseudogobio esocinus</i> (T et S)	5.0–14.5	40	72.5	4.0 (1– 20)
<i>Pseudorasbora parva</i> (T et S)	6.0– 9.5	41	85.4	21.9 (1– 98)
<i>Pungtungia herzi</i> Herzenstein	6.5–10.3	128	77.3	8.3 (1– 59)
<i>Saurogobio dabryi</i> Bleeker	6.0–10.0	108	39.8	11.9 (1– 59)
<i>Zacco platypus</i> (T et S)	7.0–13.0	100	–	–
<i>Zacco temmincki</i> (T et S)	7.0–13.0	130	–	–
Family Bagridae				
<i>Coreobagrus brevicorpus</i> Mori	7.0–17.0	26	23.1	9.7 (2– 58)
Family Channidae				
<i>Channa argus</i> (Cantor)	13.5	1	–	–
Family Serranidae				
<i>Coreoperca herzi</i> Herzenstein	6.0–10.0	15	33.3	4.0 (1– 12)
Family Siluridae				
<i>Parasilurus asotus</i> Linnaeus	8.0–13.0	4	–	–

\*T et S: Temminck et Schlegel.

†Number in parentheses means the range

*P.herzi*, *S.dabryi*, and *C.brevicorpus* were moderately infected, with an average number varying from 8.3 to 11.9 cysts. However, *A.taenianalis*, *P.esocinus* and *C.herzi* were less heavily infected, with an average of 1.7 and 4.0 cysts, respectively.

The prevalence of *C.sinensis* infection among residents in the vicinity of River Ahnseong is summarized in Table 4.

A total of 902 residents were examined, and the prevalence of infection was found in 11.0% in this area. The sex specific rate of infection was significantly higher in males than in females (13.2% in males and 8.5% in females).

The age specific rate of infections varied from 1.7 to 46.3% in males and 3.4 to 26.2% in females, and the highest infection occurred in the 40–49 year age group in males and in the 50–59 year age group in females, respectively.

The age-specific rates were somewhat higher in males than in females and the difference was significant in the 40–49 and 50–59 year age groups.

The intensity of *C.sinensis* infections by the Stoll's egg count technique among residents in the vicinity of River Ahnseong is given in Table 5.

The intensity of infection, expressed in eggs per gram of feces (EPG), was divided into 500 egg interval in the first class and 4,500 egg interval in the second, and followed by 5,000 egg intervals for convenience of explanation.

22 cases or 33.8% of the residents with clonorchiasis had less than 500 eggs and 29 cases or 44.6% showed less than 5,000 eggs. Only 4 cases or 6.2% showed heavy infections. The data indicate that most cases of clonorchiasis examined were relatively mild infections of the liver fluke.

### Discussion

The initial report on *C.sinensis* in Korea was made by Matsumoto (1915). He conducted a survey on intestinal helminths by stool examination among the Koreans in Taegu Charity Hospital located in Kyungpook Province, Korea, and reported that the infection rate of the liver fluke was 18.6%.

Kobayashi (1924) first discovered the encysted larvae of *C.sinensis* from several kinds of fresh-water fishes including *P.parva* collected in seven areas of southern Korea, and demonstrated that

Table 4 Prevalence of *Clonorchis sinensis* infections among residents in vicinity of River Ahnseong, Korea

Age group (Year)	Male		Female		Total	
	No. examined	Percent positive	No. examined	Percent positive	No. examined	Percent positive
0–9	93	2.2	84	3.6	177	2.8
10–19	234	1.7	205	3.4	439	2.5
20–29	17	29.4	13	15.4	30	23.3
30–39	19	36.4	22	18.2	41	26.8
40–49	43	46.3	30	10.0	73	31.5
50–59	40	45.0	42	26.2	82	35.4
60–	30	23.3	30	20.0	60	21.7
Total	476	13.2	426	8.5	902	11.0

Table 5 Intensity of *Clonorchis sinensis* infections by the Stoll's egg-count technique among residents in vicinity of River Ahnseong, Korea

Range of EPG	Male		Female		Total	
	No. positive	%	No. positive	%	No. positive	%
0- 500	12	26.1	10	52.6	22	33.8
501- 5,000	21	45.7	8	42.1	29	44.6
5,001-10,000	2	4.3		5.3	3	4.6
10,001-15,000	1	2.2	-	-	1	1.5
15,001-20,000	6	13.0	-	-	6	9.2
20,001-25,000	-	-	-	-	-	-
25,001-	4	8.7	-	-	4	6.2
Total	46		19		65	

fresh-water fishes belonging to the Family Cyprinidae served as the second intermediate host of *C.sinensis*.

Little factual work on *C.sinensis* in Korea was done before the end of World War II, and some studies on the incidence of *C.sinensis* infections and its intermediate hosts were performed by Japanese workers in Korea. The epidemiological studies of *C.sinensis* in Kyungpook Province, Korea were carried out mostly in the vicinity of River Naktong (Kim *et al.*, 1971; Joo and Choi, 1974; Choi *et al.*, 1976; Joo, 1984b), River Kumho (Hwang and Choi, 1980), River Hyungsan (Joo, 1984a), River Taechong (Joo *et al.*, 1983), River Ossep (Lee *et al.*, 1979), River Taega (Choi, 1978), in natural and fish breeding ponds (Kim and Choi, 1981).

As a result of previous studies, the infection rates of *C.sinensis* among residents in the vicinity of rivers in Kyungpook Province were found to be high, ranging from 5.8 to 54.8%. In addition, it has been demonstrated that approximately 10 fish species belonging to Families Cyprinidae and Bagridae play the important role in transmitting the liver fluke in the Province.

The River Ahnseong is a tributary of River Naktong and located in the southwestern part of Kyungpook Province (Fig. 1). In the Ahnseong basin, there are many peculiar houses that would sell raw-fish to local residents and visitors.

Furthermore, rural and urban residents visit these clear water on weekends or holidays, and the majority of residents in the villages along the sides of the river enjoy fishing and also consuming the raw-fish with rice wine and/or distilled spirits. They are not concerned about infection with *C.sinensis*, but believe that fresh-water fishes collected in this basin are completely free of larval trematodes because the river is clear and running over pebbles and sandy bottoms. However, this traditional concept was found to be false by this study.

In the studies on snail host in Korea, Chun (1963) reported that seven species of cercariae from *P.manhouricus* in Kimhae plain by crushing and natural emerging methods, in which the infection rate for *Clonorchis* cercaria was 0.7%.

Kim (1974) reported that the prevalence rate of *Clonorchis* cercariae in *P.manhouricus* was

relatively low, 2.3–3.1% in both high and low endemic localities, with no significant difference between them. He also observed that the cercarial liberation in the snail was seen in nature in the period from May to October.

In the present study, the infection rate for *Clonorchis* cercariae in *P.manchouricus* was 0.05%. Our results are similar to data reported by Joo (1980) in the River Taewha, but the infection rate of *Clonorchis* cercaria is lower than that reported by Choi *et al.* (1975) and Chung *et al.* (1980) in the River Kumho, by Soh *et al.* (1975) in the River Mangyeong, by Lee (1956), Chun (1963), Kim (1974) in the River Naktong, although Choi (1977) in the River Nam, and Hwang (1978) in the River Hwang reported much lower values. As also indicated by Chung *et al.* (1980), it was shown in this study that the infection rate with *Clonorchis* cercaria in fresh-water snail is very low. It was suggested that the massive drainage of industrial and home waste products together with intense pesticide spray to the rice fields and farms may have affected the survival of snails.

In the studies of fish hosts of *C.sinensis* in Kyungpook Province, Lee and Kim (1958) found *Clonorchis* metacercariae in several fresh-water fishes such as *P.parva*, *P.herzi* and *P.esocinus*, and they also reported that *P.parva* had been heavily infected with its metacercaria, whereas, *C.carassius* and *C.carpio* had been found very few in number. Choi (1976) found *Clonorchis* metacercariae from 10 fish species collected in Kyungpook Province, and he reported that *P.parva* was the most frequently infested fish being found in 92.3%, followed by *P.esocinus*, *S.sinensis*, *H.labeo*, and *P.herzi* with the infection rate of 90.4%, 87.8%, 87.2% and 60.8%, in decreasing order.

Similar results were reported by Lee *et al.* (1979) in the River Ossep, Hwang and Choi (1980) in the River Kumho, Kim and Choi (1981) in the natural and fish breeding ponds, Joo *et al.* (1983) in the River Taechong, and Joo (1984a) in the River Hyungsan.

In the present study, 17 species of fresh-water fishes belonging to the Families Cyprinidae, Bagridae, Channidae, Serranidae, and Siluridae

were collected in the River Ahnseong, of which 10 species such as, *A.taenianalis*, *G.atromaculatus*, *H.longirostris*, *P.rhombea*, *P.esocinus*, *P.parva*, *P.herzi*, *S.dabryi*, *C.brevicorpus* and *C.herzi* harboured the encysted larvae of *C.sinensis*. Of these, *G.atromaculatus*, *P.esocinus*, *P.herzi* and *P.parva* were heavily infected, and the infection rates ranged from 64.8 to 85.4%. *C.brevicorpus* and *A.taenianalis* were less frequently infected with rates of 23.1% and 12.5%, respectively.

*S.dabryi* was first recorded as the fish host of *C.sinensis* by Kubo and Makino (1941) in Manchuria, China. But no report on this fish as the second intermediate host for *Clonorchis* was recorded in Korea. In this study, the infection rate for *C.sinensis* metacercariae in 108 *S.dabryi* was 39.8%, and the average number of metacercariae per gram of flesh was 11.9 cysts (Table 3). It is clear that this fish played the second intermediate host as chief vector for the liver fluke in Korea.

As known in Table 3, no *C.sinensis* metacercaria was found in 7 species, *C.carassius*, *C.splendidus*, *M.oxycephalus*, *Z.platyptus*, *Z.temmincki*, *C.argus* and *P.asotus* in the present study. Nishimura (1943) found *Clonorchis* metacercariae in *Z.platyptus* from Yeongcheon, Korea, and recorded it as the fish intermediate host of *C.sinensis*. But according to many investigators *Clonorchis* cyst was never found in this fish. Judging from the above results, it is uncertain whether this fish could serve as fish host of the liver fluke and is to be studied further.

The fish host, *C.carassius* was first reported as the second intermediate host of the liver fluke by Kobayashi (1912), who made a survey on the fish hosts in Miyagi, Shiga, and Okayama Prefectures, Japan. Since then many studies on the encysted larvae of *C.sinensis* in *C.carassius* were carried out by numerous investigators in Korea and Japan. Miki (1922) reported that many *Clonorchis* metacercariae were found in *P.parva*, whereas no metacercaria was found in *C.carassius* and *C.carpio*. Quite recently, Rhee *et al.* (1982) reported that a large number of clavate cells were found in the epidermis of *P.asotus*, *C.carpio* and *C.carassius* which were not suitable as fish hosts for *C.sinensis*, while



clavate cells were not found in *P.parva*. Further work along this problem is needed.

In the present study, the intensity of infection, the average number of *C.sinensis* cysts per gram of flesh in the 10 fish species varied from 1.7 in *A.taenianalis* to 35.1 in *G.atromaculatus*. Our results are similar to those reported by Choi (1976), Hwang and Choi (1980), and Joo (1980), but *Clonorchis* larvae in the hosts showed a lower rate of infection.

These findings are quite conceivable that low incidence of *C.sinensis* in snails and fishes caught in the River Ahnseong may be due to the ecological change of the river. The great scale use of pesticides and the destruction of natural environment such as causing the water level to drop, and regulating the construction of many concrete septa across the river to store water for irrigation of the rice fields would affect the natural environmental conditions.

The prevalence of *C.sinensis* among the residents in the vicinity of the River Ahnseong was relatively high. The infection rate in 902 residents was 11.0%.

Our results are similar to those reported by Choi (1978) in Seongju county, although the degree of infection is not so high as reported by Joo and Choi (1974). Although probable reasons for high infection rates in these residents are unknown, it is considered to be due to social and economic factors, such as inadequate public health and improved transportation and easy availability of fish through more frequent communications between adjacent areas. Upon questioning the residents with clonorchiasis, the majority of them enjoy fishing and also eating raw fish, but are not concerned about infection of *C.sinensis*.

There was a significant difference between the infection rates of males and females. The former was 13.2% and the latter 8.5% (Table 4). These results are identical with those of previous studies (Hunter *et al.*, 1949; Choi *et al.*, 1976; Joo, 1980; Joo and Baik, 1986; Joo, 1984), and suggest that this is probably related to some differences in the opportunities of eating raw or uncooked fresh-water fish away from home. In fact, Korean people have a tradition of eating raw fresh-water

fishes, soaked simply in vinegar or red-pepper mash, as an appetizer when drinking rice wine and/or distilled spirits at social meetings. Since males frequently participate in such meetings, they have more chance of infective risk than the females.

The patterns of age specific rate of infections were appreciably varied; 2.8% in the 0–9 year age group and 2.5% in the 10–19 year age group. It subsequently showed a marked increase in the age group 20 to 29 years, reach a maximum in the age group 50 to 59 years, followed by a decrease (Table 4). It was considered that the frequent chance of eating raw fish at these age groups would be the cause of the steep increase of the infection rate and the gradual increase of the prevalence at 20–59 year age groups would be explained by the successive new infection and long survival of the parasites in human bodies. As indicated by Rim (1986), the Korean people have a custom of eating raw fishes at drinking parties. This is the main source of *C.sinensis* infections in Korea. The infection rates in children is low, but from 20 year of age onwards the infection rates increase, being the highest at the age of 40 to 59 years (Table 4). Although main reasons for *Clonorchis* infections among children are not clear, it is thought to come from the practice of giving raw fish to children by adults or elderly persons in their village areas. Sometimes, ignorant Korean mothers feed raw fish to their children believing it will help them to grow strong.

Rim *et al.* (1973) reported that the average number of eggs per gram (EPG) in feces in different age groups was found to be higher in older age groups. They also commented that such an increase in intensity was considered to be caused by an accumulation of adult worms through repeated infections. Kim (1974), on the other hand, reported that the higher intensity of the infection in the males than the females was statistically significant in the high endemic locality but not in the low endemic locality.

In the present study, approximately 78.5% of the 65 clonorchiasis residents had less than 5,000 eggs per gram of feces (Table 5). Thus, most cases of clonorchiasis residents examined were mild

infection.

Of the fish collected in the River Ahnseong, *Clonorchis* metacercariae are found most frequently in the small-sized fresh-water fishes, *P.parva*, *P.herzi*, *P.escinus*, and *G.atromaculatus*, etc. These fishes are apparently neglected by the residents for raw consumption, but are eaten only by residents living near the river basin usually cooked (roasted, boiled, fried, etc). According to the residents with clonorchiasis, they eat *C.carassius* and *C.carpio* in a state of raw, cooking them cut in slices and mixed with vinegar or soybean paste.

This assumption is supported by the fact that most cases of clonorchiasis in this study show mild infection. It is supposed that some cases of heavy infections would occur if the infections originating from the eating of small-sized fishes which usually harboured many metacercariae.

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