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Epidemiological Survey of *Metagonimus yokogawai* in Kolyung County, Kyungpook Province, Korea*

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Introduction

Metagonimus yokogawai is one of the common intestinal flukes in human beings, with high prevalence in Korea, Japan, Formosa, Siberia, Indonesia, Israel, and Spain, infected by taking orally the mature Metagonimus metacercariae with fresh-water fish and brackish-water fish.

The initial report on the existence of autochthonous cases of metagonimiasis in Korea was made by Mine(1914) for the first time by detecting the *Metagonimus* eggs among the residents in the vicinity of Seoul. Furuyama(1930) made a survey of the Heterophyidae in Korea, and reported that *C. carassius* caught in the river Naktong and some lakelets located in the Changyeong county, Kyungnam Province were heavily infected with *Metagonimus* metacercaria. The human infection rates of metagonimiasis there amounted to 21.3 per cent of residents in the area. After the World War II, the epidemiologic, clinical, immunodiagnostic and therapeutic studies on the intestinal flukes in Korea have been performed by many investigators, recognizing the urgency of the problem.

As a part of a nation-wide survey on human parasitic diseases in southern Korea, Hunter et al. (1949) reported that Seogwipo in Cheju Province (Quelpart island) was the area with the highest endemicity of metagonimiasis, being found to be 8.6 per cent, other areas were Taegu with 6.9 per cent, Chuncheon with 1.2 per cent and Pusan with 1.1 per cent, and Chun(1960) in a study on the larval trematodes in fish intermediate hosts summarized his findings on *M. yokogawai* from *P. altivelis* and *C. carassius* collected in the river Naktong.

Afterwards, many investigators have made studies on the prevalence of *M. yokogawai* among residents (Yeo and Seo, 1972; Soh et al., 1976; Soh and Ahn, 1978; Kim et al., 1979; Chung and Choi, 1979; Joo and Park, 1982) and on the infection rates and intensity for *Metagonimus* metacercaria in fish intermediate hosts(Kang et al., 1964; Hwang and Choi, 1977; Suh and Choi, 1979; Lee et al., 1979; Kim, 1980; Hwang and Choi, 1980; Song, 1981; Seo et al., 1982; Joo et al., 1983; Ahn, 1983; Joo, 1984; Yoo et al., 1984; Ahn, 1984). As a result, the distribution of metagonimiasis is found to be paralleled chiefly the distribution of the second intermediate hosts, especially of the *P. altivelis.*

Quite recently, the high prevalence of the liver fluke among the residents and the infection patterns of snail and fish hosts with larval trematodes in the vicinity of the river Ahnseong(Joo and Hong, 1989; Joo and Lee, 1992) suggested that clonorchiasis is still wide-spread in Kolyung county, Kyungpook Province, Korea.

This study has been proceeded as a part of our investigation in the epidemiology and control of human metagonimiasis, since many salmonoid and cyprinoid fish was found to act as the main vector of *M. yokogawai* prevalent in Korea and other countries.

The present paper represents the infection patterns of snail and fish hosts with larval trematodes, and the prevalence of metagonimiasis among the

* The results of this study were presented at the 34th annual meething of the Korean Society for Parasitology(1992).

residents in the county.

Geographical conditions of surveyed area

Kolyung county is about 36 kilometers by road from Taegu city and lies south-west part of Kyungpook Province at 35' 50 degree north latitude. The ave

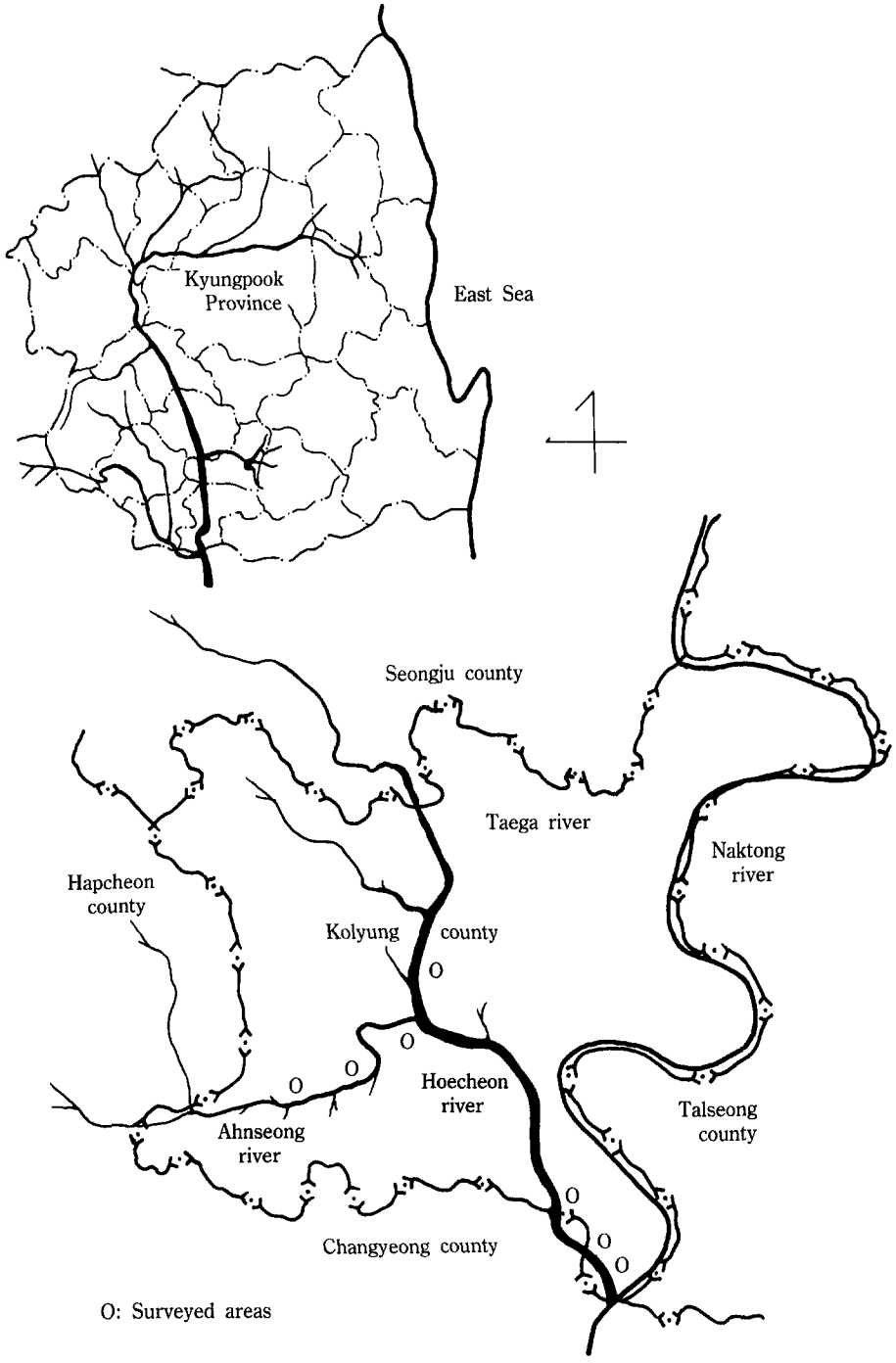

Fig. 1. Map showing the surveyed areas in the vicinity of the Ahnseong, Taega, and Hoecheon rivers, Kyungpook Province. Korea.

rage elevation is about 60 meters above the sea level. It is a rural district of about 42,000 residents and situated along the banks of Ahnseong, Taega and Hoecheon rivers, some large tributaries of the river Naktong(Fig. 1).

In the river basins, 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 rivers enjoy fishing and also consuming the rawfish with rice-wine and/or distilled spirits.

The water level in these areas is fairly constant except 5-10 days after heavy rain. Many types of marsh plants and grass cover the entire area. There are many kinds of fresh water fish and *Semisulcospira* snails in the water.

More detailed geographical conditions of surveyed areas were presented by Joo and Hong(1991.)

Materials and Methods

The snail intermediated host survey: the collections of snails were made from late June to early September in 1992. The density of the snail population was measured by the approximate number of snails collected per square meter of the riverbed. The snails were collected by hand and put into plastic buckets with marsh grass and forwarded to the laboratory.

In order to determine the infection of snails with *Metagonimus* cercariae, the snails were examined using both natural emerging method and crushing method. In the former method ten snails were put into petri-dishes containing about 40ml 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.

The fish host survey: Fresh-water fish were caught in the Ahnseong, Taega and Hoecheon rivers running through Kolyung county by netting and fishing with rod and line. The fish, after removal of their intestinal contents to prevent autodigestion, were brought to the laboratory. The specific name of the fish were determined by the keys described by Chung(1977).

The flesh, scales, all fins and tail of the fish separated from each fish using a knife, and each material was compressed between two large slides(50×90mm) and examined for the *Metagonimus* metacercariae under a binocular dissecting microscope.

In order to isolate the metacercaria 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 100ml of distilled water), and the mixture were incubated under the 37−38℃ for 30−40 minutes.

Survey of M. yokogawai infection in residents: During the period from October, 1991 to September, 1992, the fecal examination was made in order to the discovery of *Metagonimus* eggs among the 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, Ugok myun, Yunsu myun and Kolyung town of Kyungpook Province.

The feces were examined by the formalin-ether sedimentation technique and then the Stoll's egg count technique was applied.

Results

The habitats and population density of *S. libertina* in Kolyung county are listed in Table 1 and Fig. 1. The black dots in Fig. 1 indicated the habitats found in this survey. The *Semisulcospira* snails in some rivers were distributed densely on the surface of pebble and rock in water bed with the water grass, where was abundant with sluggish flow. The number of snails collected in the seven stations ranged from 2 to 140, with an average of 30 per square meter of river bed.

Table 2 summarizes the infection rates of *Me*

tagonimus cercariae among the snails collected from seven habitats along the Ahnseong, Taega and Hoecheon rivers in Kolyung county. The liberation rates for ***Metagonimus*** cercariae in the snails were very low. A total of 7 or 0.32 per cent of 2,193 snails examined were positive for *M. yokogawai.*

The infection rates in the snails varied from habitat to habitat. At Jisan, 3 or 0.52 per cent were found to be positive with *Metagonimus* cercariae, at Yeondong and Maecheon, only 0.48 and 0.20 per cent respectively, were found to be infected, while no infection was found in Sachon, Podong and Weolsan habitats.

The individual numbers of fresh-water fish collected in the vicinity of the Ahnseong, Taega and Hoecheon rivers in Kolyung county are shown in Table 3. A total of 1,239 fish of 17 species belong to the Families Cyprinidae, Bagridae, Channidae, Serranidae and Siluridae were collected in the present survey. Of these, *G. atromaculatus, P. rhombea, P. herzi, S. dabryi, Z. platypus* and *Z. temmincki* are the most frequently collected species of fish.

Table 4 lists the infection rates and intensity for *Metagonimus* metacercariae according to the species of fish collected in the vicinity of the Ahnseong, Taega and Hoecheon rivers in Kolyung county. Of the 17 species of fish examined, *Metagonimus* metacercariae in the flesh were found in the 11 kinds of fish. Of them, the most frequently infected fish was *Z. temmincki* with 21 per cent, followed by *A. taenianalis* with 16.7 per cent, *Z. platypus* with 13.6 per cent, *S. dabryi* with 12.5 per cent, and *C. carassius* with 10.3 per cent. The less frequently infected were *G. atromaculatus, P. esocinus, P. parva, P. herzi* and *C. brevicorpus,* ranging from 1.3 per cent to 5.4 per cent. Although the infection rates of metacercaria in scales were much higher than that of flesh, in these cases, some were found in the *H.*

Table 1. Habitats and population density of *Semisulcospira libertina* in Kolyung county(1992), together with environmental conditions

Environmental conditions			No. of snail/m² of river bed		
River	Locality	Bottom structure	Maximum	Minimum	Mean
Haecheon	Sachon	Pebble and Sand	20	2	10
	Yeondong	Sand and pebble	30	4	15
	Podong	Sand and pebble	10	2	5
Ahnseong	Jisan	Pebble and sand	140	10	70
	Anrim	Pebble and rock	110	10	50
	Maecheon	Pebble and rock	50	3	25
Taega	Weolsan	Pebble and sand	30	5	15

Tabel 2. Infection rates of *Semisulcospira libertina* with *Metagonimus* cercaria in surveyed areas(1992)

Habitat	No. of snail examined	No. infected	Percent positive
Sachon	170	0	0
Yeondong	207	1	0.48
Podong	82	0	0
Jisan	582	3	0.52
Anrim	468	2	0.43
Maechon	494	1	0.20
Weolsan	190	0	0
Total	2,193	7	0.32

Table 3. Fresh-water fish caught in the vicinity of the Ahnseogn, Taega and Hoecheon rivers of Kolyung county, Kyungpook Province, Korea(1992)

Species	Common name	Korean	Length (Cm)	No.of fish
Family Cyprinidae				
Acanthorhodeus taenianlis Gunter	Korean rose bitterling	큰납지리	5.0−11.0	24
Carassius carassius Linnaeus	Crussian carp	붕어	3.0−20.0	87
Coreoleucicus splendidus Mori	−	쉬리	7.2−10.5	6
Gnathopogon atromaculatus Nichols et Pope	Korean shiner	몰개	5.0− 8.0	155
Hemibarbus longirostris(Regan)	Long-nosed barbel	참마차	7.0−16.0	25
Moroco oxycephalus (Bleeker)	Fat minnow	버들치	6.0−11.5	9
Paracheilognathus rhombea(T et S)*	Fat bitterling	납지리	6.0−11.5	9
Pseudogobio esocinus(T et S)	Goby minnow	모래모치	5.0−14.5	56
Pseudorasbora parva(T et S)	Southern top-mouthed minnow	참붕어	6.0− 9.5	43
Pungtungia herzi Herzenstein	Striped shiner	돌고기	6.5−10.3	160
Saurogobio dabryi Bleeker	−	두우쟁이	6.0−10.0	128
Zacco platypus(T et S)	Pale chub	피래미	7.0−15.0	184
Zacco temmincki(T et S)	Dark chub	갈견이	6.0−13.0	156
Family Bagridae				
Coreobagrus brevicorpus Mori	Bullhead	꼬치동자개	7.0−17.0	30
Family Channidae				
Channa argus(Cantor)	Spotted serpent head	가물치	13.5	1
Family Serranidae				
Coreoperca herzi Herzenstein	Perch	꺽지	5.0−10.0	21
Family Siluridae				
Parasilurus asotus Linnaeus	Catfish	메기	8.0−13.0	4

*T et S: Temminck et Schlegel.

longirostris and *M. oxycephalus*, but none in the *P. parva* and *C. brevicorpus*.

The infection rates of encysted larvae from the fins and tail were much higher in *P. esocinus*, *S. dabryi*, *Z. temmincki*, and *P. rhombea*, 67.9, 55.5, 54.4, and 42.7 per cent, then in *G. atromaculatus*, *M. oxycephalus* and *P. herzi*, 11.6, 11.1 and 10.0 per cent, respecitvely.

The metacercarial density in the fish was low, and the average number of the cysts per gram of flesh varied from 0.5 to 6.0. *S. dabryi* was the most heavily infected and the mean number of the cysts was 6.0. *G. atromaculatus* was infected moderately, with an average of 2.5, whereas *P. rhombea* was infected with a few cysts only.

The prevalence of *M. yokogawai* among the residents in Kolyung county, Korea is summarized in Table 5. The infection rate for *M. yokogawai* in

Table 4. Infection rates and intensity for *Metagonimus* metacercariae in fresh-water fish(1992)

Species	No. of fish examined	*Metagonimus* metacercaria found in						Average No. of cysts/g of flesh
		Flesh		Scales		Fins & Tail		
		No.	%	No.	%	No.	%	
A. taenianalis	24	4	16.7	8	33.3	8	33.3	1.0
C. carassius	87	9	10.3	20	23.0	22	25.3	2.5
C. splendidus	6	0	0	0	0	0	0	0
G. atromaculatus	155	4	2.6	1	0.6	18	11.6	2.5
H. longirostris	25	0	0	1	4.0	8	32.0	0
M. oxycephalus	9	0	0	1	11.1	1	11.1	0
P. rhombea	150	8	5.3	12	8.0	64	42.7	0.5
P. esocinus	56	3	5.4	13	23.2	38	67.9	4.0
P. parva	43	1	2.3	0	0	0	0	1.0
P. herzi	160	2	1.3	2	1.3	16	10.0	1.0
S. dabryi	128	16	12.5	14	10.9	71	55.5	6.0
Z. platypus	184	25	13.6	60	32.6	75	40.8	1.5
Z. temmincki	156	34	21.8	56	35.9	85	54.5	2.0
C. brevicorpus	30	1	3.3	0	0	7	23.3	2.0
C. argus	1	0	0	0	0	0	0	0
C. herzi	21	0	0	0	0	0	0	0
P. asotus	4	0	0	0	0	0	0	0

Table 5. Prevalence of *Metagonimus yokogawai* among residents in Kolyung county(1992)

Age group (Year)	Male		Female		Total	
	No. examined	Percent positive	No. examined	Percent positive	No. examined	Percent positive
0— 9	93	0	84	2.4	177	1.1
10—19	237	0.8	206	2.4	443	1.6
20—29	18	11.1	18	0	36	5.6
30—39	37	16.2	42	4.8	79	10.1
40—49	65	23.1	46	6.5	111	16.2
50—59	59	33.9	62	11.3	121	22.3
60—	46	21.7	46	4.3	92	13.0
Total	555	9.9	507	4.1	1,062	7.2

Table 6. Intensity of *Metagonimus yokogawai* infections by Stoll's egg count technique among residents of Kolyung county(1992)

Range of EPG	Male		Female		Total	
	No. infected	%	No. infected	%	No. infected	%
0− 500	16	42.1	6	35.3	22	40.0
500−1,000	8	21.1	4	23.5	12	21.8
1,000−2,000	8	21.1	4	23.5	12	21.8
2,000−3,000	3	7.9	1	5.9	4	7.3
3,000−4,000	1	2.6	0	0	1	1.8
4,000−5,000	1	2.6	2	11.8	3	5.5
5,000−6,000	0	0	0	0	0	0
6,000−7,000	0	0	0	0	0	0
7,000−	1	2.6	0	0	1	1.8
Total	38		17		55	

1,062 residents was 7.2 per cent. The sex-specific rate of infection was significantly higher in males than in females; 9.9 per cent in males and 4.1 per cent in females, respectively.

In age-specific rate of infections, the rates varied from 1.1 per cent to 22.3 per cent, with a maximum infection in the 50-59 year age group in both sexes.

Table 6 lists the intensity of infections in 55 re sidents with metagonimiasis by sex, The intensity of infection, expressed in eggs per gram of feces was divided into 500 egg intervals in the first and second classes, and followed by 1,000 egg intervals for the purpose of convenience.

The number of discharged eggs per gram of feces was less than 500 in 22 persons, 501 to 1,000 in 12, 1,001 to 2,000 in 12, 2,001 to 3,000 in 4, 3,001 to 4,000 in 1, 4,001 to 5,000 in 3, and more than 7,000 in 1 case. The largest number was recorded to be 17,000 in a 59-year old male.

Discussion

Metagonimiasis is one of the main endemic parasites in Korea, today. Results from this study indicate that the prevalence for *M. yokogawai* was nearly two fold greater than the nationwide estimate of 4.8 per cent(Seo et al., 1982), and the fish hosts collected in the vicinity of Ahnseong, Taega and Hoecheon rivers which run through the central part of Kolyung county were infected with the encysted larvae of this fluke.

In the vicinity of the rivers, there are many peculiar houses that would sell raw-fish to local residents and visitors. Furthermore, the majority of residents in the villages along the sides of the rivers enjoy fishing and also consuming the rawfish with rice wine and/or distilled spirits. They are not concerned about infections with liver and intestinal flukes, but believe that fresh-water fish collected in these basins are completely free of larval trematodes because the rivers are clear and running over pebbles and sandy bottoms.

However, the traditional concept was found to be false by the Joo and Hong(1991), Joo and Lee (1992), and this study.

The results in this study show that the infection rate of *M. yokogawai* in 1,062 residents was 7.2 per cent and many kinds of fresh-water fish and *Semisulcospira* spp.(mainly *S. libertina*) are present in the rivers.

The cercaria of *M. yokogawai* from *S. libertina* in Hwanghae Province of Korea was reported by Muda(1913) who described the presence of metacercariae characteristic of *M. yokogawai* in fresh-water fish in the same area where the snail harboring the cercariae were found. The presence of

a cercaria in *Lymnacea japonica* in the river Rahoku near Ranan city of Korea reported by Hirose(1913) who expressed his assumption that it might be the cercaria of *C. sinensis.*

Kobayashi(1981) reported eight species of larval trematodes in *Semisulcospira* sp. in Kyunggi and Chunpook Province, two species in other snails and a furcocercaria in *Lymnacea japonica* at Seoul. During the period from 1940 to 1959, no information about cercariae was available because of the occurrence of the World War II and the Korean War. After the establishment of the first Five-year economic development plan in 1962, Han and Chun (1963) described 10 species of cercariae from *S. libertina* by crushing and natural emerging methods, in which the infection rate for *Metagonimus* cercaria was 11.7 per cent. Choi et al.(1982) conducted a survey on the infection patterns of larval trematodes from *Semisulcospira* snails in Kyungpook Province, and reported that the infection rate of *Metagonimus* cercaria was 1.48 per cent.

In the present study, the infection rate for *Meta gonimus* cercaria from *S. libertina* was found to be 0.32 per cent. Our results are lower than that reported by Choi et al.(1982) in the Kyungpook Pro vince and by Han and Chun(1963) in the Kyungnam Province. As also indicated by Choi et al.(1982), it was shown in this study that the infection rate with *Metagonimus* cercaria in *Semisulcospira* snail is very low. It was suggested that the intense pesticides spray to the farms and rice fields together with massive drainage of industrial and home waste products may have affected the survival of larval trematodes.

In the study of fish hosts in Korea, a relatively high infection rate of *Metagonimus* metacercariae have been reported in Kyungnam Province by Chun(1960), Hong and Seo(1969), and Joo and Park(1982) on brackish-water fish and Joo (1980 and 1988), and Yoo et al.(1984) on fresh-water fish, in Kyungpook Province by Lee(1968), Lee et al.(1979), Hwang and Choi(1980), Joo et al(1983), and Joo (1984) on fresh-water fish and by Hwang and Choi(1977), Suh and Choi(1979) and Roh (1980) on brackish-water fish, in Cheju Province by Kang et al. (1964) on brackish-water fish, in Chungnam Province by Kim (1980) on fresh-water fish.

Kim and Choi(1981)'s report on fresh-water fish in the natural and fish breeding ponds of Kyungpook Province and Seo et al.(1982)'s report on brac kish-water fish covered several Provinces in Korea.

As a result, it is obvious that in Korea the metacercaria of *Metagonimus* spp. are widely distributed in both fresh and brackish-water fish, and in the fresh-water fish the infection rate is lower than in the brackish-water fish.

As a few reports shown in Kyungpook Province, the infection rate of metacercaria in fresh-water fish, reported by Hwang and Choi(1980) was 60.0 per cent in *Macropodus chinensis,* 29.6 per cent in *Carassius carassius,* 27.3 per cent in *Paracheilognathus rhombea,* 18.6 per cent in *Zacco platypus,* 18.2 per cent in *Coreobagrus brevicorpus,* 17.2 per cent in *Pseudorasbora parva,* and 12.0 per cent in *Acheilognathus limbata,* while in brackish-water fish, reported by Joo and Park(1982), wsas 100.0 per cent in *Plecoglossus altivelis,* and 45.5 per cent in *Tribolodon hakonensis.*

In the present study, 17 species of fresh-water fish belonging to the families of Cyprinidae, Bagridae, Channidae, Serranidae and Siluridae were collected in the Ahnseong, Taega and Hoecheon rivers, in which 13 species of the fish harboured the *Metagonimus* cysts. Of these, *Saurogobio dabryi, Pseudogobio esocinus, Zacco temmincki, Paracheilognathus rhombea,* and *Zacco platypus* were heavily infected with rates from 40.8 per cent to 67.9 per cent. *Gnathopogon atromaculatus, Moroco oxycephalus,* and *Pungtungia herzi* were less frequently infected with rates of 11.6 per cent, 11.1 per cent, and 10.0 per cent, respectively.

In the intensity of *Metagonimus* infections, the average number of cysts per gram of flesh in 13 species of fish varied markedly from fish to fish. The average number of the metacercariae was from 0.5 in *Paracheilognathus rhombea* to 6.0 in ***Saurogobio dabryi.*** The results obtained in this study are similar

Table 7. The reported prevalence of metagonimiasis in Korea

Source	locality	No. examined	Prevalence (%)	Group tested
Mine (1914)	Seoul	150	1.7	In-and-outpatients, Nurse, and Students
Kobayashi & Gon (1917)	Seoul	323	0.6	In-and-outpatients
Kojima & Ko (1923)	Chinju	1,000	0.2	Resident
Yabe et al. (1923)	Taegu	3,328	3.4	In-and-outpatients
Hara & Himeno (1924)	Masan, Miryang Namhae et al.	1,141	4.3	Primary school children
Furuyama (1927)	Changyung	192	21.0	Resident
Oda (1929)	Cheonju	442	0.2	In-and-outpatient
Sekigutchi et al.(1937)	Kimhae	4,594	0.1	Resident
Nishimura (1943)	Taegu	341	1.2	Resident
Hunter et al. (1949)	Nation-wide	919	1.6	Resident
Lesser (1956)	Seoul & Inchon	268	1.9	Primary school Children
Lee et al. (1960)	Taegu	384	0.7	Middle school Children
Rim et al. (1962)	Wonju	1,963	0.8	Military personnel
Kim et al. (1968)	Kimhae	1,809	4.5	Resident
Seo et al. (1969)	Nation-wide	40,581	0.4	Resident
Choi et al. (1971)	Taegu	5,288	0.2	In-and-outpatients
Yeo & Seo (1971)	Hadong	521	42.4	Resident
Chai et al. (1977)	Jaugheung & Kangjin	606	26.4	Resident
Soh & Ahn (1978)	Regions along Boseong-river	360	35.6	Resident
Chung & Choi (1979)	Yeongdeok	478	18.8	Primary school children
Joo (1979)	Taegu	3,330	0.5	Military personnel
Kim et al. (1979)	Hadong	1,163	29.1	Resident
Seo et al. (1981)	Nation-wide	13,373	4.8	Resident
Joo & Park (1982)	Ulju	2,016	9.4	Resident
Ahn (1984)	Sam cheok	1,172	13.3	Resident
Joo (1984)	Taegu	1,697	1.1	Resident
Joo & Baik (1986)	Kyungpook	2,377	0.9	Resident

to those by Hwang and Choi(1980), Joo(1984), and Yoo et al. (1984), but the metacercarial rates for *M. yokogawai* varied greatly by different fish.

The main factors contributing to the variant in fection densities in different fish were considered to be due to the ecology of fish such as habitats and migration of the fish, and the changing ecology of the rivers.

In practice, 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, and massive drainage of waste products together with intense pesticide spray to the rice fields and farms may have affected the infection rates and densities for larval trematodes such as *C. sinensis* and *M. yokogawai* in the vicinity of the rivers.

In this study the infection rate of *M. yokogawai* among the residents in Kolyung county was 7.2 per cent, and there was a significant difference in the prevalence between males and females. The findings in the present study are based on discovery of *Metagonimus* eggs by formalin-ether sedimentation and Stoll's egg counting techniques on 1,062 subjects. As a matter of fact, this is no indication of the true prevalence among the residents in this county because the individuals for this study are not adjusted for the proportion of the residents belonging to each age, social situation, and socio-economics, etc. However, the results are quite comparable with earlier reports based on one time examination of feces by means of similar laboratory procedure. From the data presented in Table 7, it is noted that the present results show a relatively higher than that recorded in similar previous surveys made in Kyungpook Province(Yabe et al., 1923; Nishimura, 1943; Lee et al., 1960; Choi et al., 1971; Joo, 1979 and 1984; Joo and Baik, 1986), though it is far less than that reported by Fu ruyama(1927), Yeo and Seo(1971), Chai et al. (1977), Soh and Ahn(1978), Chung and Choi(1979), and Kim et al.(1979).

The exact cause of the high prevalence of *M. yokogawai* in this study is not readily apparent, it is considered to be due to the popularity of the hobby of fishing among the residents in the villages along the sides of the rivers and tasting the fish in a raw state.

The sex specific rate for *Metagonimus* infections, with the prevalence significantly higher in males than in females, is in agreement with previous findings(Soh et al., 1976; Chai et al., 1977; Kim, 1980; Joo and Park, 1982), and suggest that this is considerably related to some difference in the opportunity of eating raw fish as observed in cases of *C. sinensis* infections(Joo and Hong, 1991).

As to the age-specific rate of prevalence, it was ranged 1.1 per cent in 0－9 year age group to 22.3 per cent in 50－59 year age group. The infection rates in person younger than 20 year old are low, but from 20 year of age onwards the rates increase, being the highest at the age of 50 to 59 years. This is in agreement with the findings by Joo and Park (1982) showed the rates of 6.0 per cent in children and 13.5 per cent in residents over 20 years old, and the data of Yeo and Seo(1971) listed that residents at the prime of life and the aged persons showed the highest rates.

The results of this study generally indicate that the snail and fish hosts were infected with abundance of *Metagonimus* larvae, and that there was hish prevalence of the intestinal fluke among the residents. It is apparent that endemic foci of *M. yokogawai* exist in the vicinity of the Ahnseong, Taega, and Hoecheon rivers in Kolyung county, Kyungpook Province.

Summary

The population density of *Semisulocospira* snails per square meter of the habitats ranged from 2 to 140, with an average of 30. The proportion of infected snails was very low, the average being 0.32 per cent.

Seventeen species of fresh-water fish caught in the vicinity of Ahnseong, Taega and Hoecheon rivers in Kolyung county were examined for the encysted

larvae of *M. yokogawai*. Of these, 11 species were infected with *Metagonimus* cyst. The infection rates varied greatly by fish species. In the intensity with *Metagonimus* cysts, *S. dabryi* was the most heavily infected species, the average number of cyst per gram of fish flesh being 6.0 cysts, followed by *P. esocinus* with 4.0, and *C. carassius* with 2.5 cysts. *Z. platypus, A. temmincki* and *C. brevicorpus* were moderately infected, with an average number varing from 1.5 to 2.0 cysts.

The infection reate of *M. yokogawai* among the residents in Kolyung county was 7.2 per cent. The difference of infection rate between males and femlaes is found to be statistically significant($t>2$). In the age specific rate infections, the rate tended to be higher with the increase of age and reached a maximum of 22.3 per cent in the 50−59 year age group, followed by a decrease.

The intensity of *Metagonimus* infections, approximately 85 per cent of residents with metagonimiasis had less than 2,000 eggs per gram of feces.

This study indicate that endemic foci of *M. yokogawai* exist in the vicinity of Ahnseong, Taega, and Hoecheon rivers and the infection rate of the intestinal fluke among the residents is still high.

Key words: Age specific rate, Fresh-water fish, Metagonimiasis, *Metagonimus yokogawai, Semisulcospira* snail

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=국문초록=

慶北 高靈郡에 있어서 橫川吸蟲의 疫學的 調査

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慶北 高靈郡에서의 橫川吸虫 浸潤狀을 決定하기 위해 1991年 10月 부터 1992年 9月까지 高靈郡을 貫流하는 安城川, 大伽川, 會川流域에서 橫川吸虫의 第1中間宿主, 다슬기의 分布狀과 이들 다슬기에 있어서 有尾幼虫의 寄生狀, 第2中間宿主, 淡水魚에서의 被襄幼虫 寄生狀 민 住民들에서의 橫川吸虫 感染狀을 調査하였다.

7個地域의 다슬기 棲息處를 發見하였으며, 이들 棲息處에서의 다슬기의 分布密度는 河床 1m²當 2－140個, 平均 30個였으며 이들 다슬기에서 橫川吸虫 幼尾幼虫의 寄生率은 매우 낮아 0.32%였다.

11種의 淡水魚에서 橫川吸虫 被襄幼虫을 發見할 수 있었으며 그 感染率은 漁種別로 큰 差異가 있었다.

이들 淡水魚에서의 橫川吸虫 被襄幼虫 感染度에 있어서는 魚肉 1g當 幼蟲數가 두우쟁이에서는 6.0個로 가장 많았고, 그 다음은 모래모치 4.0個, 붕어 2.5個 順이었으며, 피래미, 갈견이 및 꼬치 동자개에서는 1.5－2.0個로 中間値를 나타내었다.

住民들에서의 橫川吸虫 感染率은 7.2%로 比較的 높았으며, 性別感染率에 있어서는 男性은 9.9%, 女性은 4.1%로 男女間의 有意的 差를 認定할 수 있었다($t>2$).

以上의 成績으로 미루어 보아 慶北 高靈郡을 貫流하는 3個河川流域은 橫川吸虫의 流行地域으로 남아 있을뿐만 아니라 住民들에서의 橫川吸虫 感染率은 아직도 높음을 알았다.