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Newly Found Endemic Foci of *Clonorchis sinensis* in Kyungpook Province, Korea*

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Since the first report on the existence of autochthonous cases of *Clonorchis sinensis* (*C. sienesis*) among the school children in Taegu and Yeongcheon areas (Matsumoto, 1915), there have been numerous surveys concerning the epidemiology of the fluke in Kyungpook Province. During the past fifty years, epidemiological studies into *C. sinensis* have been made by various workers (Chung, 1926; Nishimura, 1943; Lee and Kim, 1958; Walton and Chyu, 1959; Lee et al., 1960; Shin, 1963 and 1964; Yun et al., 1968; Choi et al., 1961 and 1973) in an attempt to estimate the prevalence in the general population of the Provincee. It has become clear that clonorchiasis is one of the most common parasitic diseases among the residents living near the Naktong river.

Nishimura (1943) reported that an endemic focus of the disease exists in the vicinity of Yeongcheon, Kyungpook Province. He was successful in obtaining fresh water fish from the Kumho river which contained snail with cercariae of *C. sinensis*. In that village, 41.1 per cent of the inhabitants were infected.

GEOGRAPHICAL CONDITION OF NAK-JEON-RI

Nakjeon-ri is a town of about 900 people situated along the bank of Naktong river. It is 130 kilometers by road to Taegu and lies in the middle of Kyungpook Province (Fig. 1).

The east corner of town lies the foothills of a lower mountain range and the west borderline is limited by the bank of Naktong river.

There is no irrigation in the vicinity, and the drinking water supply for the town is

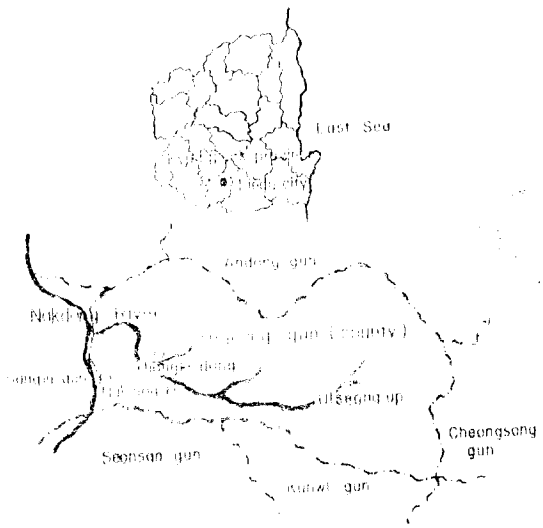

Fig. 1. Surveyed area in Uiseong county, Kyungpook Province.

* The results of this study were read before the Faculty meeting of School of Medicine, Kyungpook National University in November 1, 1974, and presented at the 1974 annual meeting of the Korean Society for Parasitology.

depended upon the wells. At the north corner of the town a somewhat larger stream, about 5 kilometers length, flows into the Naktong river. Most of the time, there is flowing water in the stream and the stream bed contains several kinds of fresh water snail and fish. The fresh water fish caught from the river are brought to town, and then sent to the surrounding cities for sale.

MATERIALS AND METHODS

1) Stool examinations:

Two thousand three hundred and twenty-six inhabitants were examined in this study. Of these, 851 were from Nakjeon-ri (village), 855 from Yongki and 590 from Uiseong villages. As a rule, a single specimen was collected from each individual. The specimens collected in cartons were forwarded to the Parasitology laboratory and examined using primarily the formalin-ether sedimentation technique(Ritchie, 1948) and the Stoll dilution egg count method(Stoll and Hausheer, 1926).

Three counts of the eggs found by the Stoll's technique were made for each specimen and expressed as an average number of eggs-per-gram. In the present study, the 0 to 5,000 egg count group indicates that *Clonorchis* eggs were found in formalin-ether sedimentation preparations but no eggs were found in the Stoll dilution preparations.

2) Intermediate host survey:

The first intermediate snail host, *Parafossarulus manchouricus*, collected in the river bed were examined for the presence of *Clonorchis* cercariae, using both immersing and crushing techniques(Komiya and Suzuki, 1964). In the examination of second intermediate host, several kinds of fresh water fish, were sent to the laboratory. They were then dissected into the flesh, scale and fins. About one ml. of the flesh were compressed between two large slides (9cm×6cm) and examined for the presence of the metacercariae under a dissecting microscope.

RESULTS

The results of the survey of *C. sinensis* among the sample of 525 children by sex and age at Nakjeon-ri are presented in Table 1. The infection rate was remarkably high (39.4%). The infection is initially established at the 3 years of age and increased progressively with age. The peak of rate was observed in the 11 year group. There were no differences in the rate of infection between boys and girls; 37.5 per cent of infected individuals were boys and 41.4 per cent were girls.

Table 2 summarizes the prevalence of *C. sinensis* in the general population at Nakjeon-ri. The overall infection rate for the fluke in 851 inhabitants was found to be 54.8 per cent.

The rates for older age groups were extraordinarily high, 90.4 per cent in the 35-39 age group and 92.6 per cent in the 45-49 age group. The rates were consistently higher for males than for females at all ages.

The intensity of infection by age and sex among the inhabitants at Nakjeon-ri is listed in Table 3. The intensity of infection, expressed in eggs per gram of stool, was divided into 5,000 egg-intervals. Although the egg-counts varied from 0 to 100,000, it may appear that the majority of the counts were more than 200,000. Thus, most inhabitants were found to be heavily infected.

The data presented in Table 4 compare the prevalence of *C. sinensis* among Nakjeon-ri inhabitants with Yongki and Uiseong residents, and indicated that great difference exist among the three groups. The inhabitants of Nakjeon-

Table 1. Prevalence of *Clonorchis sinensis* among children in Nakjeon ri, Danmil myun, Uiseong gun, Kyungpook province (1974).

Age	Male		Female		Total	
	No. examined	Percent positive	No. examined	Percent positive	No. examined	Percent positive
1	0	0	0	0	0	0
2	2	0	5	0	7	0
3	11	18.2	2	0	13	15.6
4	16	18.8	12	16.73	28	17.9
5	17	23.5	13	15.6	30	20.0
6	29	31.0	36	36.1	65	33.8
7	38	31.6	48	41.7	86	37.2
8	27	37.0	13	38.5	40	37.5
9	44	43.2	31	45.2	75	44.0
10	44	45.5	32	53.2	76	48.7
11	17	58.8	18	50.0	35	54.3
12	19	52.6	51	51.0	70	51.4
Total	264	37.5	261	41.4	525	39.4

Table 2. Prevalence of *Clonorchis sinensis* among general population in Nakjeon ri, Danmil myun (1974).

Age group (Years)	Male		Female		Total	
	No. examined	Percent positive	No. examined	Percent positive	No. examined	Percent positive
0— 4	29	17.2	19	10.5	48	14.6
5— 9	155	34.8	117	36.8	272	35.7
10—14	92	47.8	115	54.8	207	51.7
15—19	22	77.3	14	28.6	36	58.3
20—24	19	84.2	12	50.0	31	71.0
25—29	30	70.0	19	63.2	49	67.3
30—34	18	83.3	18	55.6	36	68.4
35—39	38	92.1	14	85.7	52	90.4
40—44	17	94.1	14	71.4	31	83.9
45—49	15	93.3	12	91.4	27	92.6
50—54	11	90.9	17	64.7	28	75.0
55—59	10	80.0	11	90.9	21	85.7
60 -	11	90.9	9	77.8	20	85.0
Total	465	57.0	386	52.1	851	54.8

ri had the highest prevalence of the fluke (54.8%), and revealed no differences in the rate of infection between males and females. Whereas, the dwellers of Yongki and Uiseong had somewhat higher prevalence (35.3%, and 33.2%, respectively) than the general prev-

alence (appoximately 20%) of Kyungpook Province, and both groups showed marked differences between males and females.

The results of demonstration of *Clonorchis* metacercariae from five kinds of fresh-water fish which caught in the Nakjeon stream are presented in Table. 5. Of five species, three harbored the metacercariae. The demonstration rate for the larva in 12 *Pseudorasbora parva* was the highest (91.7%), and next *Pseudogobio esocinus* (60.0%). The metacercaria rate of *Gnathopogon* species was the least. However, no metacercaria was found from *Zacco platypus* and *Cyprinus carpio*.

DISCUSSION

The most important result obtained in this study is the finding that the prevalence of *C. sinensis* in Nakjeon village was the highest (54.8%) in Kyungpook Province. Until more recently Yeongcheon area has been known as a serious endemic focus of *C. sinensis* in Kyungpook province (Nishimura, 1943).

As shown in Table 6, the prevalence of the fluke in Yeongcheon area was found to be much lower than that found in Nakjeon village. In the former, the prevalence rate

Table 3. Distribution of Stoll egg-counts among inhabitants in Nakjeon-ri, Danmil myun, Uiseong gun, Kyungpook Province (1974).

Eggs per gram	Male		Female		Total	
	No. examined	Percent positive	No. examined	Percent positive	No. examined	Percent positive
0— 5,000	9	4.2	30	15.4	39	9.6
5,000—10,000	15	7.0	26	13.3	41	10.0
10,000—15,000	11	5.2	20	10.3	31	7.6
15,000—20,000	18	8.5	14	7.2	32	7.8
20,000—25,000	14	6.6	16	8.2	30	7.4
25,000—30,000	11	5.2	12	6.2	23	5.6
30,000—35,000	10	4.7	9	4.6	19	4.7
35,000—40,000	11	5.2	4	2.1	15	3.7
40,000—45,000	11	5.2	8	3.1	17	4.2
45,000—50,000	9	4.2	4	2.1	13	3.2
50,000—55,000	11	5.2	3	1.5	14	3.6
55,000—60,000	8	3.8	2	1.0	10	2.5
60,000—65,000	8	3.8	4	2.1	12	2.9
65,000—70,000	7	3.3	3	1.5	10	2.5
70,000—75,000	10	4.7	2	1.0	12	2,9
75,000—90,000	10	3.7	4	2,1	14	3.6
90,000—85,000	7	3.3	3	1.5	10	2.5
85,000—90,000	8	3.8	3	1.5	11	2.7
90,000—95,000	7	3.3	9	4.1	15	3.7
95,000—100,000	7	3.3	9	4.1	15	3.7
100,000—	11	5.2	14	7.2	25	6.1
Total	213		195		408	

Table 4. Comparison of prevalence rates for *Clonorchis sinensis* among the residents of Uiseong gun, Kyungpook Province, Korea (1974).

Age group (Years)	Sex	Nakjeon-ri		Yhongki-dong		Uiseong-up		Total	
		No. examined	Percent positive	No. examined	Percent positive	No. examined	Percent positive	No. examined	Percent positive
0— 4	M	27	18.5	11	9.1	7	0	45	13.5
	F	14	14.3	8	0	4	0	26	7.7
5— 9	M	155	34.8	65	18.5	38	13.2	258	27.5
	F	117	36.8	47	21.3	37	10.8	201	28.4
10—14	M	92	47.8	77	41.6	35	20.0	204	40.7
	F	115	54.8	187	26.7	32	18.8	334	35.6
15—19	M	22	77.3	159	42.1	48	32.3	229	43.2
	F	14	28.6	119	30.3	43	23.3	176	28.4
20—24	M	19	84.2	10	60.0	33	39.4	62	56.5
	F	12	50.0	9	22.2	20	25.0	41	31.7
25—29	M	30	70.0	23	47.8	40	45.0	93	53.8
	F	19	63.2	8	25.0	17	23.5	44	40.9
30—34	M	18	83.3	25	40.0	27	48.1	60	63.3
	F	18	55.6	12	33.3	16	25.0	46	39.1
35—39	M	17	94.1	22	54.5	25	60.0	64	67.2
	F	14	71.4	8	37.5	15	26.7	37	45.9
45—49	M	15	93.3	19	84.2	11	63.6	45	82.2
	F	12	91.7	7	42.9	13	23.1	32	53.1
50—54	M	11	90.0	11	81.8	12	75.0	34	82.4
	F	17	64.7	6	50.0	11	27.3	34	50.0
55—59	M	10	80.0	3	66.7	16	68.8	29	72.4
	F	11	90.0	5	40.0	1	36.4	27	59.3
60—	M	11	90.9	7	57.1	24	58.3	42	66.7
	F	9	77.8	8	25.0	17	35.3	34	44.1
	M	465	57.0	453	42.8	336	41.4	1,254	47.7
	F	386	52.1	432	27.3	254	22.4	1,072	35.1
Total		851	54.8	885	35.3	590	33.2	2,326	41.9

Table 5. Demonstration of *Clonorchis* metacercariae from fresh-water fish.

Species	Length (cm)	No. examined	No. of fish harbored *Clonorchis* metacercaria	Positive (%)
Pseudorasbora parva (T et S*)	6— 9	12	11	91.7
Gnathogopon species HERZENSTEIN	5—10	14	4	28.6
Pseudogobie esocinus (T et S)	8—13	5	3	60.0
Zacco platypus (T et S)	5—15	15	0	0
Cyprinus carpio LINNAEUS	15—20	21	0	0

* T et S: TEMMINCK et SCHLEGEL.

Table 6. The reported prevalence of *Clonorchis sinensis* in Kyungpook Province, Korea.

Source	Locality	Group tested	No. tested	Prevalence (%)	Method
Matsumoto (1915)	Taegu city & Yeongcheon gun	School children & general population	349	18.6	Stool examination
Chung (1926)	Andong gun	School children	192	12.0	Stool examination
Nishimura (1943)	Yeongcheon gun	General population	331	41.1	Stool examination
Lee & Kim (1958)	Yeongcheon gun, Kyungsan gun & Taegu city	School children	2,700	7.5	Flotation technique
Walton & Chyu (1959)	Andong city, Yeongcheon gun & Pohang city	Public officlals	1,129	35.3	intradermal test
Lee et al. (1960)	Taegu city, Kyungsan gun & Yeongeon gue	School children & general population	13,109	19.4	Intradermal test
Shin (1963)	Pohang city, Kyungju city & Weolseong gun	School children & general population	4,603	39.5	Intradermal test
Shin (1964)	Yeongcheon gun, Uisong gun, Andong city, Sangju gun, Cheongsong gun, Yeongyang gun & Taegu city	School children & general population	24,252	27.7	Intradermal test
Yun et al (1968)	Taegu city	School children & general population	4,603	0.9	Formalin ether sedimentation technique and stoll egg counts
Choi et al (1971)	Kyungpook province	In and out patients clinic of Kyungpook Univ. Hospital	1,574	29.8	Formalin ether sedimentation technique
Choi et al (1973)	Yeongcheon gun, Kyungsan gun & Taegu city	School children	3,574	4.1	Intradermal test and stoll egg counts
Present survey (1974)	Nakjeon-ri, Uiseong gun	School children & general population	851	54.8	Intradermal test and Stoll egg-counts

was 41.1 per cent, whereas in the latter, the percentage was 54.8. This difference might have been due, in part, to chance of eating raw fresch water fish and the lack of symptoms in the early stage of the infection.

In Nakjeon, there are many peculiar houses that would sell raw-fish to local inhabitants and visitors. Furthermore, the majority of dwellers enjoy fishing, but they also enjoy consuming the raw-fish.

According to local officials, approximately 300-500kg of fresh water fish are caught from Naktong river daily, and the majority of fish are sent to surrounding towns or cities. The remainder of fish are being sold at these peculiar houses of their town.

These conditions increased the incidence of eating infected fish therefore increase the

incidence of more serious infections with *C. sinensis*.

It has been established that the prevalence of *C. sinensis* among the inhabitants in the vicinity of Naktong river is somewhat higher than the others. The high prevalence of the fluke in the province had been established by numerous workers (Matsumoto, 1915; Chung, 1926; Nishimura, 1943; Lee and Kim, 1958; Walton and Chyu, 1959; Lee et al., 1960; Shin, 1963 and 1964; Yun et al., 1968; Choi et al., 1971 and 1973). The average rate of clonorchiasis was approximately 20 per cent of all inhabitants of Kyungpook Province.

Recently Choi et al. (1973) in the study of *C. sinensis* among the school children in the vicinity of Kumho river found a decrease in the rate of prevalence. This finding is similar to a survey of intestinal helminths in Taegu by Yun et al (1968). However, no decrease in the prevalence of the fluke at Nakjeon village was observed in this study.

With the high incidence of *Clonorchis* larvae in the fresh water fish host and the highest prevalence of the fluke among the dwellers of Nakjeon village makes it very apparent that the Nakjeon village is an endemic focus.

SUMMARY

Nishimura in 1943 indicated for the first time that a serious endemic focus of *Clonorchis sinensis* is located in the vicinity of Yeongcheon (Kyungpook Province, Korea). Later, numerous surveys of this fluke in the Province have been made, but no additional report on the endemic focus of the fluke has been available.

The overall percentage of *Clonorchis sinensis* infections, based on the discovery of eggs by the formalin-ether sedimentation technique, was found to be 54.8 percent from 851 residents in Nakjeon ri (village), Danmil myun, Uiseong gun (county), Kyungpook Province and no significant difference was observed in the sex specific rate of the individuals infected.

There is a high incidence of infection with *Clonorchis sinensis*. The infection rate in the age group from 0 to 4 years was 14.6 per cent, 5 to 9 years was 35.7 per cent and 10 to 14 years was 51.7 per cent.

In the worm burdens for residents, the average number of egg-counts was 41,800.

It is found that a serious endemic focus of *Clonorchis sinensis* exists in the vicinity of Nakjeon village.

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=국문 초록=

경상북도에서 간흡충의 새 침윤지

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경북에서 1943년 西村가 영천지역을 간흡충의 침윤지로 지적한 이래 아직 새 침윤지에 대한 추가 보고는 찾아볼 수 없다.

의성군 단밀면 낙전리의 전 주민을 대상으로 집단법과 Stoll씨충란 계산법으로 간흡충 감염상을 조사하였던 바 본충 감염율은 54.8%(851명중 466명)였고, 남녀 간의 감염율에 유의적 차를 인정할 수 없었다.

연령별로는 0—4세군은 14.6%, 5—9세군은 35.7%로 심히 높았으며 10—14세군은 51.7%로 과반수의 아동이 본충에 감염되어 있었다.

본충 감염자 408명의 감염정도는 Stoll씨 충란 계산법으로 대변 1g당 충란수는 평균 41,800개로서 중감염이 있다. 이번 조사 결과 의성군 단밀면 낙전리는 경상북도에서 간흡충의 침윤지임을 나타내었다.