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Epidemiological survey of *Paragonimus westermani* among residents in Ulchin county, Kyungpook Province, Korea*

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=國文抄錄=

慶北 蔚珍郡 住民들에 있어서 肺吸蟲 疫學的 調査

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肺吸蟲 浸潤地로 알려진 慶北 蔚珍郡 住民들에 있어서 肺吸蟲 最近 感染狀을 알아보기위해 1989年 3月부터 1990年 6月까지 蔚珍郡內 10個面 43個部落 住民 1,262名을 調査對象으로 皮內反應을 調査함과 同時에 調査地域에서 採集한 가재에서 本蟲 被囊幼蟲 感染狀을 調査하였다

調査마을 43個 가운데 22個마을 住民들에 있어서 肺吸蟲 陽性者가 檢出되었으며, 그 率은 最高 29.8%, 最低 1.3%로 마을마다 큰 差異를 나타내었다

住民 1,262名中 皮內反應 陽性者는 146名, 그 率은 10.2%였으며, 性別感染率에 있어서는 男性에서는 12.4%, 女性에서는 10.2%로 兩者間에 有意的 差를 認定할 수 없었다

皮內反應 陽性者 146名 가운데 18名은 喀痰檢査에서 蟲卵을 檢出할 수 있었으며, 3名은 大便檢査에서만 蟲卵을 檢出할 수 있었고, 9名은 喀痰 및 大便檢査 모두에서 蟲卵을 發見할 수 있었다

年令群別 感染率에 있어서는 0-9歲群에서는 6.4%였으며, 年令이 많아질수록 그 率도 增加하여 30-39歲群에서는 最高値 31.7%를 나타내었다

調査地域에서 採集한 가재에서 肺吸蟲 被囊幼蟲 檢出率은 地域에 따라 큰 差異를 나타내었고, 가재 部位別 寄生狀은 頭胸部(69.1%), 아가미(25.2%), 및 肝(5.5%) 順이었으며, 가재 한마리當 肺吸蟲 被囊幼蟲數는 18個였다

調査地域 住民들에 있어서 肺吸蟲에 對한 保健知識 및 中間宿主 攝取에 關한 設問書 調査에서는 皮內反應 陽性者와 陰性者사이에 뚜렷한 差를 認定할 수 없었으며, 肺吸蟲 感染에 關한 知識을 얻을 수 있었던 保健敎育 媒體의 種類는 學校敎育을 통하여 알게 되는 경우가 41.5%로 가장 높았으며, 다음은 라디오 및 텔레비젼(25.5%), 保健所(13.4%) 및 病院(12.5%) 順이었다

以上의 成績으로 미루어보아 慶北 蔚珍郡은 肺吸蟲 流行地域으로 남아 있을 뿐만 아니라 住民들에서의 肺吸蟲 感染率은 아직도 높음을 알았다

Key words *Cambaroides similis*, Intradermal test, Metacercaria, *Paragonimus* antigen, *Paragonimus westermani*, Prevalence, Ulchin county, Kyungpook Province

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Introduction

Many studies on the Oriental fluke, *Paragonimus westermani*, in Kyungpook Province, Korea have appeared in literature Miyairi(1917) first reported on the discovery of *Paragonimus* metacercariae from crayfish collected at Keomoon stream, Chilgok county of the Province Ichinomyia(1924) made a survey of the infestation with larval trematodes in the snail and crayfish hosts and the prevalence of *P westermani* among residents of 5 counties of Kyungpook Province Kobayashi(1926) in his review study covered the districts where there were positive findings in 7 9 per cent of 353, 729 residents Bercovitz(1937) reported clinical studies on human lung fluke disease (endemic hemoptysis) caused by *P westermani* infections

In Korea, during the period from 1940 to 1955, the movement of population and unsanitary conditions caused by the War increased the prevalence and intensity of *Paragonimus* infections to such an extent that it became a major public health problem of nation-wide significance

After the Korean War, the epidemiologic, clinical, immunodiagnostic and therapeutic studies on *P westermani* in Korea have been carried out extensively by many investigators, recognizing the urgency of the problem

As part of a ntation-wide survey on the prevalence of clonorchiasis and paragonimiasis in Korea, Walton and Chyu(1959) reported that the prevalence rate of *P westermani* among residents in Kyungpook Province was 4 3 per cent, and Park and Song(1961) in their epidemiological and clinical study on paragonimiasis in Korean children summarized their findings on the fluke at the Presbyterean hospital in Taegu city of the Province

Afterwards, results of studies on *P westermani* in Kyungpook Province have been reported by Sohn and Choi(1977), Kim and Choi(1977), and Lee and Choi(1979) in Chilgok county, by Choi and Hwang (1980) and Choi et al (1981) in Wiseong county, by Chung et al (1974) in Dalseong county, by Kim et al (1974) on comprehensive surveys in several counties of Kyungpook Province, Korea

Quite recently, the high prevalence of *P westermani* among the residents and the demonstration of the metacercariae from the crayfish host in the vicinity of the stream Namdae, Wyangpi, and Kwang in Ulchin county(Joo et al , 1985, Hong et al., 1986, and Shin and Joo, 1989) indicated that Ulchin county is one of the endemic foci in Kyungpook Province But aside from these studies, no data are available with regard to the epidemiological patterns of occurrence of the lung fluke in this county

The objectives of this survey were to obtain recent information on the prevalence of *P westermani* among residents and to secure other data which might be useful in the prevention and control of the fluke

Materials and Methods

1 Surveyed area Ulchin county is situated in the northeast part of Kyungpook Province, having an area of 987 77 square kilometers, and is bordered on the north by Samcheok county, on the west by Bongwha and Yeongyang counties, on the south by Yeongdeok county, and on the east by the eastern Sea of Korea(Fig 1)

The western part of Ulchin county is highly mountainous, the other parts of the county consisting of agricultural fields and coastal areas.

This county contains two towns and eight myuns, and has a population of about 83,900; 41,000 are males and 42,000 females, almost equally distributed between mountainous and coastal areas In this survey, Deoksan and Samdang primary school children, Samckeon and Oncheong middle school pupils, Ulchin agricultural high school students, and the residents in one town and eight myuns of the county were selected

2 Prevalence of *P westermani* in residents: From March, 1989 to June, 1990, the authors carried out an epidemiological survey in order to estimate the recent patterns of paragonimiasis using *Paragoni-*

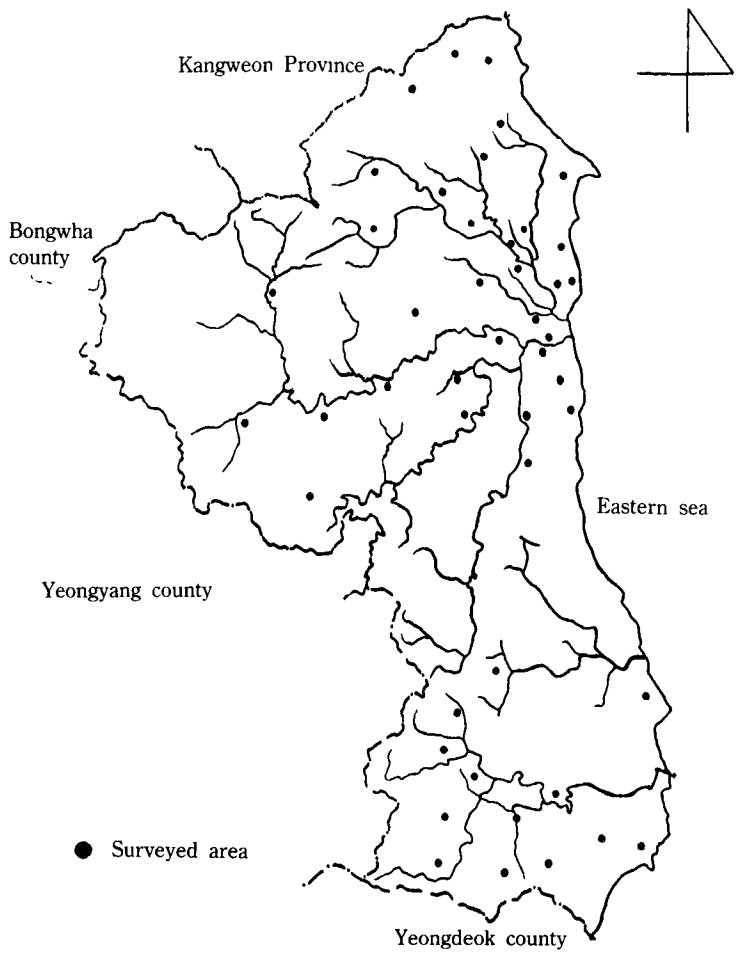

Fig 1 Surveyed areas in Ulchin county in Kyungpook Province, Korea

mus antigen for intradermal test The *Paragonimus* antigen, Lot No. 890417, made in the Department of Parasitology, National Institute of Health, Tokyo, Japan was used in this survey Intradermal injections, approximately 0.02 ml of 1 10,000 *Paragonimus* antigen(VBS), were made on the volar surface of the forearm.

The wheals obtained were measured immediately after the injections, and another measure was taken from 15 to 30 minutes later Wheals which had increased an average of 4 mm or more were considered as positive reactions, 3 mm or less were negative, while 3 5 mm were recorded as doubtful

3 Examination of *Paragonimus* eggs in Sputum and stool: Sputum specimens were collected from residents who showed a positive intradermal test for paragonimiasis

The specimens, collected in sterilized bottles, were brought to the Department of Parasitology laboratory They were dissolved in 5 per cent NaOH solution, and centrifuged for 5 minutes at 3,000 revolutions per minute

The supernatant fluid was discarded except for about 0 5 ml in which deposit was suspended. The deposit was put on the microslide, and examined microscopically for *Paragonimus* eggs

Stool specimens were collected from the residents with positive intradermal tests and were forwarded

to the Parasitology laboratory

The specimens were examined by the formalin-ether sedimentation technique(Ritchie, 1948)

4 Examination of *Paragonimus* metacercariae from the second intermediate host In order to demonstrate the *Paragonimus* metacercariae from the second intermediate hosts, the fresh-water crayfish collected were brought to the laboratory and were dissected, separating the liver, heart, gills, cephalothorax, and the legs These were compressed between two large slides(50 X 90 mm), and examined for the presence of the metacercariae of *P westermani* under a binocular dissecting microscope

5 Survey on the eating habits of second intermediate hosts and health education on paragonimiasis among the residents In order to obtain the additional information of the *Paragonimus* infections, the answers to the questions were derived by a questionnaire formula to the individuals who tested positive with the *Paragonimus* intradermal test for lung fluke infections

The respondents were asked to check columns indication whether they had each item "one" or "two" and Yes or No

Results

The prevalence of *P westermani* among school children by sex and age groups in Ulchin county, based on the *Paragonimus* intradermal test, is given in Table 1

Twenty-two children out of 213 examined were found to be infected with *P westermani*, this amounting to 10 3 per cent of the children

There were no differences in the positive rate between boys and girls, 11 7 per cent of positive individuals were boys and 8 9 per cent were girls

The patterns of the positive rates for age groups were appreciably varied, it was found to be 3 2 per cent in the 8 year old group and increased progressively with age The peak rate was observed in the 11 year old group

It subsequently dropped to 9 7 per cent in the 12 year old group, after which it increased again to 18 2 per cent in the 13 year old group

Table 2 lists the positive rate of *Paragonimus* intradermal tests among middle and high school students The overall positive rate for lung fluke in 628 students was somewhat lower than in the school children, 4 6 per cent compared with 10 3 per cent

In these cases, no significant difference in the positive rate between males and females was found

In Table 3, the prevalences for *P westermani* among the residents is tabulated by the forty-three villages and by number examined and the positive percent of the intradermal reactions

A total of 1,262 residents were examined, 146 or 11 6 per cent were found to be positive reactors

Table 1 Prevalence of *Paragonimus westermani* with intradermal test among primary school children in Ulchin county, Kyungpook Province(1989-1990)

Age (Y)	Male		Female		Total	
	No examined	Percent positive	No examined	Percent positive	No examined	Percent positive
6	11	—	9	—	20	—
7	10	—	4	—	14	—
8	14	7 1	17	—	31	3 2
9	17	11 8	18	—	35	5 7
10	20	20 0	16	12 5	36	16 7
11	21	19 0	14	28 6	35	22 9
12	13	7 7	18	11 1	31	9 7
13	6	16 7	5	20 0	11	18 2
Total	112	11 7	101	8 9	213	10 3

Table 2 Positive rate for *Paragonimus* antigen among middle and high school students in Ulchin county(1989-1990)

Age (Y)	Male		Female		Total	
	No examined	Percent positive	No examined	Percent positive	No examined	Percent positive
12	6	—	3	—	9	—
13	73	4 1	72	2 6	145	2 8
14	74	6 8	64	9 4	138	8 0
15	107	2 8	83	2 4	190	2 6
16	130	6 2	1	—	131	6 1
17	11	9 1	—	—	11	9 1
18	4	—	—	—	4	—
Total	405	4 9	223	4 0	628	4 6

The positive rates of lung fluke widely varied from one village of the Myun to another

In general, rates in the mountainous villages were relatively high, 29 8 per cent in Hadang ri village of Buk-myun, 21 1 per cent in Haweon ri village of Seo-myun, and 14 3 per cent in Chokum ri village of Oncheon-myun, respectively

Table 4 summarizes the positive intradermal test with *Paragonimus* antigen by sex and age groups among the residents in Ulchin county

The overall positive rate for the fluke was found to be 11 6 per cent

In age specific rate of infections, it was found to be 3 0 per cent in the 0-9 year age group and 6 4 per cent in the 10-19 year age group

The rates subsequently increased and reached the maximum of 31 7 per cent in the 30-39 year age group, after which it remained around 25.0 per cent followed by an abrupt decrease in the 60 or older age group

In the sex specific rate of infections, the rates were consistently higher for males than for females at all age groups

The results of sputum and stool examinations of the 146 positive intradermal cases are presented in Table 5 Of the 95 males and 51 females examined 60 produced stool and sputum, 66 produced stool only, and from 10 residents only sputum sample was received Detection rate of *Paragonimus* eggs by sputum examination was 38 7 per cent, and by stool examination 8 8 per cent

Of them, *Paragonimus* eggs were positive in 9 of both samples, and 18 were negative in the stool but positive in sputum In certain cases *Paragonimus* eggs were found in 3 cases in stool specimens but were negative in the sputum

Table 6 presents the demonstration of *Paragonimus* metacercariae from crayfish in the surveyed areas of Ulchin county A total of 394 crayfish were examined and metacercariae were recovered from 31 The infection rates ranged from 11 2 per cent in Ducheon habitat to 1 7 per cent in Sokwang habitat The average number of metacercariae per positive crayfish was relatively less, 2.1 in the Ducheon habitat, 1.3 in the Hadang, and 1 0 in the Sokwang habitats, respectively

The numerical distribution of *Paragonimus* metacercariae in the body parts showed wide variations according to the surveyed areas In Ducheon habitat the majority of larvae were found in the cephalothorax, the gills and the liver in that order The rates were 69.0 per cent, 23 8 per cent, and 7 1 per cent, respectively

In the Sokwang and Hadang habitats, the metacercariae were found in only the cephalothorax and gills

The data shown in Table 7 summarizes the answers to the questions Nine hundred and sixty-five questionnaires were returned and calculated in our Department. The eating rate of the crayfish among the positive cases was 71 4 per cent and that among

Table 3 Prevalence of *Paragonimus westermani* with intradermal test among residents in different villages of Ulchin county, Kyungpook Province, Korea(1989-1990)

Town&Myun	Village	Male		Female		Total	
		No examined	Percent positive	No examined	Percent positive	No examined	Percent positive
Ulchin	Eupnae ri	52	3.8	–	–	52	3.8
	Chungrim ri	50	28.0	35	11.4	85	21.2
	Eupnam ri	16	–	–	–	16	–
	Yeonhgi ri	14	–	–	–	14	–
	Howeol ri	11	–	–	–	11	–
	Shinrim ri	10	–	–	–	10	–
	Koseong ri	9	–	–	–	9	–
	Taehung ri	5	–	–	–	5	–
	Myungdo ri	4	–	–	–	4	–
	Oyang ri	4	25.0	–	–	4	25.0
	Subtotal	175	9.7	35	11.4	210	10.0
Buk Myun	Hadang ri	53	32.1	31	25.8	84	29.8
	Ducheon ri	71	31.0	67	13.4	138	22.5
	Sangdang ri	55	21.8	47	21.3	102	21.6
	Jum ri	8	12.5	–	–	8	12.5
	Sogok ri	5	–	–	–	5	–
	Shinwha ri	2	–	–	–	2	–
	Chumseong ri	1	–	–	–	1	–
	Nagok ri	1	–	–	–	1	–
	Subtotal	196	26.5	145	18.6	341	23.2
Seo myun	Samkwon ri	35	2.9	43	–	78	1.3
	Sangcheon ri	3	–	7	–	10	–
	Sokwang ri	35	9.4	14	–	49	6.1
	Whangpy ri	16	12.5	14	–	30	6.7
	Haweon ri	27	25.9	25	16.0	52	21.1
	Subtotal	116	11.2	103	3.9	219	7.8
Kennam Myun	Noyum ri	12	–	–	–	12	–
	Susan ri	5	–	–	–	5	–
	Sugok ri	5	–	–	–	5	–
	Gusan ri	7	14.3	–	–	7	14.3
	Subtotal	29	3.4	–	–	29	3.4
Oncheon Myun	Kumcheon ri	27	11.1	20	5.0	47	8.5
	Chokum ri	13	7.7	15	20.0	28	14.3
	Kwangpum ri	5	–	10	10.0	15	6.7
	Deoksan ri	55	9.1	57	3.5	112	6.3
	Sotae ri	26	3.8	32	6.3	58	5.2
	Deokin ri	22	13.6	17	11.8	39	12.8
	Seonku ri	17	5.9	18	–	35	2.9
	Oncheon ri	58	8.6	33	3.0	91	6.6
	Yesanmi ri	8	–	12	–	20	–
	Subtotal	231	7.8	214	5.6	445	6.7
Weonnam Myun	Maewha ri	3	–	–	–	3	–
	Kummae ri	1	–	–	–	1	–
	Subtotal	4	–	–	–	4	–
Kiseong Myun	Bongsan ri	1	–	–	–	1	–
	Ipung ri	1	–	–	–	1	–
	Subtotal	2	–	–	–	2	–
Jukbyun Myun	Huchung ri	1	–	–	–	1	–
Hupo Myun	Hupo ri	2	–	–	–	2	–
	Samyul ri	2	50.0	–	–	2	50.0
	Subtotal	4	25.0	–	–	4	25.0
Other districts		6	33.3	1	–	7	28.6
Total		764	12.4	498	10.2	1,262	11.6

Table 4 Summary of positive intradermal test with *Paragonimus* antigen by sex and age groups among residents in Ulchin county, Kyungpook Province(1989-1990)

Age group (Y)	Male		Female		Total	
	No examined	Percent positive	No examined	Percent positive	No examined	Percent positive
0– 9	53	5 7	48	–	101	3 0
10–19	476	6 3	279	6 5	755	6 4
20–29	16	25 0	16	18 8	32	21 9
30–39	39	30 8	21	33 3	60	31 7
40–49	39	30 8	34	14 7	73	23 3
50–59	81	23 5	49	24 5	130	31 5
60–	60	25 0	51	11 8	111	18 9
Total	764	12 4	498	10 2	1,262	11 6

Table 5 Frequency of detection of *Paragonimus* eggs by sputum and stool examinations among 146 positive intradermal cases(1989-1990)

Age group (Y)	No of intradermal positive cases	Sputum test			Stool test		
		No examined	No positive	Percent positive	No examined	No positive	Percent positive
0– 9	3	3	2	66 7	3	1	33 3
10–19	48	30	14	46 7	48	6	12 5
20–29	7	4	1	25 0	7	–	–
30–39	19	8	1	12 5	19	1	5 3
40–49	17	6	1	16 7	7	–	–
50–59	31	13	7	53 8	31	3	9 7
60–	21	6	1	16 7	21	1	4 8
Total	146	70	27	38 6	136	12	8 8

Table 6 Demonstration of *Paragonimus* metacercariae from crayfish in surveyed areas in Ulchin county(1989-1990)

Streams (Habitat)	No examined	No infected	No of cyst detected	Mean of cyst per crayfish	Body parts of crayfish			
					Cephalo-thorax	Gills	Liver	Others*
Ducheon	179	20(11 2)	42	2 1	39(69 0)**	10(23 8)	3(7 1)	–
Sokwang	120	2(1 7)	2	1 0	1(50 0)	1(50 0)	–	–
Samdang	57	5(8 8)	6	1 2	5(83 3)	1(16 7)	–	–
Hadang	38	4(10 5)	5	1 3	3(60 0)	2(40 0)	–	–
Kusan	7	–	–	–	–	–	–	–
Sangcheon	3	–	–	–	–	–	–	–
Total	394	31(7 9)	55	1 8	38(69 1)	14(25 5)	3(5 5)	–

* Others include the heart, leg muscle and tail muscles
** Number in parentheses means the percentage

Table 7 Summary of additional information of *Paragonimus* infections among the residents(1989-1990)

Item	*Paragonimus* intradermal test					
	Positive cases		Negative cases		Total	
	No	%	No	%	No	%
Eating chances of crayfish or crab						
Yes	40	71.4	478	52.6	518	53.7
No	16	28.6	375	41.3	391	40.5
No answered	-	-	56	6.2	56	5.8
Eating habits of crayfish and/or crab						
Raw	4	7.1	36	4.0	40	4.1
Roasted	18	32.1	229	25.2	247	25.6
Boiled	19	33.9	251	27.6	270	28.0
Soysource soaked	-	-	11	1.2	11	1.1
Fried	5	9.5	67	7.4	72	7.5
Others	-	-	12	1.3	12	1.2
No answered	10	17.9	303	33.3	313	32.4
Administration of crayfish juice						
Yes	3	5.4	59	6.5	62	6.4
No	53	94.6	794	87.3	847	87.8
No answered	-	-	56	6.2	56	5.8
Recognition for source of *Paragonimus* infection						
Yes	31	55.4	558	61.4	589	61.0
No	25	44.6	295	32.5	320	33.2
No answered	-	-	56	6.2	56	5.8
Media of the health education on the cause of paragonimiasis						
Journal	1	1.8	52	5.7	53	5.5
Newspapers	3	5.4	66	7.3	69	7.2
Radio&Television	5	9.5	238	26.2	243	25.2
Health center	7	12.5	122	13.4	129	13.4
Hospital&clinics	29	51.8	92	10.1	121	12.5
Schools	4	7.1	396	43.6	400	41.5
Neighbours&friends	1	1.8	119	13.1	120	12.4
Movies	1	1.8	26	2.9	27	2.8
Advertisements	-	-	30	3.3	30	3.1
Others	12	21.4	218	24.0	230	23.8
No answered	56		909		965	

the negative cases was 52.6 per cent

In the eating habits, boiling was found most popular, in 28.0 per cent of the residents, followed by roasting with 25.6 per cent and frying with 7.5 per cent

The most prevalent media of health education on the cause of paragonimiasis was the hospitals and clinics among the positive cases and in negative cases

it was schools The other important media were radio and television, health centre, neighbours and friends, and newspapers, in that order

Discussion

Since the first report on the discovery of *Paragonimus* metacercariae from *Eriocheir sinensis* collected in Kanghwa island(Moriyasu, 1916) and from *Cambaroides similis* in the stream Keomoon(Miyairi, 1917), epidemiological studies of *P westermani* in Kyungpook Province, Korea were instituted mostly in the neighbourhood of mountain streams of Andong(Ichinomyia, 1924, Walton and Chyu, 1959, Kim et al, 1974, and Park et al, 1984), Chilgok(Ichinomyia, 1924; Park and Choi, 1974, Kim and Choi, 1977, Shon and Choi, 1977, and Lee and Choi, 1979), Cheongsong (Ichinomyia, 1924, Park and Song, 1961, Park and Choi, 1974, Kim et al, 1974, Choi et al, 1983, and Choi et al, 1987), Dalseong(Park and Song, 1961, Park and Choi, 1974, Kim et al, 1974, Chung et al, 1974, and Choi et al, 1983), Ulchin(Joo et al, 1985, Hong et al, 1986, and Shin and Joo, 1989), Wiseong (Ichinomyia, 1924, Kim et al, 1974, Choi and Hwang, 1980, and Choi et al, 1981), Yeongpung(Ichinomyia, 1924, Park and Choi, 1974, Choi et al, 1983, and Lee and Choi, 1984), Yeongyang(Park and Choi, 1974, and Choi et al, 1983), Yeongcheon(Walton and Chyu, 1959, Kim et al, 1974, and Park and Choi, 1974)counties, and Pohang(Walton and Chyu, 1959) and Taegu (Park and Song, 1961, and Kim et al., 1974) cities

As a result, human paragonimiasis is found to be endemic in the neighbourhood of mountain streams of some counties of this Province where crayfish and crabs, the second intermediate hosts of *P westermani*, were abundant and recognized as a major clinical and public health problem

Ulchin county lies in the mountainous and coastal area of the northeast part of Kyungpook Province at 36'10-37'8 north latitude which was incorporated from Kangweon Province in 1963

In this county, there is one of the Natural Monuments(No 155) in Korea, Ulchin Seongnyugul cave which is the oldest cave in the Orient, and is famous for its mysterious deep valley, Ulchin Pulyounggyegok(Science place No 6) which has clear water and various kinds of seasonal flowers

According to local officials, rural and urban residents often visit these clear water and/or Ulchin Seongnyugul cave on weekends or holidays, and the majority of residents in the villages along the sides of the streams enjoy the collection of the crayfish and also consuming raw or uncooked crayfish with ricewine, which is done primarily by males They are not concerned about infection of *P westermani*, but believe that crayfish collected in these clear waters are completely free of larval trematodes because the water is clear and running over pebbles and rocky bottoms

However, this traditional concept was found to be false by the results obtained by Joo et al (1985), Hong et al (1986), Ha and Joo(1987), Shin and Joo(1989), and this study The results in the present study show that the positive rate of *P westermani* in 1,262 residents in the neighbourhood of some streams in Ulchin county was 11 6 per cent and *Semisulcospira* snail and crayfish are present in the streams

In the surveys on *P westermani* in Kyungpook Province, little work was done before the end of the Japanese occupation, although *C similis* and *E japonicus* were known as the source of *Paragonimus* infections in Korea, After the Korean War, the epidemiological, clinical and therapeutic studies of *P westermani* and other human parasitic diseases in Korea have made remarkable progress with the efforts of medical parasitologists and public health officials

Walton and Chyu(1959) conducted a study on the prevalence of clonorchiasis and paragonimiasis in Korea, using purified skin test antigen, and reported that positive rate for *P westermani* among the residents and public officials in Yeongcheon, Pohang, and Andong cities was 4 9 per cent, 4 6 per cent, and 3 5 per cent, respectively

Park and Song(1961) in an epidemiological and clinical study on paragonimiasis in Korean children reported that the prevalence of *P westermani* was high in such place as Chilgok, Cheongsong, Dalseong, and Yeongyang counties which is removed from the

river Nakdong and its tributaries where mountain streams with crayfish are found From their study on *Paragonimus* infections related to measles, it was found that of 2,385 measles cases examined, 632 cases or 32 8 per cent had ingested crayfish juice, and of that number 297 or 42 9 per cent became infected with lung fluke

They also commented that the most important source of *Paragonimus* infections was from crayfish ingestion during measles infections for the mistaken idea that raw crayfish juice was effective in "bringing out" the rash

Such a custom, which was prevalent throughout Korea in both city and rural areas, originated with herb doctors The common practice is to mash and strain the raw crayfish and administer the juice

Such consideration was also recognized by Ichinomyia(1924), Walton and Chyu(1959), Yun(1960), Kim et al (1974), and Chung et al (1974)

Thirteen years later, Kim et al (1974) carried out a comprehensive survey on the prevalence of human paragonimiasis in Kyungpook Province and its relation to the presence of *Paragonimus* metacercariae in the second intermediate hosts, and reported the prevalence rate of lung fluke was 4 3 per cent among 16,106 residents examined They also stressed that paragonimiasis was prevalent among the residents and represented one of the major clinical and public health problems in the Province, and Choi and Hwang(1980) in a study of *P westermani* in Wiseong county also recognized such considerations

Quite recently, Joo et al (1985) conducted a survey of *P westermani* in Ulchin county, and first confirmed that some Myuns of the county are endemic areas of human paragonimiasis They examined the residents in the neighbourhood of mountain streams, using skin reaction with *Paragonimus* antigen, and reported the prevalence rate of this fluke to be high, 25 8 per cent At the same time they also demonstrated the existence of *Paragonimus* metacercariae from crayfish collected in surveyed areas

In the present study, a total of 1,262 individuals were tested with *P westermani* antigens in the forty-three villages of Ulchin county and the positive rates of lung fluke among the residents widely varied from one village of Myun to another

Therefore, the prevalence rate for *P westermani* among the residents based on consideration of Myun boundaries alone are meaningless and often misleading

In fact, prevalence rates in the villages along the sides of the mountain streams with crayfish found were strikingly high, 29 8 per cent in Hadang ri and 22 5 per cent in Ducheon ri of Buk myun, 21 2 per cent in Haweon ri of Seo myun, and 21 2 per cent in Chungrim ri of Ulchin town, respectively

In contrast, the rates in the villages in the neighbourhood of the plain and/or coastal districts were less than 3.0 per cent

A study of Sadun and Buck(1960) emphasized the need to consider the habitat and the number and seasonal migratory behavior of infected crabs and crayfish, and the influence of socioeconomic factors on the behavior and dietary habits of the population at risk, in evaluating the distribution of paragonimiasis, and Park and Song(1961) and Kim et al (1974) in a study of *P westermani* in Kyungpook Province also recognized such considerations

The results of this survey generally indicated clear evidence that among individuals residing in the same town 21 2 per cent of those living along the mountain streams had positive reactions, as contrasted to less than 1 0 per cent of those located in downtown or coastal districts

The results presented in Table 4 and Table 5 indicate that of 1,262 residents examined by intradermal tests, sputum and stool examinations, 146 or 11 6 per cent, 27 or 2 1 per cent, and 12 or 1 0 per cent were positive for *P westermani* infections, respectively

These results are similar to data reported by Kim et al (1974) in Dalseong county, Kim and Choi(1977) in Chilgok county, and Shin and Joo(1989) in Ulchin county, Kyungpook Province, Korea

However, this study shows a lower prevalence than those reported by Ichinomyia(1924) in Yeongju county, Kim et al (1974) in Cheongsong county, Shon and Choi(1977) in Chilgok county, and Joo et al (1985)

in Ulchin county, Kyungpook Province, Rim et al (1975) in Kanghwa county, and Lee et al (1980) in Pajoo county, Kyungggi Province, Sadun and Buck (1960), and Kim and Yang(1964) in Cheju island, Cheon(1971) in Haenam county, Cheonnam Province, Korea, although Walton and Chyu(1958), Lee and Choi(1979), Choi and Hwang(1980), and Choi et al (1981) reported much lower figures

In the sex-specific rate, the positive rate for paragonimiasis was higher in the males than in the females These findings are in agreement with those of previous investigators(Kim and Choi, 1977, Lee and Choi, 1979, Choi and Hwang, 1980, and Choi et al, 1981), and suggest that this is probably related to some differences in the opportunities of eating raw or uncooked crayfish intermediate hosts as was observed in cases of *C sinensis* and other intestinal flukes

A study of Joo(1977) commented that Korean males were fond of rice-wine with uncooked crayfish and crabs, but women usually were not, and did not share such a habit Such consideration was also recognized also by Sadun and Buck(1960), Kim et al (1974), and Joo et al (1985)

The patterns of age-specific rate of prevalence showed a tendency to be higher with the increase of age and reached a maximum of 31 7 per cent in the 30-39 year age group and decreased afterwards

Although the main reasons for the decrease in the percentage of positive intradermal reactors in older age groups are not readily apparent, it was considered to be due to a decrease in the consumption of raw crabs and/or crayfish, anti-parasitic health education, and improvement of the socioeconomic conditions, and Sadun and Buck(1960), and Shon and Choi(1977) in the surveys on paragonimiasis in Korea also recognized such considerations

In earlier studies on the second intermediate host of *P westermani* in Korea, Kobayashi(1918) carried out a study on the lung fluke in Korea, and reported that 5-80 per cent of *C similis* were infested with metacercariae of *P westermani* in an endemic area, one of them having a maximum of 1,016 metacercariae and the sites of the encysted larvae were mainly in the muscle of the body and the liver

From their study on the distribution of the metacercariae in the second intermediate host of lung fluke, Park and Choi(1974) reported the infestation rate for *Paragonimus* metacercariae among crayfish to be high and that 49 3 per cent of total metacercariae detected were found in the cephalothorax and 26.6 per cent in the gills and 24 1 per cent in the liver, heart, and other parts of the body

Quite recently, Hong et al (1986) in a study on the infestation status of *Paragonimus* metacercariae in the second intermediate host in Ulchin county reported that the population density of the crayfish ranged from 1 to 13, with an average of 4 per man-hour, and that the average number of metacercarial larvae per infected crayfish ranged from 1 0 to 1 9, with an average of 1 7

In the present study, the infestation rate of *Paragonimus* metacercariae in the crayfish was found to be 7 9 per cent This result is similar to data obtained by Park and Choi(1974) in Yeongpung county and Choi et al (1983) in Cheongsong county

The intensity of infestation with the metacercarial larvae in crayfish in this study was very low These findings are in agreement with those of previous investigators(Choi et al., 1983, Lee and Choi, 1984, Park et al, 1984, and Hong et al, 1986), and support the assumption that the low intensity of the larvae may be due to pesticides and artificial modifications of the water, which are inhibitory to the survival of larval trematodes

As Choi et al (1983) indicated, the large-scale use of pesticides and the destruction of natural environment by constructing dams and ponds in upper streams would affect the ecology of snails and crayfish

In earlier surveys on the eating habits of foods infested with parasites in Koreans, Loh(1963) conducted a survey on the eating habits of second intermediate hosts and health education of distomiasis among residents in Pusan city, and reported that the eating rate of the fresh-water crayfish was 48 6 per cent, and that the most popular way of eating was boiling

He also commented that educational campaigns on the cause and effect relationship of eating fresh-

water fish, crab and crayfish and distomiasis alone were not adequate because of the continous consuming of fresh-water fish, crab and crayfish even with knowledge of its possible harm, and Kang et al (1965) in a survey on the eating habits of food infected with parasites among inhabitants in Cheju Province also recognized such considerations

In this survey, the eating rate of the crayfish in 965 residents responding was relatively high, 71 4 per cent in the positive cases and in the negative cases 52.6 per cent Of the eating habits, boiling was found most popular in 28.0 per cent of the residents

These findings are in agreement with those of previous investigators (Loh, 1963, and Kang et al., 1965)

Summary

In order to estimate the recent information on the prevalence of *Paragonimus westermani* among residents in Ulchin county and its relation to the demonstration of *Paragonimus* metacercariae in second intermediate hosts, a survey based on intradermal tests with *Paragonimus* antigen and encysted larvae examination of crayfish collected in surveyed areas was carried out during the period from March, 1989 to June, 1990

In a total of 1,262 individuals examined, 146 cases or 11 6 per cent were revealed positive of *Paragonimus westermani* In approximately 40 0 per cent of positive intradermal cases, *Paragonimus* aggs could be detected by single sputum and stool examinations Of them, *Paragonimus* eggs were positive in 18 cases in sputum, 3 cases in stool specimen only, and 9 cases in both sputum and stool specimens

In the sex-specific rate of *Paragonimus westermani*, it was a little higher in males than in females

In the age-specific rate patterns, an increase in the prevalence of infections up to adulthood were observed, with a decrease afterwards

Of three hundred and ninety-four crayfish examined, 31 or 7 9 per cent harboured the encysted larvae of *Paragonimus westermani* The majority of the larvae were found in the cephalothorax, the gills and the liver

The average number of metacercarical larvae per infected crayfish ranged from 1 0 to 2 1, with an average of 1 8

In the questionnaire studies, although no apparent difference in the results obtained between positive and negative intradermal cases was noted, the most prevalent media of the health education on the cause of paragonimiasis was the hospitals and clinics among the positive cases and in negative cases it was schools

The results of this study generally indicate that *Paragonimus westermani* infections are still prevalent among the residents of Ulchin county, on the basis of the infective cases found among the residents and the demonstration of encysted larvae of lung flukes from the crayfish intermediate host

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