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Prevalence of *Entameba histolytica* and other Intestinal Parasites in some Counties of Kyungpook, Korea*

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Introduction

Amebiasis has been known from early in this century as an endemic disease in Korea, China and other countries. In those days a considerable number of serious patients suffering from *E. histolytica* infections in Seoul had been reported by Kessel(1925), Choy(1926), Chiba(1931), Kuwabara(1932), Ogura(1933), Takemura(1934) and others.

In Korea(1940~1959) the population movements and unsanitary conditions caused by the World war II and the Korean war increased the incidence of *E. histolytica* and other intestinal parasites to such an extent that they became a major public health problem of nation-wide significance.

The Korean Government made plans to control human parasitic diseases since the begining of the Saemaul movement, and carried out the mass diagnosis and chemotherapy of parasitic infection cases, focusing on school children at the outset.

As a result, these operations resulted on a gradual decrease in the incidence of human helminthic diseases. However, published reports on intestinal parasites among the residents in Kyungpook Province revealed that *E. histolytica* infections still remained highly prevalent, especially in the localities with poorly controlled sanitary conditions. And the incidence found varies according to reporters, method of examinations, number of examinees, and localities even when in the same Province.

This study has proceeded as a part of our investigation in the epidemiology and control of human amebiasis and other intestinal parasitic diseases.

This paper deals with recent patterns of *E. histolytica* and other intestinal parasite infections among the residents in Kyungpook, Korea.

Materials and Methods

1. **Surveyed areas**: Kyungpook Province is located in the southeast part of the Korean peninsula, having an area of 19,700 square kilometers, and is chiefly separated into the eastern and western hilly areas, and the central lowland is located in the valley of the river Naktong between the two hilly areas. The Province is under the influence of a typical continental climate of the eastern coast affected by both high atmospheric pressure from the cold continent and a low one from the Pacific Ocean in the summer season. Therefore, seasonal fluctuation of temperature and precipitation is very great. This Province is divided into 34 administrative districts(city or county). The five counties in the Province were selected: Andong, Bongwha, Wiseong, Kunwie and Yeongcheon counties.

Of which Wiseong county was previously surveyed by Lee(1969), and Yeongcheon county by Nishimura(1943).

* The results of this study were presented at the 36th annual meeting of the Korean society for Parasitology(1994).

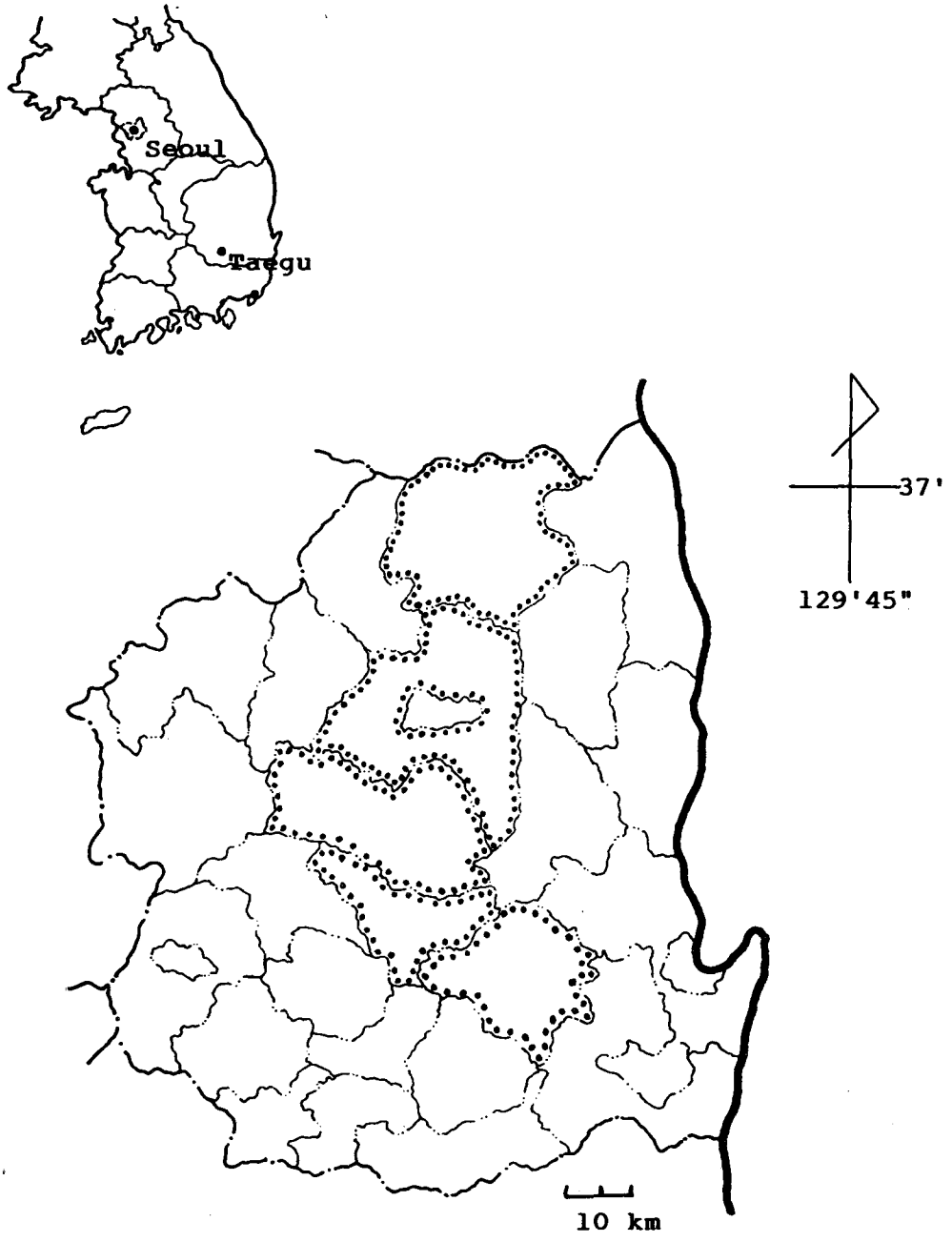

Fig. 1. Map of Kyungpook Province, Black bold lines show the counties surveyed.

The more detailed geographical conditions of surveyed areas were presented by Joo and Baik (1986).

2. Parasitological methods: From September, 1993 to August, 1994, the authors were carried out a parasitological survey in order to determine the recent patterns of *E. histolytica* and other intestinal parasite infections based on the discovery of protozoan cysts and helminthic eggs among the residents aged from 1 to 89 years living in the Province.

From the 5 counties included in the study 3,460 specimens were examined, and average of 692 specimens from each county. This represented about 0.12 per cent of the total population of the Province.

The specimens were collected in cardboard cartons and brought to the laboratory. Since trophozoite disintegrate within a short time, only cysts were examined in solid stools. The formalin-ether sedimentation mehod was used to recover protozoan cysts. One drop of the sediment was first placed on a microscopic slide and one drop of Lugol's iodine solution was mixed. The preparation was mounted with a cover slip, and the entire area was examined for cysts.

When *E. histolytica* cysts were found, the size of a sufficient number of cysts were measured with a micrometer to determine the relative prevalence of large and small races, cysts measuring smaller than 10 micron being assigned to the latter.

Results

Table 1 showed the species and prevalence rates of intestinal protozoa among the residents in Kyungpook. Approximately 6.0 per cent of the 3,460 stool specimens contained one or more species of protozoa.

The most prevalent species were *E. nana* with the prevalence rate of 2.51 per cent, followed by *E. coli* with the rate of 1.45 per cent and *E. histolytica* with 1.24 per cent. Both large and small races of *E. histolytica* were found. Altogether twenty-nine individuals had large race cysts only; 11 had small race cysts only; and 3 had both large and small race cysts.

I. bütschlii was found in 0.78 per cent of the residents examined, and *G. lambria* was detected in 0.49 per cent. As to the sex-specific rates of *E. histolytica* and *E. coli*, females showed higher prevalence than in males, while in cases of *E. nana*, *I. bütschlii* and *G. lambria*, the males were a little higher.

Table 1. Prevalence of intestinal protozoa among residents in Kyungpook, Korea(1994)

Species	Male		Female		Total	
	No. infected	Percent positive	No. infected	Percent positive	No. infected	Percent positive
Entameba histolytica						
Large race	10	0.55	19	1.15	29	0.84
Small race	4	0.22	7	0.42	11	0.32
Both*	1	0.06	2	0.12	3	0.09
Entameba coli	20	1.11	30	1.81	50	1.45
Endolimax nana	48	2.66	39	2.35	87	2.51
Iodameba bütschlii	20	1.11	7	0.42	27	0.78
Giardia lambria	10	0.55	7	0.42	17	0.49
Total No. examined	1,803	5.88**	1,657	6.04	3,460	5.95

* Both : Large race and small race together

** Number means overall positive rate.

The observed and estimated prevalence rates of *E. histolytica* by age groups of residents were shown in Table 2 and Table 3. The age distribution of *E. histolytica* infection was initially established in the 20-29 year age group with an average of 1.42 per cent. It reached its maximum level of mearly 2.1 per cent in the 40-49 year age group, followed by a decrease of varying degree until the oldest age group.

The high level of 3.45 per cent for the people in the 80 and over age group may have been a chance occurrence due to the small number of individuals examined. The heterogeneity $X^2(12.87)$ was significant at the 0.005 level of probability, indicating that the prevalence was not independent of ages, i. e., the prevalence rate was associated with age, becoming higher with increasing age.

A weighted regression analysis resulted in the estimating equation: $p = a + bx = -0.00283 +$

Table 2. Age specific rate *Entameba histolytica* infection among residents by sex(1994)

Age group (Year)	Male		Female		Total	
	No. examined	Percent positive	No. examined	Percent positive	No. examined	Percent positive
0- 9	98	0	67	0	165	0
10-19	220	0	169	0	389	0
20-29	69	0	72	2.78	141	1.42
30-39	237	0.42	242	1.24	479	0.84
40-49	287	2.09	285	2.11	572	2.10
50-59	475	1.26	439	1.37	914	1.31
60-69	291	0.69	270	2.22	561	1.43
70-79	115	0	95	4.21	210	1.90
80-	11	0	18	5.56	29	3.45
Total	1,803	0.83	1,657	1.69	3,460	1.24

Table 3. Observed and estimated prevalence of *E. histolytica* by age of residents(1994)

Age group (Year)	X*	No. of individuals		Prevalence	
		No. examined	No. positive	Observed	Estimated**
0-9	-1	165	0	0	-0.00616
10-19	0	389	0	0	-0.00283
20-29	1	141	2	0.0142	0.0005
30-39	2	479	4	0.0084	0.00383
40-49	3	572	12	0.0210	0.00716
50-59	4	914	12	0.0131	0.01049
60-69	5	561	8	0.011111	0.01382
70-79	6	210	4	0.0190	0.01715
80-	7	29	1	0.0345	0.02048
		3,460	43		

* Coded age group : Midpoint of age interval minus 15, divided by the interval length.

** $P = a + bx = -0.00283 + 0.00333x$; $S_a = 0.00436$. $S_b = 0.00078$. $p = 0.0036$.

0.00333x, in which p is the estimated prevalence and x is the coded age group. Estimated of the standard errors are $S_a = 0.00436$, and $S_b = 0.00078$.

The data shown in Table 4 presented the prevalences of four species protozoa among residents by sex and age group. The prevalence rates of *E. coli*, *E. nana*, *I. bütschlii* and *G. lambria* varied from age to age.

As to the age-specific rates of *E. coli*, it was found to be 1.21 per cent and 1.03 per cent in the 0−9 and 10−19 year age groups, and reached its maximum level of 2.09 per cent in the 30−39 year age group, and followed by a gradual decreased rates.

E. nana was the most prevalent in the 0−9 year age group with almost the same prevalence in males and females of all age groups. Since a few individuals had other intestinal protozoa, *I. bütschlii* and *G. lambria*, no reliable age and/or sex distribution could be determined.

Table 4. Age specific rates for intestinal protozoa except *E. histolytica* among residents by sex(1994)

Age group (Year)	Sex	No. examined	Prevalence(%)			
			E. coli	*E. nana*	*I. butschlii*	*G. lambria*
0− 9	M	98	2.04	1.02	0	1.02
	F	67	0	5.97	0	0
	Subtotal	165	1.21	3.03	0.10	0.61
10−19	M	220	0.91	1.82	0	0.45
	F	169	1.18	0.59	0	0
	Subtotal	389	1.03	1.29	0	0.26
20−29	M	69	0	0	0	2.90
	F	72	1.39	1.39	0	0
	Subtotal	141	0.71	0.71	0	1.42
30−39	M	237	2.11	4.64	1.27	0.42
	F	242	2.07	1.24	0.83	0.83
	Subtotal	479	2.09	2.92	1.04	0.63
40−49	M	287	0.70	2,44	1.39	0.35
	F	285	2.46	2.81	0.70	0
	Subtotal	572	1.57	2.62	1.05	0.17
50−59	M	475	1.47	3.16	1.68	0.42
	F	439	1.82	2.73	0.23	0.91
	Subtotal	914	1.64	2.95	0.98	0.66
70−79	M	115	0	0.87	0.87	0
	F	95	2.11	3.16	0	0
	Subtotal	210	0.95	1.90	0.48	0
80−	M	11	0	0	9.09	0
	F	18	0	0	0	0
	Subtotal	29	0	0	3.45	0
Total	M	1,803	1.11	2.66	1.11	0.55
	F	1,657	1.81	2.35	0.42	0.42
	Subtotal	3,460	1.45	2.51	0.78	0.49

The prevalence of *E. histolytica* and other intestinal protozoa among the residents of 5 counties in Kyungpook Province were shown in Table 5 and Table 6. In *E. histolytica* infections, the prevalence rates were consistently higher for females than for males through all different counties.

The rates of *E. histolytica* varied widely from one county of the Province to another. In practice, the rates among the residents in Wiseong and Andong counties were relatively high, while in Kunwie and Yeongcheon counties were lower.

In *E. coli* infections, the highest prevalence was found in the residents of Yeongcheon county, being found in 2.86 per cent, followed by Bongwha county with the rate of 1.90 per cent and Kunwie county with 1.61 per cent. Wiseong county was

Table 5. Prevalence of *Entameba histolytica* among residents by county in Kyungpook Province(1994)

County	Male		Female		Total	
	No. examined	Percent positive	No. examined	Percent positive	No. examined	Percent positive
An-dong	525	0.38	473	2.33	998	1.30
Bong-wha	317	1.26	314	1.27	631	1.27
Kun-wie	336	0.60	346	1.73	682	1.17
Wi-seong	498	1.20	311	1.61	729	1.37
Yeong-cheon	207	0.97	213	0.94	420	0.95
Total	1,803	0.83	1,657	1.69	3,460	1.24

Table 6. Prevalence for intestinal protozoa except *E. histolytica* among residents according to county in Kyungpook, Korea(1994)

County	Sex	No. examined	Prevalence(%)			
			E. coli	*E. nana*	*I. butschlii*	*G. lambria*
Andong	M	525	0.57	2.67	0.38	0.19
	F	473	1.48	2.96	0	0
	Subtotal	998	1.00	2.81	0.20	0.10
Bongwha	M	317	1.58	1.89	0.32	0.32
	F	314	2.23	1.91	0.32	0
	Subtotal	631	1.90	1.90	0.32	0.16
Kunwie	M	336	1.19	2.98	2.68	0.30
	F	346	2.02	1.73	0.29	0.58
	Subtotal	682	1.61	2.35	1.47	0.44
Woseong	M	418	0.24	2.39	0.72	0.96
	F	311	1.29	2.25	1.29	0.64
	Subtotal	729	0.69	2.33	0.96	0.82
Yeongcheon	M	207	3.38	3.86	2.42	1.45
	F	213	2.35	2.82	0.47	1.41
	Subtotal	420	2.86	3.33	1.43	1.43
Total	M	1.803	1.11	2.66	1.11	0.55
	F	1,657	1.81	2.35	0.42	0.42
	Subtotal	3,460	1.45	2.51	0.78	0.49

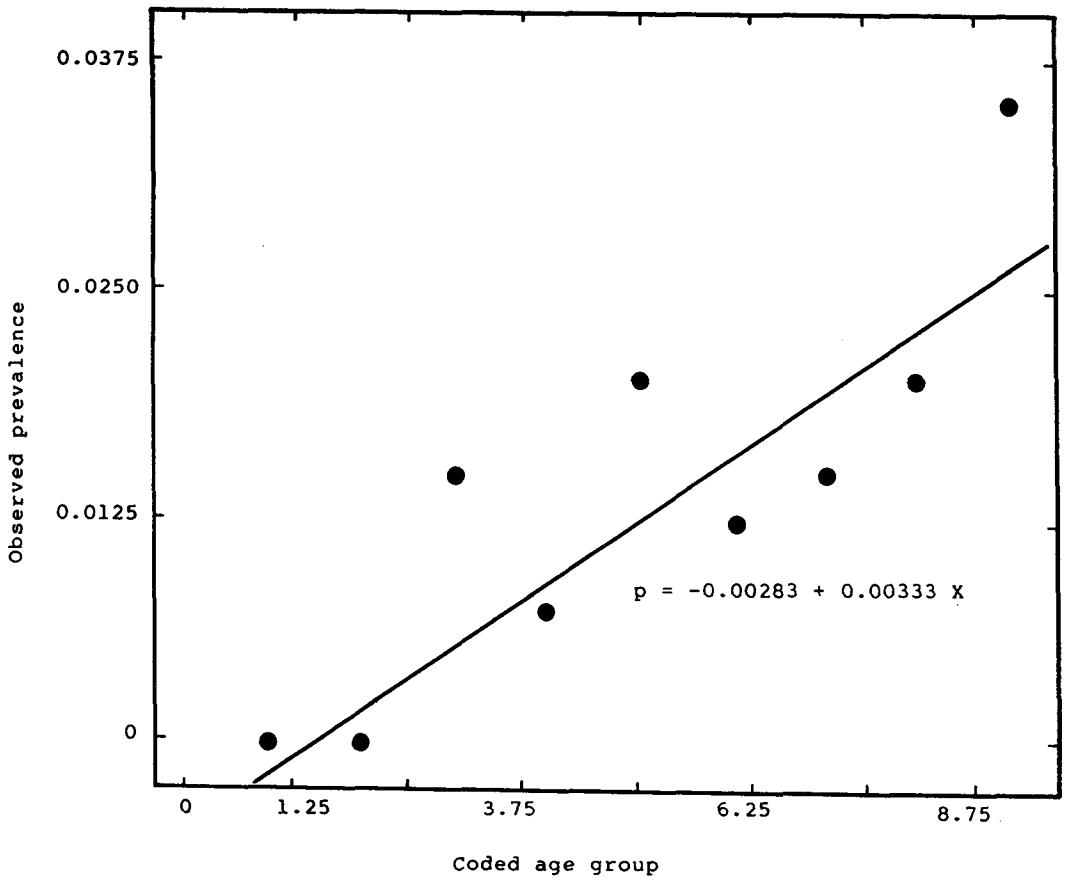

Fig. 2. Prevalence of *E. histolytica* among residents by age. Straight line is fitted regression line.

the least rate, being found in 0.69 per cent. In *E. nana* infections, the highest rate was 3.33 per cent in the residents of Yeongcheon county, and the all surveyed counties were found. In *G. lambria* infections, Yeongcheon county was the highest rate, being found in 1.45 per cent and 1.41 per cent in the both sexes, but no this species was found in female group of Andong and Bongwha counties.

Table 7 listed the species and prevalences of intestinal helminths in a single examination of the specimens. Among them, one or more species of helminths were found in 405, which becomes an overall prevalence of 11.71 per cent. *C. sinensis* was the most frequent helminth, being found in 10.72 per cent, followed by *M. yokogawai* with 1.45 per cent, and *Trichostrongylus* species with 0.14 per cent.

A. lumbricoides and *T. trichiura* were unexpectedly the least prevalent, and *Taenia* species was found from only 0.06 per cent of the residents.

The single or multiple infections with intestinal protozoa among the residents in Kyungpook were shown in Table 8. Among the 3,460 specimens examined, one or more species of protozoa were found in 206, which becomes an overall prevalence of 5.95 per cent. The number per parasitized individuals was 1.3. One individual had 4 parasites; four had 3 each; and forty-four had 2 each.

Table 7. Prevalence of intestinal helminths among residents in Kyungpook, Korea(1994)

Species	Male		Female		Total	
	No. positive	Percent positive	No. positive	Percent positive	No. positive	Percent positive
Ascaris lumbricoides						
Unfertilized	2	0.11	1	0.06	3	0.09
Fertilized	1	0.06	1	0.06	2	0.06
Enterobius vermicularis	1	0.06	1	0.06	2	0.06
Trichostrongylus species	1	0.06	4	0.24	5	0.14
Trichuris trichiura	1	0.06	1	0.06	2	0.06
Taenia species	2	0.11	0	0	2	0.06
Clonorchis sinensis	297	16.47	74	4.47	371	10.72
Metagonimus yokogawai	38	2.11	12	0.72	50	1.45
Total No. examined	1,803	17.58*	1,657	5.31	3,460	11.71

* Number means overall positive rate.

Table 8. Single or multiple infections with intestinal protozoa among residents in Kyungpook, Korea (1994)

Parasites	Male		Female		Total	
	No.	%	No.	%	No.	%
Single infection						
E. histolytica	9	8.49	21	21.0	30	14.56
E. coli	16	15.09	21	21.0	37	17.96
E. nana	28	26.42	28	28.0	56	27.18
I. bütschlii	14	13.21	4	4.0	18	8,74
G. lambria	9	8.49	7	7.0	16	7.77
Double infections						
E. histolytica & *E. coli*	2	1.89	4	4.0	6	2.91
E. histolytica & *E. nana*	0	0	1	1.0	1	0.49
E. histolytica & *C. sinensis*	2	1.89	2	2.0	4	1.94
E. histolytica & *M. yokogawai*	1	0.94	0	0	1	0.49
E. coli & *C. sinensis*	1	0.94	1	1.0	2	0.97
E. coli & *E. nana*	0	0	2	2.0	2	0.97
E. nana & *I. bütschlii*	3	2.83	1	1.0	4	1.94
E. nana & *C. sinensis*	15	14.15	5	5.0	20	9.71
I. bütschlii & *C. sinensis*	2	1.89	1	1.0	3	1.46
G. lambria & *C. sinensis*	1	0.94	0	0	1	0.49
Triple infections						
E. histolytica, *E. coli* & *M. yokogawai*	1	0.94	0	0	1	0.49
E. coli, *E. nana* & *Trichostrongylus* species	0	0	1	1.0	1	0.49
E. nana, *C. sinensis* & *M. yokogawai*	1	0.94	0	0	1	0.49
E. nana, *I. bütschlii* & *C. sinensis*	1	0.94	0	0	1	0.49
Quadruple infections						
E. coli, *E. nana*, *I. bütschlii* & *C. sinensis*	0	0	1	1.0	1	0.49
Total No. positive	106		100		206	

Discussion

Studies on the prevalence of *E. histolytica* and other intestinal protozoa in Kyungpook Province were carried out in Yeongcheon county by Nishimura(1943), in Seonsan and Wiseong counties by Lee(1969), in Kyungsan county by Kim et al. (1971), and in Ullung county by Cho et al.(1973). Recently, the prevalence of these protozoan infections in Ulchin county(Ha and Joo, 1987), and in Kolyung county(Joo and Lee, 1992) has been reported.

In *E. histolytica* infections, the highest prevalence reported up-to-date was 9.9 per cent in Yeongcheon(Nishimura, 1943) and in Kyungsan counies(Kim et al., 1971) while the lowest rate was 3.1 per cent in Kolyung county(Joo and Lee, 1992).

In the present survey *E. histolytica* infections were found in 43 cases, with a prevalence of 1.24 per cent. Of them, twenty-nine cases had large race cysts only; 11 had small race cysts only; and 3 had both large and small race cysts.

It is clear that, although higher prevalence is expected if examinations were repeated, our figures showed a marked decrease in the prevalence of *E. histolytica* infections compared with earlier reports available.

The exact causes of the lower prevalence of amebiasis are difficult to explained, but the remarkable improvements of sanitary conditions and dwellings by Saemaul movement in combination with extensive public health education, specific chemotherapeutic administrations, and attention to personal hygiene should be emphasized in this connection.

There was a significant difference between the prevalence rates of males and females. The former was 0.83 per cent and latter 1.69 per cent. These findings were in agreement with those of previous studies in Kyungpook Province(Kim et al., 1971; Choi and Hwang, 1980; Joo, 1984; Ha and Joo, 1987; Kim and Joo, 1988; Joo and Lee, 1992; Choi and Joo, 1994), and suggested that this was probably related to the habits and physical conditions of each sex, and the environmental factors.

The assumption is supported by the fact that Korean females tend to remain in the home. They handle children, wash clothes, make pickled vegetables, and perform other tasks which might involve the risk of intestinal protozoan infections.

Since males infrequently involve with household duties, they have much less exposure to the amebiasis.

The patterns of age specific rate *E. histolytica* infections were appreciably varied: No case in the 0−19 year age group, 1.42 per cent in the 20−29 year age group and 0.84 per cent in the 30−39 year age group.

It subsequently showed a higher prevalence of 2.1 per cent in the 40−49 year age group, followed by a decrease of varying degree untill the oldest age group was reached. The high level of 3.45 per cent for the individuals in the 80 and over age group may have been a chance occurrence due to the small number of individuals examined.

The prevalence being higher among the older age group may be due to the fact that the parasites were more consistently present in recognizable numbers in the older individuals, rather than to an actual difference of the rate. Although main reasons for amebiasis among the younger age groups are not clear, it is considered to be the adequate, safe supplies of water for drinking and household purposes obtained by filtration, sedimentation and/or sterilization, and protection from contamination of human excreta used as fertilizer and from infected foodhandlers. Such considerations were recognized by Kim and Joo(1988), Kim et al.(1988), Joo and Lee(1992), and Choi and Joo(1994).

Non-pathogenic large intestinal amebae such as *E. coli*, *E. nana* and *I. butschlii* showed variable prevalences according to the investigators, exami-

nation methods and surveyed area even when in the same Province.

A study of Kim et al.(1971) reported that the prevalences of *E. coli*, *E. nana* and *I. bütshlii* in Kyungsan county were 28.1 per cent, 11.8 per cent and 1.0 per cent. Ha and Joo(1987) reported in Ulchin county, the prevalences were: *E. coli* 2.2 per cent, *E. nana* 2.3 per cent, and *I. bütschlii* 0.4 per cent, Joo and Lee(1992) reported *E. coli*, *E. nana* and *I. bütschlii* infections in Kolyung county were 0.8 per cent, 4.8 per cent and 0.2 per cent, respectively. Choi and Joo(1994) reported those protozoa infections among the residents in Taegu city were *E. coli* 0.4 per cent, *E. nana* 1.0 per cent and *I. bütschlii* 1.5 per cent, respectively.

The present data showed some decrease of prevalences compared with the above mentioned reports. The decrease of the protozoan infections was considered to the improvement of environmental sanitation and public health education.

G. lambria was the most common species among the intestinal flagellates, with an infection rate of 0.49 per cent. Nishimura(1943) and Kim et al. (1971) reported that the prevalences of *G. lambria* were 6.6 per cent and 6.4 per cent, whereas Ha and Joo(1987), Kim and Joo(1988), Joo and Lee (1992), and Choi and Joo(1994) reported 1.9 per cent, 0.5 per cent, 0.2 per cent and 0.4 per cent, respectively. Our figure was very similar to the Kim and Joo(1988) and Choi and Joo(1994) though it was far less than those of Nishmura (1943), Lee(1969), Choi et al.(1971), Kim et al, (1971), and Ha and Joo(1988).

Of the 7 species of helminths recorded, *C. sinensis* was the most common, with a prevalence of 10.72 per cent. The sex-specific rate for the liver fluke, with the prevalence signficantly higher in males than in females, was in agreement with previous findings(Joo and Choi, 1974; Joo, 1980; Rim, 1986; Joo and Hong, 1991; Hyun and Joo, 1994; Lee, 1994), and suggested that it was related to some difference in the opportunities of eating raw fresh-water fish and in social customs.

The prevalences of the soil-transmitted helminths such as *A. lumbricoides*, *T. trichiura* and *Trichostrongylus* species were markedly decreased as compared with earlier reports available. This changes are unquestionable results of the almost complete elimination of the fecal soil pollution, public health education, specific anthelminthic administrations and others.

Although the *Enterobius* eggs were observed in 0.06 per cent of the fecal specimens, this is no indication of the true prevalence rate, as the fecal examination is unsuited for determining the prevalence of this helminth. Since *Enterobius* eggs in the stool examinations are not found in more than 5.0 per cent of infected individuals, special techniques using perianal swabs are necessary.

Summarizing the results, this survey indicated that the infection rates of *E. histolytica* and other intestinal parasites were much less prevalent, due to improvement of sanitation by Saemaul movement, in combination with extensive public health education.

Summary

In order to determine the recent patterns of *E. histolytica* and other intestinal parasite infections among the residents in some counties of Kyungpook, this studies were made from September, 1993 to August, 1994. The method employed was MGL technique and one slide was stained with Lugol's iodine solution and examination was made for protozoan cysts. Of 3,460 specimens examined, 43 cases of 1.24 per cent were revealed positive of *E. histolytica*. The prevalence of this parasites tended to be higher with the increase of age.

E. nana was the most frequently, the rate being 2.51 per cent, followed by *E. coli* with the rate of 1.45 per cent, *I. bütschlii* with 0.78 per cent and *G. lambria* with 0.49 per cent.

Of the helminths recorded, *C. sinensis* was the most frequent helminth, being found in 10.72 per cent, followed by *M. yokogawai* with 1.45 per cent,

and *Trichostrongylus* species with 0.14 per cent.

A. lumbricoides and *T. trichiura* were unexpectedly the least prevalent.

Single infection was 76.21 per cent of all positive cases. Of the double infections, the percentage of *E. histolytica* in combination with other protozoa and helminths was higher than that of *E. coli*.

The findings indicated that the prevalence rates of *E. histolytica* and other intestinal parasites were much less prevalent, due to improvement of sanitation in combination with extensive public health education.

Key words : *Entameba histolytica*, intestinal parasite, protozoan cyst formalin-ether sedimentation, prevalence, Kyungpook.

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=초록=

慶北 一部地域住民들에 있어서 痢疾아메바 및 腸內寄生蟲의 有病率

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慶北道內 5個 市郡 住民들에 있어서 痢疾 아메바 및 腸內 寄生蟲症의 最近 感染狀을 알아보기 위해 1993年 3月부터 1994年 8月까지 調査對象으로 選定된 住民들의 糞便을 採集하여 集卵한 後 沃度 染色을 하여 原蟲類 胞囊과 윤충류란을 調査하였다.

總 被檢者 3,460名中 腸內 原蟲類 感染率은 5.95%였으며, 윤충류 感染率은 11.71%였다. 痢疾 아메바의 感染率은 1.24%였으며 性別로는 男性에서는 0.83%, 女性에서는 1.69%였으며, 年令群別로는 老年層이 靑少年層보다 높았다. 小型 아메바의 感染率은 2.51%, 大腸 아메바는 1.45%였으며, 람블 鞭毛蟲은 0.49%였다.

檢出된 윤충류 中 肝吸蟲은 10.72%, 그 다음은 요꼬가와 1.45%였으며, 蛔蟲과 鞭蟲의 感染率은 매우 낮았다. 混合 寄生狀에 있어서는 1種 寄生이 많았으며, 4種 寄生은 1例였다.

以上의 成績으로 미루어 보아 慶北道內 一部地域 住民들에서의 痢疾 아메바 및 腸內 寄生蟲 感染率은 아직도 높다는 것을 알았다.