

# Status of Intestinal Parasite Infections among 4,137 Residents from Provinces Nationwide and Metropolitan Areas in the Republic of Korea (2004)

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## 전국 주요 시도별 주민 4,137명의 장내 기생충 감염 현황(2004년도)

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**Background** : The status of intestinal parasite infections among the residents of nationwide geographical areas in the Republic of Korea has been little investigated since 1997. The present study was designed to estimate the infection status of intestinal parasites among residents of several geographical areas in the Republic of Korea.

**Materials and Methods** : Fecal samples of 4,137 people (men : 2,170, women : 1,967) who visited the Korea Association of Health Promotion for a health check-up were collected from July to September, 2004. Specimens were examined for helminth eggs, larvae, and protozoan cysts using the Kato-Katz thick smear, formalin-ether sedimentation, and modified acid-fast staining techniques.

**Results** : Helminth eggs, larvae, and protozoan cysts were found in 322 (7.8%) of the 4,137 specimens examined. The helminth species detected were *Clonorchis sinensis* (in 259 specimens; 6.3%), *Metagonimus* sp. (14; 0.34%), *Pygidiopsis summa* (5; 0.12%), unidentified heterophyids (24; 0.58%), *Echinostoma* sp. (4; 0.1%), *Gymnophalloides seoi* (4; 0.1%), *Paragonimus westermani* (1; 0.02%), *Trichuris trichiura* (10; 0.24%), *Ascaris lumbricoides* (1; 0.02%), hookworms (1; 0.02%), and *Strongyloides stercoralis* (larva positive) (1; 0.02%). The protozoans detected were *Entamoeba coli* (9; 0.22%), *Giardia lamblia* (1; 0.02%), and *Isospora* sp. (1; 0.02%). The parasite positive rate was the highest in Gyeongsangnam-do (38 specimens; 15.3%), followed in decreasing order by Gwangju/Jeollanam-do (56; 13.9%), Busan (58; 12.3%), Gyeongsangbuk-do (18; 11.2%), Daejeon/Chungcheongnam-do (42; 8.1%), Chungcheongbuk-do (18; 8.0%), Incheon (10; 7.0%), Daegu (22; 6.8%), Gyeonggi-do (25; 5.0%), Jeollabuk-do (7; 4.4%), Gangwon-do (6; 3.5%), Seoul (20; 2.6%), and Jeju-do (2; 2.0%). The male positive rate (225/2,170; 10.4%) was significantly higher than that of females (95/1,967; 4.8%) ( $P<0.01$ ).

**Conclusion** : Fish-borne trematodes including *C. sinensis* and heterophyids appear to be the major intestinal parasites among residents of the Republic of Korea. Control efforts are required against these fish-borne parasitic zoonoses.

**Key Words** : Intestinal parasites, Trematode, Fecal examination, Human, Korea

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## INTRODUCTION

Parasitic infections of humans, particularly soil-transmitted nematodes, such as *A. lumbricoides*, *T. trichiura*, and hookworms, were highly prevalent in the Korean population before the 1970s (1,2). In order to estimate the national status with respect to intestinal parasite infections, seven nationwide surveys were performed every 5 years since 1971 until 1997. The overall infection rate was found to be extremely high (54.9%) in the first 1971 survey, but by 1997 the rate had decreased remarkably to 2.4% (3,4). This rapid decrease in overall prevalence is attributed to national control activities undertaken to reduce the prevalence of soil-transmitted nematode infections and to greatly improved hygiene and sanitary conditions among the Korean people.

However, despite this remarkable decrease in the prevalence of soil-transmitted nematodes, the prevalence of fish-borne trematodes, such as *C. sinensis* and *Metagonimus* spp. has been maintained at a high level, particularly in riverside areas (5,6). In addition to these 2 species, heterophyids (*Heterophyes nocens* and *P. summa*) and a gymnophallid (*G. seoi*) have also been reported to be prevalent in coastal areas and on many off-shore islands (7-11).

Available figures indicate that soil-transmitted nematodes have become of negligible importance but that fish-borne trematodes have become a major public health concern in the Republic of Korea (7, 8). Although some local data is available on this issue (5,6,9,10), no nationwide surveys have been conducted to determine the breadth of the problem. Therefore, the present study was performed to evaluate the status of intestinal parasite infections in the population of different regions in the Republic of Korea.

## MATERIALS AND METHODS

A total of 4,137 fecal specimens (2,170 men and 1,967 women) were collected from people who visited the Korea Association of Health Promotion (KAHP) clinics in each province and major urban areas during the period July to September, 2004. The specimens were kept refrigerated before being transported to the De-

partment of Parasitology and Tropical Medicine, Seoul National University (Seoul, Korea). The Kato-Katz thick smear and formalin-ether sedimentation techniques (12) were used to examine helminth eggs, larvae, and protozoan cysts. Oocysts of *Cryptosporidium* and *Isospora* were examined by modified acid fast staining (13). Helminth eggs, larvae, protozoan cysts, and oocysts were identified by microscopic observations of specimens by experienced personnel. Age- and locality-dependent parasite prevalences were compared, and sex-dependent differences were analyzed using the Chi-square test.

## RESULTS

Of 4,137 fecal samples examined, 322 (7.8%) were positive for any kind of parasite (Table 1). Findings included helminth eggs (310 samples; 7.5%), larvae (1; 0.02%), protozoan cysts (10; 0.24%), and oocysts (1; 0.02%). Of the helminth eggs detected, the eggs of fish-borne trematodes including *C. sinensis* and heterophyids comprised the great majority of positive cases.

### 1. Egg positive rate of trematodes

The eggs of *C. sinensis* were detected in 259 (6.3%) of 4,137 samples, and composed 80.4% of all parasite positive cases (Table 1, Fig. 1). The eggs of hetero-

**Table 1. Results of Fecal Examination\* of 4,137 Korean Residents Who Visited the Korea Association of Health Promotion for a Health Check-up**

Species of parasite	No. positive cases (%)
Overall helminth egg, larva, protozoan cyst, or oocyst positive	322 (7.8)
<i>Clonorchis sinensis</i>	259 (6.3)
<i>Paragonimus westermani</i>	1 (0.02)
<i>Echinostoma</i> sp.	4 (0.10)
<i>Metagonimus</i> sp.	14 (0.34)
<i>Pygidioopsis summa</i>	5 (0.12)
Other heterophyid	24 (0.58)
<i>Gymnophalloides seoi</i>	4 (0.10)
<i>Ascaris lumbricoides</i>	1 (0.02)
Hookworms	1 (0.02)
<i>Trichuris trichiura</i>	10 (0.24)
<i>Strongyloides stercoralis</i>	1 (0.02)
<i>Giardia lamblia</i>	1 (0.02)
<i>Isospora</i> sp.	1 (0.02)
<i>Entamoeba coli</i>	9 (0.22)

\*Examined using the Kato-Katz thick smear and formalin-ether sedimentation techniques.

phyid flukes were detected in 42 cases (1.0%), and included *Metagonimus* sp. (14 cases; 0.34%), *P. summa* (5; 0.12%), and unidentified species (24; 0.58%). The eggs of other trematode species such as *Echinostoma* sp. (4; 0.1%), *G. seoi* (4; 0.1%), and *P. westermani* (1; 0.02%) were also found (Table 1).

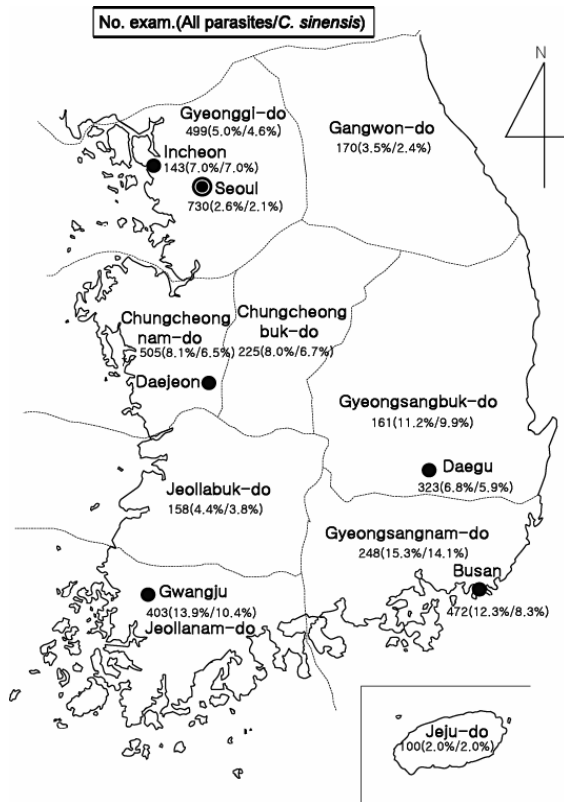


Figure 1. Map showing the geographical distribution of parasite infections. Numbers illustrated (see box) are the numbers of specimens examined and positive rates (%) for overall parasites and *Clonorchis sinensis*, respectively.

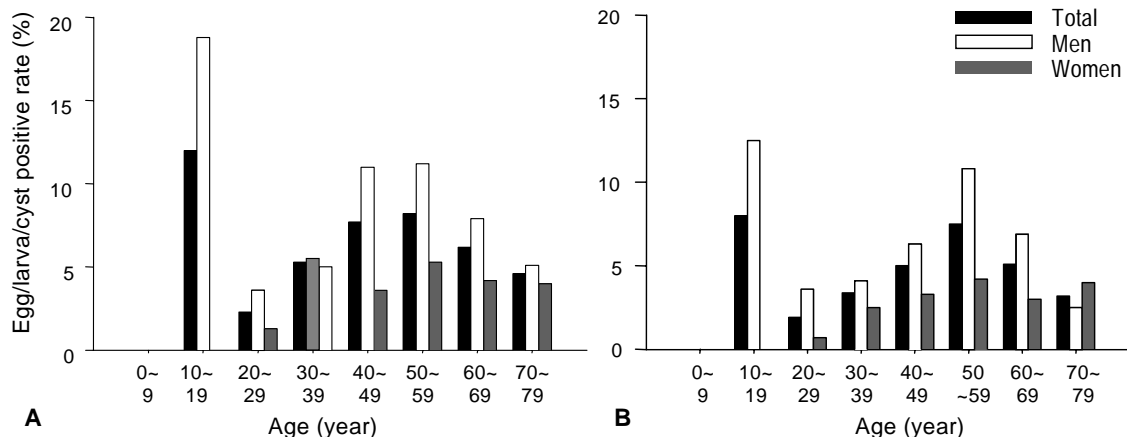


Figure 2. The age- and sex-prevalence of parasite infections among Koreans. A) overall parasites, B) *Clonorchis sinensis*. Men showed significantly higher ( $P<0.01$ ) egg positive rates (225/2,170=10.4%) than women (95/1,967=4.8%).

## 2. Egg positive rate of other parasites

The eggs of soil-transmitted nematodes, such as *T. trichiura* (10 cases; 0.24%), *A. lumbricoides* (1; 0.02%), hookworms (1; 0.02%), and *S. stercoralis* (larvae) (1; 0.02%) were detected (Table 1). But the eggs of cestodes, such as *Taenia* sp. and *Diphyllobothrium latum*, were not observed. The protozoan cysts detected were *E. coli* (9; 0.22%) and *G. lamblia* (1; 0.02%), and oocysts of *Isospora* sp. were found (1; 0.02%) (Table 1).

## 3. Variations in prevalence according to provinces and cities

Parasite positive rates varied significantly according to surveyed areas. The highest rate was observed in Gyeongsangnam-do (38 samples; 15.3%), followed in decreasing order by Gwangju/Jeollanam-do (56; 13.9%), Busan (58; 12.3%), and Gyeongsangbuk-do (18; 11.2%) (Figure 1). Lowest rates were found in Gangwon-do (6; 3.5%), Seoul (20; 2.6%), and Jeju-do (2; 2.0%). The egg positive rate of *C. sinensis* was highest in Gyeongsangnam-do (39; 14.1%), followed by Gwangju/Jeollanam-do (42; 10.4%), Gyeongsangbuk-do (16; 9.9%), and Busan city (39; 8.3%) (Figure 1). Lower rates were observed in Gangwon-do (4; 2.4%), Seoul (15; 2.1%), and Jeju-do (2; 2.0%).

## 4. Age- and sex-prevalence of parasites

The overall parasite positive rate varied according to age of subjects (Figure 2A). The rate was highest in men aged 10-19 years (3/16; 18.8%), followed in order by women of 10-19 (2/16; 12.5%), men of 50-59 (61/

544; 11.2%) and 40–49 (47/428; 11.0%), and women of 50–59 (59/544; 10.8%), and men of 60–69 years (32/403; 7.9%) (Figure 2A). Rates were lowest in women of 20–29 (2/153; 1.3%), 10–19 (0/9; 0%), and 0–9 years (0/4; 0%), and man of 0–9 years (0/4; 0%). This age-prevalence was very similar for *C. sinensis* infection (Figure 2B). The overall parasite positive rate was significantly ( $P<0.01$ ) higher in men (225/2,170; 10.4%) than in women (95/1,967; 4.8%). Positivity for *C. sinensis* eggs was also significantly ( $P<0.01$ ) higher in men (185/2,170; 8.5%) than in women (74/1,967; 3.8%).

## DISCUSSION

The present study shows that the overall prevalence of intestinal parasites in the Korean population is at around 7.8% (7.5% for helminths and 0.3% for protozoa). This figure of 7.5% for helminths is considerably higher than the national intestinal helminth prevalence of 2.4% reported in 1997 by the Ministry of Health and Welfare and Korea Association of Health Promotion (4). However, it should be taken into considerations that the determined prevalence in 1997 (4) was based on a national, statistically designed, random survey of Korean residents, whereas the present study was performed only on residents who voluntarily visited KAHF clinics for a health check-up. Therefore, our population may have included more subjects with gastrointestinal problems caused by parasitic infections than the 1997 survey.

It was interesting to find that the majority (84%) of the helminth-positive cases (7.5% of the study population) in the present study were those infected with *C. sinensis*. It was also interesting that the prevalence of heterophyids and a gymnophallid was 1.2%, and these were second only to the liver fluke in terms of prevalence. These results indicate that fish-borne trematodes are currently the most important human intestinal helminths in the Republic of Korea. A small number of subjects were found to be infected with *A. lumbricoides*, hookworms, *S. stercoralis*, and *T. trichiura*; however, these soil-transmitted helminths are nowadays regarded as parasites of negligible importance in Korea.

With regard to *C. sinensis* infection, the national egg positive rate among 40,581 randomly sampled individuals countrywide in 1969 was reported to be 4.6% (1), and

this decreased to 1.4% among 45,832 people in 1997 (4). Comparison of our results with these figures are subject to the reservation stated above; however, it is interesting to find that the prevalence of *C. sinensis* infection in the present study (6.3%) is remarkably higher than the 1969 and 1997 figures. These figures suggest that the long life span of *C. sinensis* in the human liver, i.e., longer than 10 years (14,15), and the continuous occurrence of new infections may be responsible for sustaining, or even increasing, of the prevalence among the Korean people.

Fish-borne trematode infections, particularly *C. sinensis*, have been well known to be endemic in riverside communities (8,16). According to a 2002 report (6), *C. sinensis* egg positive rates along the Geum-gang (River) in Okcheon-gun (County) were 9.3%. In the present study, *C. sinensis* infection was also found to be higher in Gyeongsangnam-do (14.1%), Gyeongsangbuk-do (9.9%), and Pusan (8.3%), through which the Nakdong-gang (River) runs, than in other provinces and cities. The prevalence of *C. sinensis* was also high in Chungcheongbuk-do (6.7%) and Chungcheongnam-do (6.5%), in which the Geum-gang (River) is contained, and in Jeollanam-do (3.8%) with the Youngsan-gang (River). The major mode of *C. sinensis* infection is the consumption of raw freshwater fish, including carps, pond smelts, and minnows (8,14,15,17).

Riverside areas have been known to be endemic foci of *Metagonimus* infection, i.e., *M. yokogawai*, *M. miyatai*, and *M. takahashii* (7,8,16), although the prevalence of these flukes was not so high in the present study. In 2000, a high level of *M. yokogawai* infection (a 29.7% egg positive rate) was found in a village nearby the Oship-cheon (stream) of Samchok-shi (City), Kangwon-do (Province) (18). In another 2002 report (6), the egg positive rate of *Metagonimus* spp. along the Geum-gang (River) in Okcheon-gun (County) was found to be 5.5%. This infection is known to be due to sweetfish (*M. yokogawai*), minnow (*M. miyatai*), and carp (*M. takahashii*) consumption (8).

Areas endemic for heterophyid flukes such as *H. nomenclis* and *P. summa* differ from those endemic for *C. sinensis* and *Metagonimus* spp. These heterophyid flukes are encountered predominantly among the population of the western and southern coastal areas and off-shore

islands (8,9). It is notable that the prevalences of *H. nicens* and *P. summa* infections among residents of the 45 western and southern coastal islands were 11.0% and 1.2%, respectively (9). Brackish water fish such as mullet, perch, and goby are important sources of infections with these intestinal flukes.

The prevalences of intestinal parasites have been studied among hospital patients in various localities. In the 1960s, the prevalences were exceptionally high, as compared with present figures: the helminth egg positive rate was 86.7% (29.8% for *C. sinensis*) among 5,288 patients at Kyungpook National University Hospital (1962-1968), and protozoan cysts were found in 35.7% of 2,414 samples examined (19). However, in June 1985 to July 1986, a total of 5,251 fecal samples were examined in Hanyang University Hospital in Seoul, and the helminth egg positive rate was found to be only 2.5% (1.4% for *C. sinensis*) (20). Meanwhile, the helminth egg positive rate among 52,552 patients at Seoul Paik Hospital (1984-1992) was 6.5% (3.2% for *C. sinensis*) and the protozoan cyst positive rate was 2.5% (21). A similar *C. sinensis* egg positive rate (3.0%) was reported among HIV patients admitted to the Seoul National University Hospital, during 1995 and 2003 (22). In contrast, in 2002, fecal examinations of residents who visited Public Health Centers in Hamyang-gun, Gyeongsangnam-do, where a branch (Nam-gang) of the Nakdong-gang (River) originates, showed a high *C. sinensis* egg positive rate of 16.0% (5).

We regret that the number of cases examined in younger age groups (0-9 and 10-19 years), both men and women, was smaller than that of the older age groups. This was because the examinees were those who voluntarily visited the KAHF clinics for their health check-up, and thus mostly adults. Therefore, high prevalences of overall parasites and of *C. sinensis* in the 10-19 age groups may be insignificant. In adult ages, the prevalence of overall parasites and of *C. sinensis* increased with age gradually up to 50 years, and then decreased. The increase in *C. sinensis* prevalence in the 50-59 age groups might be due to accumulation of infection during many years, whereas its decrease in those aged over 70 years might be due to infection-related mortality in endemic areas (15). The proportion of men affected was significantly higher ( $P<0.01$ ) than

that of women in terms of overall parasite and *C. sinensis* infection. We presume that men are more exposed to overall parasites, including *C. sinensis*, infection.

Our findings suggest that fish-borne trematode infections, particularly those caused by the liver and intestinal flukes, are currently the major parasitic infections in the Korean people.

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## SUMMARY

**배 경 :** 전국 규모의 장내 기생충 감염 현황에 관한 연구는 1997년 이후 시행된 바 없었다. 이번 연구는 국내 여러 지역 주민에서 장내 기생충 감염 상황을 파악하고자 수행하였다.

**재료 및 방법 :** 한국건강관리협회 전국 시도 지부별로 2004년 7월부터 9월까지 건강검진을 위해 방문한 지역 주민 4,137명(남자:2,170명, 여자:1,967명)으로부터 대변을 수집하였다. 검체는 Kato-Katz 후충도말법과 formalin-ether 침전법을 이용하여 연충류 충란(helminth eggs), 유충 및 원충 포낭(protozoan cysts) 등을 검사하였다.

**결 과 :** 연충류 충란 및 유충, 그리고 원충 포낭이 335 (8.1%)명에서 확인되었다. 연충류로는 간흡충(*Clonorchis sinensis*) (양성자 수 및 양성률:259명, 6.3%), *Metagonimus* sp. (14명, 0.34%), 표주박이형흡충(*Pygidioopsis summa*) (5명, 0.12%), 기타 이형흡충류(24명; 0.58%), 극구흡충류(*Echinostoma* sp.) (4명, 0.1%), 폐흡충(*Paragonimus westermani*) (1명, 0.02%), 편충(*Trichuris trichiura*) (10명, 0.24%), 회충(*Ascaris lumbricoides*) (1명, 0.02%), 구충(hookworm) (1명, 0.02%)의 충란과 분선충(*Strongyloides stercoralis*)의 유충(1명, 0.02%)을 확인하였다. 대장아메바(*Entamoeba coli*) (9명, 0.22%) 및 람블편모충(*Giardia lamblia*) (1명, 0.02%)의 포낭과 *Isospora* sp.의 난포낭(1명, 0.02%)을 검출하였다. 지역별로는 경상남도(15.3%)가 감염률이 가장 높았고, 광주·전라남도(13.9%), 부산(12.3%), 경상북도(11.2%), 대전·충청남도(8.1%), 충청북도(8.0%), 인천(7.0%), 대구(6.8%), 경기도(5.0%), 전라북도(4.4%), 강원도(3.5%), 서울(2.6%), 제주도(2.0%)의 순이었다. 성별 감염률에 있어서는 남자(10.4%)가 여자

(4.8%) 보다 유의하게 높았다( $P<0.01$ ).

**결론:** 간흡충, 이형흡충류 등 어류-매개성 흡충류가 한국 국민의 주요 장내 기생충임이 확인되었다. 이들 어류-매개성 인수공통 기생충 관리대책이 요망된다.

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