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A survey of *Enterobius vermicularis* infection among children on western and southern coastal islands of the Republic of Korea

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Abstract: To determine the status of *Enterobius vermicularis* infection among children living on western and southern coastal islands of the Republic of Korea, children (3-10 years) in 39 kindergartens and primary schools were examined using the cello-tape anal swab method, during July and August 2000. Of 1,661 children examined, 307 (18.5%) were found to be positive for *E. vermicularis* eggs. The highest infection rate (59.3%) was found in a kindergarten and a branch school of Shinyang primary school on Chujado, Jeju-do (Province). Remarkable differences in egg positive rates were observed in different localities. The egg positive rate for boys (21.3%) was significantly higher than that of girls (15.4%) ($P = 0.02$). However, positive rates were not significantly dependent on age. The results of the present study show that *E. vermicularis* infection is highly prevalent among pre-school and primary school children living on the western and southern coastal islands of the Republic of Korea, and indicate the need for efforts to control this infection.

Key words: *Enterobius vermicularis*, enterobiasis, prevalence, cello-tape anal swab, children, islands, Korea

INTRODUCTION

Enterobiasis is a nematode infection caused by the pinworm, *Enterobius vermicularis*. Its principal mode of transmission is direct contact between infected and uninfected persons. For this reason, this infection is prevalent among primary school children who are easily exposed to overcrowded conditions and inadequate sanitation, and who actively contact each other (Beaver et al. 1984; Cook, 1994).

In the Republic of Korea, *E. vermicularis* is a common human intestinal parasite among pre-school and primary school children (Chai et al., 1976; Lee et al., 2000; Kim et al., 2003). Even though the national prevalence of soil-transmitted helminth infections has decreased remarkably, for example, only 0.05% of the general population were positive for *Ascaris lubmricoides* in 2004 (Ministry of Health and Welfare and Korea Association of Health Promotion, 2004). However, the same cannot be said for *E. vermicularis*, for example, in two nation-wide surveys on the general population in 1997 and 2004, the egg positive rates

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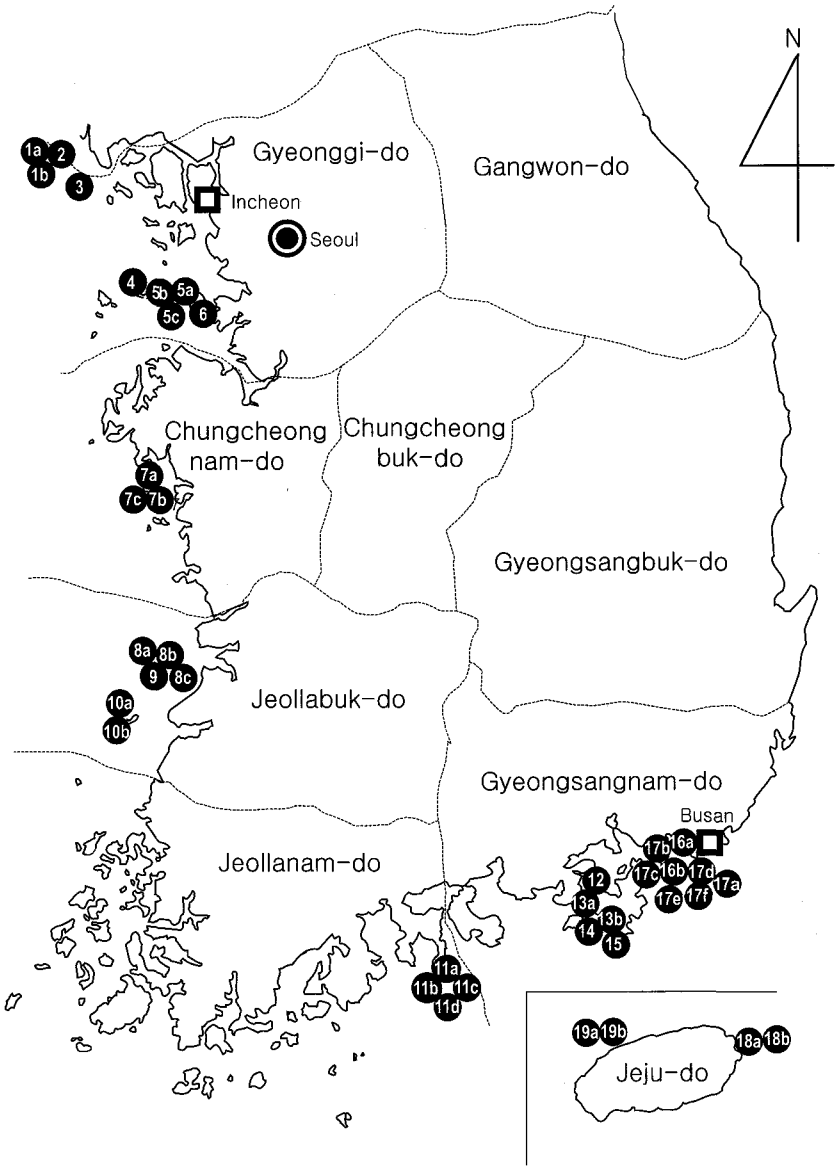

Fig. 1. Areas surveyed (●) for *Enterobius vermicularis* infection using the cello-tape anal swab technique on western and southern islands of the Republic of Korea.

of *E. vermicularis* were unchanged at 0.6% (Ministry of Health and Welfare and Korea Association of Health Promotion, 1997, 2004). Moreover, its prevalence among children is much higher than in the general population.

The patterns and prevalence of human helminth infections on coastal islands seem to be quite different from those of the inland (Chai et al., 2001, 2004). For instance, intestinal trematodes including heterophyids and a gymnophallid are prevalent among residents of western and southern coastal islands, i.e., *Heterophyes nocens* (11.0%), *Gymnophalloides seoi* (3.8%), and *Pygidiopsis summa* (1.2%) (Chai et al., 2004). Moreover, because of their geographical isolation, less medical attention has been paid to these areas, and with regard to *E. vermicularis* infection, no surveys have been conducted. Therefore, the present survey was performed to determine the status of *E. vermicularis* infection among children living on these off-shore islands of the Republic of Korea.

Table 1. Egg positive rates of *Enterobius vermicularis* among children living on different islands

Island code[a)]	Name of Island	Name of kindergarten (K) or primary school (PS)	No. children positive/ No. examined (%)		
			Boys	Girls	Total
Incheon city					
1a	Baenyeongdo	Bukpo (PS)	11/51 (21.6)	6/52 (11.5)	17/103 (16.5)
1b	Baenyeongdo	Baengnyeong (PS)	9/41 (22.0)	1/40 (2.5)	10/81 (12.3)
2	Daechungdo	Daecheong (PS)	1/17 (5.9)	3/21 (14.3)	4/38 (10.5)
3	Yeonpyeongdo	Yeonpyeong (PS)	4/34 (11.8)	1/25 (4.0)	5/59 (8.5)
4	Youngheungdo	Yeongheung (PS)	2/23 (8.7)	4/21 (19.0)	6/44 (13.6)
	Subtotal		27/166 (16.2)	15/159 (9.4)	42/325 (12.9)
Gyeonggi-do					
5a	Daebudo	Daenam (K & PS)	2/42 (4.8)	1/16 (6.3)	3/58 (5.2)
5b	Daebudo	Daebu (K & PS)	8/55 (14.5)	2/52 (3.8)	10/107 (9.3)
5c	Daebudo	Daedong (PS)	1/14 (7.1)	0/13 (0)	1/27 (3.7)
6	Jebudo	Jebu Br[b)] (K & PS)	1/25 (4.0)	1/20 (5.0)	2/45 (4.4)
	Subtotal		12/136 (8.8)	4/101 (4.0)	16/237 (6.8)
Chungcheongnam-do					
7a	Anmyeondo	Anmyeon (PS)	18/63 (28.6)	8/61 (13.1)	26/124 (21.0)
7b	Anmyeondo	Gonam (PS)	11/33 (33.3)	11/38 (28.9)	22/71 (31.0)
7c	Anmyeondo	Bangpo (PS)	5/25 (20.0)	4/24 (16.7)	9/49 (18.4)
	Subtotal		34/121 (28.0)	23/123 (18.7)	57/244 (23.3)
Jeollabuk-do					
8a	Shinsido	Saesoonseon (PS)	3/4 (75.0)	0/6 (0)	3/10 (30.0)
8b	Shinsido	Seonyudo (PS)	0/4 (0)	0/4 (0)	0/8 (0)
8c	Shinsido	Shinsido (PS)	0/4 (0)	0/6 (0)	0/10 (0)
9	Munyeo	Munyeo (PS)	0/6 (0)	0/3 (0)	0/9 (0)
10a	Wido	Wido (PS)	3/18 (16.7)	4/14 (28.6)	7/32 (21.9)
10b	Wido	Sikdo Br (PS)	0/1 (0)	0/5 (0)	0/6 (0)
	Subtotal		4/37 (10.8)	7/38 (18.4)	11/75 (14.6)
Jeollanam-do					
11a	Dulsando	Dulsanchungang (K & PS)	5/17 (29.4)	6/23 (26.1)	11/40 (27.5)
11b	Dulsando	Daesin Br (PS)	3/9 (33.3)	4/14 (28.6)	7/23 (30.4)
11c	Dulsando	Dulsan (PS)	9/31 (29.0)	8/38 (21.1)	17/69 (24.6)
11d	Dulsando	Baekcho (PS)	11/49 (22.4)	8/31 (25.8)	19/80 (23.8)
	Subtotal		28/106 (26.4)	26/106 (24.5)	54/212 (25.4)
Gyeongsangnam-do					
12	Kajodo	Changho (PS)	3/8 (37.5)	1/10 (10.0)	4/18 (22.2)
13a	Tongyeong	Weonryang (PS)	4/23 (17.4)	6/25 (24.0)	10/48 (20.8)
13b	Tongyeong	Weonkwang (K)	15/42 (35.7)	6/40 (15.0)	21/82 (25.6)
14	Yeonhwado	Yeonhwa (PS)	2/11 (18.2)	2/7 (28.6)	4/18 (22.2)
15	Bijindo	Bijin (PS)	2/7 (28.6)	0/3 (0)	2/10 (20.0)
	Subtotal		26/91 (28.6)	15/85 (17.6)	41/176 (23.3)
Busan city					
16a	Nulchado	Nulcha (PS)	1/16 (6.3)	0/10 (0)	1/26 (3.9)
16b	Nulchado	Nulcha (K)	1/5 (20.0)	0/9 (0)	1/14 (7.1)
17a	Gadukdo	Cheonga (K)	2/15 (13.3)	2/12 (16.7)	4/27 (14.8)
17b	Gadukdo	Daehang Br (PS)	0/6 (0)	0/4 (0)	0/10 (0)
17c	Gadukdo	Cheonsung Br (PS)	0/6 (0)	0/5 (0)	0/11 (0)
17d	Gadukdo	Cheinsung Br (K)	1/6 (16.6)	1/3 (33.3)	2/9 (22.2)
17e	Gadukdo	Soyang (K)	0/4 (0)	0/3 (0)	0/7 (0)
17f	Gadukdo	Cheonga (PS)	4/20 (20.0)	1/22 (4.5)	5/42 (11.9)
	Subtotal		9/78 (11.5)	4/68 (5.9)	13/146 (8.9)
Jeju-do					
18a	Udo	Udo (PS)	6/28 (21.4)	3/14 (21.4)	9/42 (21.4)
18b	Udo	Yonpyung (K & PS)	17/37 (45.9)	9/33 (27.3)	26/70 (37.1)
19a	Chujado	Chuja (K & PS)	8/50 (16.0)	14/57 (24.6)	22/107 (20.6)
19b	Chujado	Shinyang Br (K & PS)	14/17 (82.4)	2/10 (20.0)	16/27 (59.3)
	Subtotal		45/132 (34.0)	28/114 (24.5)	73/246 (29.6)
Total			185/867 (21.3)	122/794 (15.4)	307/1,661 (18.5)

[a)]Area code in Fig. 1.
[b)]A branch school of the primary school.

MATERIALS AND METHODS

A total of 19 western and southern coastal islands in Gyeonggi-do, Incheon city, Chungcheongnam-do, Jeollabuk-do, Jeollanam-do, Gyeongsangnam-do, Busan city, and Jeju-do were involved in this study during July and August 2000, and a total of 39 kindergartens and primary schools were selected (Table 1; Fig. 1). After obtaining informed consent, 1,661 children (3-10 years old) in these schools were examined using the cello-tape anal swab technique (one smear per child), for the presence of *E. vermicularis* eggs. Skilled laboratory technicians of the branch offices of the Korea Association of Health Promotion (KAHP) collected samples. Anal swabs were transported to the Department of Parasitology and Tropical Medicine, Seoul National University College of Medicine, and examined using a light microscope. Results were analyzed with respect to locality, age, and sex using Fisher's exact test and the chi-square test.

RESULTS

A total of 307 (18.5%) of the 1,661 samples were positive for *E. vermicularis* eggs. The egg positive rate ranged from 0% to 59.3% by location (Table 1; Fig. 1). The egg positive rate among boys (21.3%) was significantly higher than that among girls (15.4%) (P = 0.02) (Tables 1, 2). No significant differences in egg positive rates according to age were observed in boys and girls (Table 2).

Table 2. Age- and sex-prevalence of *Enterobius vermicularis* infection among kindergarten and primary school children on 19 coastal islands[a)]

Age	No. children showing *E. vermicularis* eggs/No. examined (%)		
	Boys	Girls	Total
3	3/12 (25.0)	2/10 (20.0)	5/22 (22.7)
4	2/36 (5.6)	4/27 (14.8)	6/63 (9.5)
5	12/43 (29.5)	10/44 (22.7)	22/87 (26.1)
6	28/110 (27.9)	9/83 (10.8)	37/193 (19.2)
7	26/131 (19.9)	18/132 (13.6)	44/263 (16.7)
8	44/214 (20.6)	34/208 (16.3)	78/422 (18.5)
9	39/171 (21.0)	23/162 (14.2)	62/333 (18.6)
10	30/143 (21.0)	20/119 (16.8)	50/262 (19.1)
Unknown	1/7 (14.3)	2/9 (22.2)	3/16 (18.8)
Total	185/867 (21.3)	122/794 (15.4)	307/1,661 (18.5)

[a)]Examined by cello-tape anal swab during July and August 2000.

DISCUSSION

The results of the present study demonstrate a high prevalence (av. 18.5%) of *E. vermicularis* infection among children attending kindergartens and primary schools on the western and southern islands of the Republic of Korea. This prevalence is higher than those reported by other workers (7.8-17.5%) since 1991 in the Republic of Korea (Kim et al., 1991; Yang et al., 1997; Lee et al., 2000; Yoon et al., 2000, Kim et al., 2003), and is remarkably higher than the national figures of 4.2% for children aged 1-4 years and 3.5% for those aged 5-9 years in 2004 (Ministry of Health and Welfare and Korea Association of Health promotion, 2004).

It is of note that the detection of *E. vermicularis* eggs from the peri-anal region means the termination of parasitism by the adult worms that produced these eggs (Akagi, 1973; Cho and Kang, 1975), and that such a finding does not necessarily mean that further worms are present in the intestine. Nevertheless, egg detection from the perianal region is significant, because egg positivity indicates a high probability of infection in the intestine (Cho and Kang, 1975).

In the present study, *E. vermicularis* infection was found to be prevalent in all ages from 3 to 10 years, and boys were more highly infected than girls. Children in this age group contact each other more frequently in kindergartens and primary schools than children of other ages, and are also exposed to unsatisfactory sanitary environments (Chai et al., 1976; Kim et al., 2003). Inadequate personal hygiene could also increase the risk of *E. vermicularis* infection among children, particularly among boys. Other factors including playing on the floor, nail biting, a failure to wash hands before meals, and living in non-apart-

ment dwellings have also been reported to be associated with the prevalence of enterobiasis (Sung et al. 2001). In this respect, kindergarten- and school-based mass control activities are likely to be more effective than individual treatment.

Enterobiasis is a disease with usually mild symptoms such as, perianal itching and dermatitis; it is asymptomatic in most adults who have low worm burdens. However, in children, particularly who have heavy worm burdens, neurological symptoms including nervousness, restlessness, irritability, and distraction may occur, and these may influence child growth (Beaver et al. 1984; Cook, 1994; Song et al. 2003). Rarely, ectopic infections in the pelvic area or urinary tract of women can occur (Ok et al. 1999; Tandan et al. 2002).

Effective chemotherapeutic regimens have been developed and used for decades; however, the control of enterobiasis is difficult because of frequent reinfection and a short life cycle (Lohiya et al. 2000; Lee et al., 2001). Repeated health education concerning improved personal hygiene and regular inspections and mass chemotherapy with appropriate anthelmintics are essentially required to control enterobiasis among children living on off-shore islands in the Republic of Korea.

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