

Parents' Knowledge about Enterobiasis Might Be One of the Most Important Risk Factors for Enterobiasis in Children

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Abstract: To know the prevalence of *Enterobius vermicularis* infection and what are the most important risk factors, we evaluated the incidence and risk factors of enterobiasis among children attended in kindergartens in Busan metropolitan city, Republic of Korea. A total of 1,674 children from 21 kindergartens in 11 of 16 autonomous districts of Busan were evaluated for *E. vermicularis* infection by the cellotape anal swab technique. The overall egg-positive rate for *E. vermicularis* was 10.7% (179/1,674), and the prevalence of enterobiasis in each kindergarten ranged between 0% and 32.4%. There was an increasing tendency of the egg positive rate according to the population density; the higher the population density communities had, the higher egg-positive rate for *E. vermicularis* was detected ($P = 0.001$). Among personal hygiene factors involving children, thumb-sucking ($P = 0.036$) and fingernail-trimming ($P = 0.024$) were highly associated with enterobiasis. In addition, taking anthelmintic medications against *E. vermicularis* infection was strongly associated with enterobiasis ($P = 0.014$). Moreover, parents' knowledge of enterobiasis was correlated significantly with the incidence of enterobiasis of their children ($P = 0.006$). In conclusion, we need to consider not only personal hygiene but also parents' knowledge about enterobiasis as a factor in order to develop new strategies for elimination or to complete reduction of enterobiasis in Korea.

Key words: *Enterobius vermicularis*, risk factor, cellotape anal swab, health education

INTRODUCTION

Enterobius vermicularis (the pinworm) inhabits at least 400 million people; this fact is, perhaps, less surprising than the fact that practically nothing is currently being done to eliminate infections [1]. Part of the reason for this was that the symptoms of enterobiasis are not fatal, and it can be readily transmitted via direct contact between infected and uninfected persons. Although the majority of infections are asymptomatic, they can induce bothersome symptoms in some cases, including an itching sensation and irritation in the perianal area, along with mental distraction. Very rarely, pinworms will penetrate into the wall of the colon, in the retrocaecal tissues, and on the peritoneum [2]. Commonly, live worms wander into the vulva, where they remain for several days, and cause vulval itching associated with

scanty vaginal discharge and mild irritation [3,4].

The prevalence of enterobiasis has been decreased every year in Korea. The egg positive rate of *E. vermicularis* was 0.6% in the general population, according to a nationwide survey of intestinal parasites conducted in 2004 by The Ministry of Health and Welfare, Korea, and Korea Association of Health Promotion. Nevertheless, in primary school children, a relatively high egg-positive rate (from 7.8% to 18.5%) has been reported in both urban and rural areas of Korea [5-7]. Since 2004, however, we have not found any literature about the prevalence of enterobiasis in Korea, especially there have been no reports on the infection rates of *E. vermicularis* in Busan metropolitan city up to now. Recently, the number of young children being cared for at a kindergarten is increasing because their mothers may be employed, or parents want their children to play and be educated in a well-organized educational system. Therefore, the majority of *E. vermicularis* infections in children probably occurs in daycare centers [7].

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Many studies have been conducted to explore the risk factors for enterobiasis. The main risk factors are associated with indoor living conditions, including personal sanitary and close contact with other people, as pinworms spread mainly indoors directly from one human to another. Although infected children are given anthelmintics after a survey, reinfection is strong and very rapid. For this reason, the prevalence of enterobiasis has not shown a decrease in recent years. It is needed to consider health educational aspects, in particular, parent's correct knowledge about enterobiasis.

Currently, little information is available regarding the prevalence and possible risk factors of enterobiasis among kindergarten children in metropolitan cities in Korea. In this study, we evaluated the incidence and risk factors of enterobiasis in 11 of 16 autonomous districts of the metropolitan city of Busan. Suggestions were made to reduce the prevalence of enterobiasis in this study.

MATERIALS AND METHODS

Survey

For recruitment, the letter that contained information about the nature, significance, and objectives of the study, copies of a questionnaire, a guide for swab examination, and a consent form were sent to 302 directors of kindergartens registered in the Busan Association of Kindergartens. Among them, 21 kindergartens from 11 of the 16 communities in Busan agreed to participate in this study (Fig. 1). This study was presented by the researcher to the directors of each kindergarten, and then the directors sent the parent's consent form, letter of information, and a questionnaire. Of 3,194 parents, 1,695 (53.1%) agreed to participate in this study. Among the 1,695 children aged 1-7 years, 21 children for whom more than 10% of the relevant survey data were missing were excluded. Ultimately, the data from 1,674 (98.8%) children examined for *E. vermicularis* infection using the cellotape anal swab technique were collected and analyzed in this study.

Questionnaire survey to determine the risk factors of enterobiasis

A questionnaire was provided to the parents of each child asking them about their child's personal hygiene, sanitary environment, and the family's socioeconomic status and general knowledge of enterobiasis.

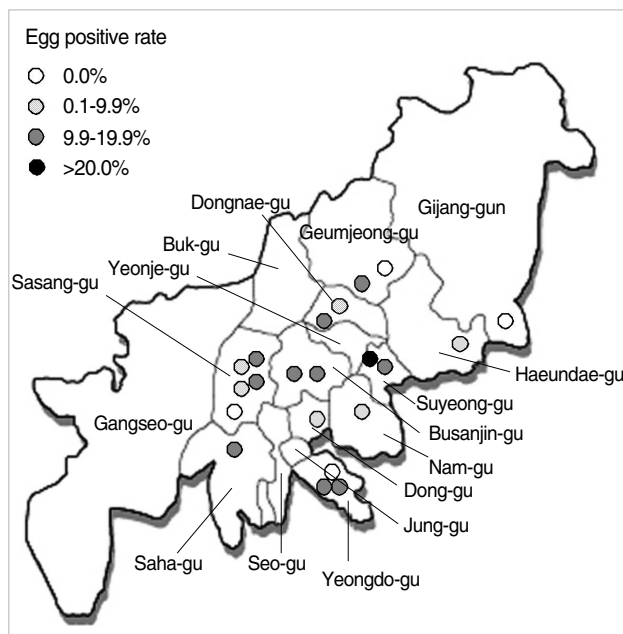


Fig. 1. Distribution of surveyed areas and egg positive rates for *Enterobius vermicularis* infections in Busan Metropolitan City.

Statistical analysis

Data were analyzed using SPSS for Windows, version 14 (SPSS, Chicago, Illinois, USA). The association of the egg-positive rate of *E. vermicularis* and factors involving children and their family were analyzed using χ^2 test and Fisher's exact test. The correlation between the rate of *E. vermicularis* infection and population density was analyzed using Pearson's correlations. Also, the correlation between *E. vermicularis* infection rates and knowledge of *E. vermicularis* infection was analyzed using Pearson's correlations.

RESULTS

The overall egg-positive rate for *E. vermicularis* was 10.7% (179/1,674), and the prevalence of enterobiasis in each kindergarten ranged between 0% and 32.4%. There was significant difference of the egg-positive rate for *E. vermicularis* according to the population densities of the community ($P = 0.001$), with egg-positive rate of 4.7% for communities of not more than 5,000 people per km², 9.1% for 5,001-10,000, 10.8% for 10,001-15,000, and 16.5% for not less than 15,001 people per km². A significantly close correlation was detected between the *E. vermicularis* infection rate and population density ($P = 0.020$) (Table 1).

Table 2 shows the personal hygiene and other factors that

Table 1. *Enterobius vermicularis* egg positive rates in surveyed areas

Surveyed area	Population density (no. people/km ²)	No. of surveyed kindergarten (No. of samples)	Egg positive rate (%)
Dong-gu	11,246	1 (185)	8.6
Yeongdo-gu	7,651	3 (95)	13.7
Busanjin-gu	13,830	2 (222)	13.1
Dongnae-gu	16,773	2 (179)	9.5
Nam-gu	11,657	1 (18)	5.5
Haeundae-gu	7,865	1 (42)	9.5
Saha-gu	9,093	1 (147)	13.6
Geumjeong-gu	4,063	2 (59)	6.8
Suyeong-gu	17,501	2 (137)	25.5
Sasang-gu	7,742	5 (564)	7.1
Gijang-gun	368	1 (26)	0.0
Total	4,766	21 (1,674)	10.7

may potentially be associated with the egg-positive rates of *E. vermicularis*. In general, the prevalence of enterobiasis increased with advancing age; however, this was not significant. The infection rate was significantly higher in boys than in girls. The educational level of the parents was not found to be associated with enterobiasis (data not shown). Among several personal hygiene factors, thumb-sucking and fingernail-trimming were associated with enterobiasis. The children with the habit of scratching around the anus were more infected by *E. vermicularis* than those who did not have this habit; however, this was not significant. The cleanliness of the home environment was not found to be a significant risk factor. On the screening day, children who had received anthelmintic medication within 1 month were not infected by *E. vermicularis*, but after 1 month,

Table 2. Egg positive rate of *Enterobius vermicularis* among children according to their family factors

Variables	Number of positive	Number of examined	Egg positive rate (%)	P value	Variables	Number of positive	Number of examined	Egg positive rate (%)	P value
Age (years)				0.274	Scratching around the anus				0.108
≤3	6	106	5.7		Yes	84	682	12.3	
4	31	303	10.2		No	95	977	9.7	
5	59	556	10.6		Subtotal	179	1,659	10.8	
≥6	81	681	11.9		Cleaning of home				0.120
Subtotal	177	1,646	10.8		1/day	116	1,151	10.1	
Gender				0.001	2-3/week	63	494	12.8	
Boys	116	887	13.1		Subtotal	179	1,645	10.9	
Girls	63	786	8.0		Cleaning of bedding				0.548
Subtotal	179	1,673	10.7		≤7	55	564	9.8	
Housing				0.571	≥8	110	1,020	10.8	
Apartment	135	1,216	11.1		Subtotal	165	1,584	10.4	
Private residence	28	251	11.2		Family size				0.624
Row house	11	133	8.3		2	2	27	7.4	
Others	5	70	7.1		3	25	263	9.5	
Subtotal	179	1,670	10.7		4	116	1,045	11.1	
Thumb sucking				0.024	5	24	250	9.6	
Yes	49	347	14.1		≥6	12	81	14.8	
No	129	1,320	9.8		Subtotal	179	1,666	10.7	
Subtotal	178	1,667	10.7		Number of siblings				0.346
Fingernail trimming				0.036	1	30	315	9.5	
1/week	117	1,193	9.8		2	132	1,154	11.4	
1/2weeks	60	460	13.0		≥3	17	200	8.5	
Subtotal	177	1,653	10.7		Subtotal	179	1,669	10.7	
Frequency of bathing				0.330	Recent premedication of anthelmintics				0.014
1/day	32	346	9.2		≤ 1 month	0	66	0	
2-3/week	146	1,303	11.2		>1 months	89	769	11.6	
Subtotal	178	1,649	10.8		Never	90	839	10.7	
Hand washing				0.618	Subtotal	179	1,674	10.7	
Yes	146	1,333	11.0						
No	32	327	9.8						
Subtotal	178	1,660	10.7						

Table 3. Correlation of *Enterobius vermicularis* infection and knowledge of *E. vermicularis* infection

No.	Questions	Correct answer rate (%)		
		Egg positive group	Egg negative group	Total
1	Stool examination is the best way to exam for <i>Enterobius vermicularis</i> infection.	32.2	31.7	31.8
2	The adult worm of <i>E. vermicularis</i> migrates around the anus to mate.	30.5	27.1	27.5
3	<i>E. vermicularis</i> enters back to the anus. Some worms can migrate to the female genital tract so that they cause aberrant infection.	78.0	80.4	80.1
4	Anal itching (pruritus ani) is one of the most common symptom of enterobiasis.	92.1	93.8	93.6
5	Enterobiasis usually occurs by ingestion of eggs of contaminated hands.	68.9	71.2	71.0
6	<i>E. vermicularis</i> infection also occurs by contact with contaminated water.	53.7	51.9	52.1
7	Group therapy is the most effective for curing the <i>E. vermicularis</i> infection.	67.6	68.1	68.6
8	<i>E. vermicularis</i> infection needs to repeat treatment with anthelmintic medication after 2 weeks.	58.8	61.0	60.8
9	<i>E. vermicularis</i> infection is prevented through keeping clean and dry bedding with sunlight.	96.0	93.5	93.7
10	It is crucial to practice careful hand washing and keep the nails short in preventing <i>E. vermicularis</i> infection.	96.0	97.1	96.9
Average		67.4	67.6	67.6

Correlation between *Enterobius vermicularis* infection rates and knowledge of *E. vermicularis* infection.

Enterobius vermicularis infection* vs Knowledge of *Enterobius vermicularis* infection
0.799 ($P = 0.006$)

*Dummy coded: 1= positive.

the children might be readily reinfected by the worms. Also, about a half of children has not taken anthelmintic medications.

We evaluated the correlation between the parents' knowledge regarding enterobiasis and the incidence of enterobiasis in their children using a questionnaire (Table 3). The children of the parents with the higher of correct answers on the survey evidenced lower rates of *E. vermicularis* infection ($P = 0.006$). Scores of items (No. 1, 2) about *E. vermicularis* life cycle were very low (27.5-31.8), also scores of items (No. 7, 8) about treatment methods (60.8-68.6) were comparatively lower than those of personal hygiene (52.1-96.9). These results show although most of parents knew that good personal hygiene can help to reduce the chances of becoming infected by *E. vermicularis*, they did not know well about the correct methods for treatment of *E. vermicularis* infection.

DISCUSSION

Although enterobiasis is generally considered to be a nuisance rather than a fatal disease, the level of morbidity is significant, particularly in children. Therefore, this worm is one of the most frequently encountered and ubiquitous nematodes. Although enterobiasis can be readily cured by anthelmintic medications, the prevalence of this infection has not diminished over the past decade [5,7-9].

Why has the infection rate of *E. vermicularis* not been reduced? In this study, we identified some important factors in enterobi-

asis; personal hygiene involving children, population density, repeated medications, and accurate knowledge of the infection. Firstly, personal hygiene factors are closely associated with *E. vermicularis* infection. Previous reports suggested that inadequate personal hygiene can increase the risk of enterobiasis among primary school children. In addition, factors significantly associated with enterobiasis include playing on the floor, nail biting, failure to wash hands before meals, and living in non-apartment dwellings [10]. In our study, children with the habits of thumb-sucking or fingernail trimming evidenced significantly higher rates of *E. vermicularis* infection than those who did not have these habits.

Secondly, anthelmintic therapy is one of the most effective tools for eradication of enterobiasis; whether it is correctly treated or not (group therapy and repeated treatment with anthelmintic medications). In this study, just 1 among 21 kindergartens scheduled anthelmintic medication programs in which all children and teachers in a kindergarten take the medication at the same time every 6 months, keeping repeated treatment with the medicines after 2 weeks (personal communication). Therefore, the children in the kindergarten have no enterobiasis; although other kindergartens, where located same an administrative district with similar environments with the infection free kindergarten, have higher-than-average rates of *E. vermicularis* infection (Fig. 1). In addition, approximately a half of children have never taken anthelmintic medicine against parasites, including the pinworm. Although the other half of the children

have an experience to take an anthelmintic medicine at least once a year, the medication methods was not likely to be correct (discussed in below). These results provide a clue for why the incidence of enterobiasis has not decreased further. Each child takes an anthelmintic medicine on different days of the year the children can readily become reinfected with *E. vermicularis* within 1 month after beginning of the medication. Because the medicine for enterobiasis is not effective to eggs and larval stages of *E. vermicularis*, recent infection before treatment could not be cured by 1 time medication. Therefore, the infected children should take the medicine 1 more time after the first treatment [11,12]. Interestingly, in 1 family, 1 brother had enterobiasis but the other brother did not have enterobiasis, although both regularly took anthelmintics every 6 months. This result shows that reinfection of *E. vermicularis* occurs very commonly in a contaminated kindergarten class, rather than at home. Additionally, some previous reports have suggested that the environments of daycare centers constitute a crucial factor in enterobiasis, especially as compared to personal hygiene factors [7, 13,14].

Finally, parents were asked questions regarding their knowledge of enterobiasis, using a structured questionnaire. The accurate response rate for *E. vermicularis* infection characteristics was 67.6%. The overall egg-negative group was more knowledgeable than the egg-positive group, especially on items related to treatment of helminthic infections (Table 3). As most parents know like that anthelmintic medication could easily cure every intestinal helminthic infection, including *E. vermicularis*, by just 1 time treatment. Therefore, they think that their children may take just 1 time medication. They have no idea for the necessity of re-treatment against pinworm infections, because they have known that most pinworm infections are not fatal and that they can eliminate the worms whenever they want. Our results suggested that parents' correct knowledge about enterobiasis is one of the most important factors for eradication of *E. vermicularis*. Because parents have the greatest influence on their child's habits, we need to assess whether parents have correct knowledge about enterobiasis, for instance, how often they have to take the medicine.

Directors and teachers of the kindergartens included in this study hesitated to provide information regarding the characteristics of a kindergarten, such as the numbers and times that the classroom was cleaned, the times the toys were washed, the numbers of children in a class, and so on. Therefore, we were unable to evaluate the potential risk factors associated with the

kindergartens assessed in this study. However, it is necessary to identify environmental risk factors for enterobiasis, as the majority of *E. vermicularis* infections might be transmitted in those places.

In conclusion, enterobiasis is commonly detected in kindergartners in Busan. In addition, a half of the children have never taken any medicine for treatment of enterobiasis, and most of the other half has been treated but without correct medication guidelines. Therefore, it is necessary not only to do mass screening and regular group therapy for children with correct medication methods, but also to develop pinworm eradication programs, such as health education programs (about enterobiasis) for the parents, in order to control *E. vermicularis* infection in Korea.

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