

Prevalence of *Enterobius vermicularis* among Preschool Children in Gimhae-si, Gyeongsangnam-do, Korea

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Abstract: The present study was performed to determine the prevalence of *Enterobius vermicularis* among preschool children in Gimhae-si, Korea. A total of 6,921 preschool children in 76 kindergartens were examined using the cellotape perianal swab method. The overall egg positive rate (EPR) was 10.5%. The EPR in boys was higher than that in girls (adjusted odds ratio [AOR]: 1.5, $P < 0.001$), and it was higher in rural than in urban children (AOR: 1.2, $P = 0.022$). The present study confirmed that the prevalence of *E. vermicularis* infection is fairly high among preschool children in Gimhae-si. Therefore, systematic control and preventive measures should be adopted to reduce morbidity associated with this nematode infection.

Key words: *Enterobius vermicularis*, prevalence, preschool children

Enterobius vermicularis is the representative contact-borne contagious helminth in the Republic of Korea. It is especially prevalent among children in crowded and unsanitary conditions [1]. Recently, the egg positive rate (EPR) of *E. vermicularis* in preschool children was reported to be 18.1% in western and southern coastal islands [2] and 7.9% in Cheongju-si [3]. More recently, the prevalence of enterobiasis in Busan metropolitan city was shown to be 10.7% [4]. Some reports have described enterobiasis among preschool children, but the EPR varied by cities and areas in Korea. According to recent data reported by the Korea Association of Health Promotion in 2006, the EPR of *E. vermicularis* in Gyeongsangnam-do (Province) was 15.6% (358/2,290), which was the highest among all tested provinces. For this reason, the authors selected Gimhae-si in Gyeongsangnam-do for this study and did not undertake an extensive epidemiological survey regarding the prevalence of *E. vermicularis* infection in the city. This study was conducted to survey on the prevalence of *E. vermicularis* among preschool children in kindergartens in Gimhae-si.

A total of 6,921 children in 76 kindergartens belonging to

14 districts (dong) in urban and 8 districts (1 eup and 7 myon) in rural areas were examined using the cellotape perianal swab method. Pressings were performed by the parents between 7 and 9 a.m. according to the authors' guidance, and all samples were collected by the teachers of every kindergarten. The samples were then transported to the Division of Malaria and Parasitic Diseases, Korea Centers for Disease Control and Prevention and assessed by qualified technicians via light microscopy. The EPR was defined as the number of positive samples per 100 individuals. Comparisons of categorical variables were conducted via chi-square tests, and logistic regression analyses were performed. We also carried out multiple logistic regressions to adjust for epidemiological variables (sex, age, area, and type of kindergarten). Statistical significance ($P < 0.05$) was defined at a 95% confidence interval. All statistical analyses were conducted using the SAS software (ver. 9.1).

The EPR for *E. vermicularis* was 10.5% among the examined preschool children. With regard to sex, the EPR in boys and girls was 12.3% and 8.4%, respectively. With regard to age group, 6-year-old and younger children showed 5.8% EPR, and 7-year-old children 8.0%. Regarding the type of kindergarten, the EPR of kindergartens attached to elementary schools was 9.3%, and whereas that in general kindergartens was 10.8%. In terms of regions, an EPR of 11.7% was seen in preschool children who lived in rural areas, compared with 10.0% in urban areas.

E. vermicularis is the representative intestinal parasite in the

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Republic of Korea that easily results in infection among crowds of children. The prevalence of *E. vermicularis* in preschool children has varied in Korea. In the present study, the EPR range was widely distributed, from 3.3% to 18.6% by kindergarten (data not shown). The average EPR for *E. vermicularis* in the present study was lower than that previously reported by the Korea Association of Health Promotion in 2006, higher than that in Cheongju-si, and similar to that reported in Busan. The EPR of boys was significantly higher than that of girls ($P < 0.001$). This finding indicates that boys are more likely to contact *E. vermicularis* compared to girls [2,4]. Song et al. [1] reported that 6-7-year-old children evidenced significantly higher EPRs compared with younger children. In our study, EPR could not be accurately analyzed by age, because of missing data; however, there were no significant differences between the age groups that could be assessed. The number of children in general kindergartens ($n = 5,810$) was over 5 times that of children in kindergartens attached to elementary schools ($n = 1,111$). The EPR in general kindergartens was slightly higher than that in kindergartens attached to elementary schools, but this difference was not statistically significant (Table 1). Nevertheless, different conditions involved in *E. vermicularis* infection between these 2 types of kindergartens should be surveyed. Further, the number of participants who lived in urban areas was over 2 times that of participants who lived in rural areas. The EPR in rural areas was only slightly higher than that in urban areas; however, this difference was significant ($P = 0.022$).

According to previous reports regarding risk factors for *E. vermicularis* infection, inadequate personal hygiene and parents' knowledge of enterobiasis increased the risk of enterobiasis

among primary school children [4-6], whereas the socioeconomic status of the family and personal hygiene were not identified as associated risk factors for enterobiasis among Korean preschool children [1]. In Jangyu-myon, 1 of the rural regions surveyed in this study, located next to urban areas, urbanization processes took place recently, with roads opened and increased constructions. It is presumed that this environmental condition exerted some effects on *E. vermicularis* EPR, due to awareness of environmental hygiene conditions from a public health perspective. However, it is necessary to further study of risk factors for *E. vermicularis* infection, particularly on environmental hygiene.

In conclusion, *E. vermicularis* infection among preschool children was widely prevalent in all regions of Gimhae-si. Therefore, a systematic control and preventive program for children should be adopted to reduce morbidity associated with *E. vermicularis* infection.

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Table 1. Egg positive rates for *Enterobius vermicularis* among preschool children by epidemiological factors

		No. of tests (%)	No. of positive	Positive rate (%)	Adjusted	
					OR (95% CI)	P-value
		6,921	729	10.5		
Sex	Girl	3,145 (45.4)	263	8.4	1.0	-
	Boy	3,776 (54.6)	466	12.3	1.5 (1.3-1.8)	<0.001
Age ^a	<6	364 (5.3)	21	5.8	1.0	-
	6	532 (7.7)	31	5.8	0.9 (0.5-1.7)	0.814
	7	762 (11.0)	61	8.0	1.3 (0.8-2.2)	0.287
Kind of kindergarten	Attached	1,111 (16.1)	103	9.3	1.0	-
	General	5,810 (83.9)	624	10.8	0.8 (0.6-1.1)	0.139
Area	Urban	4,672 (67.5)	466	10.0	1.0	-
	Rural	2,249 (32.5)	263	11.7	1.2 (1.0-1.4)	0.022

CI, Confidence interval; OR, Odds ratio.

^aIn the number of total tests, the proportions of age group were calculated without missing cases (8 cases were not surveyed). Missing values are not shown in the table.

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