

## Comparison of Egg Positive Rates of *Enterobius vermicularis* among Preschool Children in Three Korean Localities

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**Abstract:** This survey was performed to investigate and compare egg positive rates (EPRs) of *Enterobius vermicularis* among preschool children in 3 Korean localities (Chuncheon-si, Inje-gun, and Paju-si) in 2008. A total of 7,048 preschool children were examined. Overall, the total EPR was 4.0%; the EPR was the highest in Chuncheon-si (5.6%), followed by Inje-gun (4.5%) and Paju-si (3.4%). The EPR of boys (4.9%) was higher than that of girls (3.1%). The EPR significantly increased with age, with the highest observed in 5~7-year-olds. These findings demonstrate that *E. vermicularis* infection is widely prevalent among preschool children in Chuncheon-si, Inje-gun, and Paju-si, Republic of Korea.

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

*Enterobius vermicularis* is one of the most highly prevalent gastrointestinal worms in children; more than 30% of children around the world are infected [1]. Especially, school-age children (5~14-year-olds) are predominantly subjected to *E. vermicularis* infection [2]. Enterobiasis is usually asymptomatic, but it may cause perianal pruritus, discomfort, insomnia, and restlessness in children. Reasons for the continued presence of the worm among children include improper treatment, reinfection, and rapid transmission among children [3,4]. For these reasons, a continuous epidemiologic survey of enterobiasis in children is being regionally undertaken. In the Republic of Korea, the prevalence of *E. vermicularis* infection has been reported in various regions with varied egg positive rates (EPRs). However, the majority of the survey was performed in primary school children, with limited data in preschool children. Recently, the EPRs in primary school children ranged from 9.8% to 18.6% [5-7], whereas they ranged from 7.9% to 18.1% in preschool children [7-9]. However, previous assessments of the prevalence of *E. vermicularis* infection in preschool children have been limited to local regions or cities, with no compar-

isons of the EPR among preschool children in different cities and different regions.

Therefore, the present survey was performed to investigate and compare the EPR of *E. vermicularis* in preschool children among 3 different localities of Korea. In 2008, a total of 7,048 preschool children were sampled from 188 kindergartens in Chuncheon-si (1,441 children from 23 kindergartens, urban area) located in a western part of Gangwon-do, an area of Inje-gun (788 children from 17 kindergartens, mountainous area) located in the central part of Gangwon-do, and in Paju-si (4,819 children from 148 kindergartens, rural area) in Gyeonggi-do (Fig. 1). In order to estimate the EPR of *E. vermicularis*, the adhesive cello-tape anal swab method was used only once. All examinations were carried out with permission of the preschool teachers and the children's parents. Pressings were performed by the parents at 7-9 a.m. who followed the authors' guidance, and all samples were collected by the teachers of the kindergartens. Thereafter, the samples were transported to the Division of Malaria and Parasitic Diseases, Korea National Institute of Health. Statistical analyses were conducted using the SPSS software (version 17.0 K); the chi-square test and the linearity test were used on all data. The statistical significance ( $P < 0.05$ ) was defined at 95% confidence interval.

Of the 7,048 children examined, 4.0% were found to be positive for *E. vermicularis* eggs; this value was lower compared to the EPR observed in other cities such as 7.9% in Cheongju

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[8], 10.7% in Busan [10], and 28.4% in Wonju-si [11]. Analysis by region revealed that the EPR was the highest in Chuncheon-si (5.7%), followed by Inje-gun (4.6%) and Paju-si (3.5%) (Table 1). There was no significant difference between the urban (Chuncheon-si and Paju-si) and mountainous (Inje-gun) areas. However, in the same region, the EPR was higher in urban areas (Chuncheon-si) than in mountainous areas (Inje-gun), which was similar to a previous report by Kim et al. [11] ( $P < 0.0001$ ) (Table 1). The reason why the EPR was higher in urban areas compared with mountainous and rural areas could be explained by epidemiological characteristics of *E. vermicularis* infection, such as high population density and crowded condition in kindergartens [10]. In addition, the EPR in kindergartens observed in this survey was lower when it was compared to a previous report in Chuncheon-si by Yoon et al. [12]. The risk factors for the lower EPR in the present study was not surveyed, therefore, further studies on changes of personal hygiene, life style in kindergartens, and environment should be

performed. The EPRs recorded in Inje-gun and Paju-si could not be compared with other data, because there were no previous data on enterobiasis prevalence in preschool children in Inje-gun and Paju-si. In our study, we have proven that enterobiasis is indeed present among preschool children in these 2 localities.

With regard to gender, the total EPR in boys (4.9%) was significantly higher than that in girls (3.1%) ( $P = 0.0001$ ), and this tendency was observed in all localities (Table 1). The EPR in boys was significantly higher than that in girls in Chuncheon-si and Paju-si, but there was no statistical difference in Inje-gun (data not shown). The reason why the EPR was higher in boys than that in girls was not surveyed in the present study. Thus, further studies on high prevalence of *E. vermicularis* infection in boys compared to girls should be needed. With regard to age, *E. vermicularis* eggs were found to be prevalent across all ages, from less than 3-year-olds to 7-year-olds, in our study, and high EPRs were observed in 5~7-year-olds group ( $P < 0.0001$ , Table 1). The EPR was also found to significantly increase with age ( $P = 0.0017$ ), as previously reported by Kang et al. [8]. Especially, the EPR in Paju-si had a high tendency to increase with age ( $P = 0.0002$ ) and similar tendency

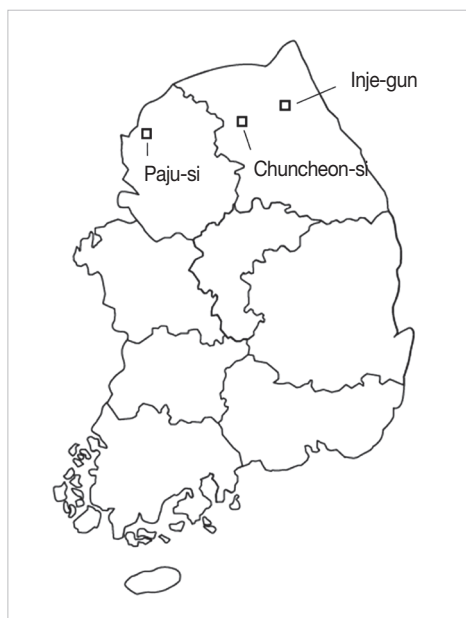


Fig. 1. The 3 localities on the map of South Korea.

Table 1. Egg positive rates of *Enterobius vermicularis* by sex among preschool children in 3 localities

| Category     | No. of total examined | No. of positive children (%) | Adjusted      |          |
|--------------|-----------------------|------------------------------|---------------|----------|
|              |                       |                              | OR (95%CI)    | P-value  |
| Total        | 7,048                 | 285 (4.0)                    |               |          |
| Gender       |                       |                              |               |          |
| Girl         | 3,313                 | 102 (3.1)                    | 1             | -        |
| Boy          | 3,735                 | 183 (4.9)                    | 1.6 (1.3-2.1) | 0.0001   |
| Age          |                       |                              |               |          |
| 0-4          | 2,252                 | 46 (2.0)                     | 1             | -        |
| 5-7          | 4,796                 | 239 (5.0)                    | 2.5 (1.8-3.5) | < 0.0001 |
| Region       |                       |                              |               |          |
| Paju-si      | 4,819                 | 167 (3.5)                    | 1             | -        |
| Inje-gun     | 788                   | 36 (4.6)                     | 1.2 (0.8-1.7) | 0.3717   |
| Chuncheon-si | 1,441                 | 82 (5.7)                     | 1.8 (1.4-2.4) | < 0.0001 |

Table 2. Distribution of egg positive rates for *E. vermicularis* by age among preschool children in 3 localities

| City             | Age (No. of egg positive cases/ No. examined) |              |                |                |                |                | P-value for linearity test |
|------------------|---|--------------|----------------|----------------|----------------|----------------|----------------------------|
|                  | <3  | 3            | 4              | 5              | 6              | 7              |                            |
| Chuncheon-si (%) | 4/90 (4.4)                                    | 10/180 (5.5) | 12/254(4.7)    | 28/398 (7.0)   | 21/360 (5.8)   | 7/159 (4.4)    | 0.7498                     |
| Inje-gun (%)     | 0 (0)   | 0/19 (0)     | 1/93 (1.0)     | 9/235 (3.8)    | 16/242 (6.6)   | 10/199 (5.0)   | 0.0120                     |
| Paju-si (%)      | 4/414 (1.0)                                   | 3/451 (0.6)  | 12/751 (1.6)   | 38/1,064 (3.5) | 51/1,153 (4.4) | 59/986 (5.9)   | 0.0002                     |
| Total (%)        | 8/504 (1.5)                                   | 13/650 (2.0) | 25/1,098 (2.2) | 75/1,697 (4.4) | 88/1,755 (5.0) | 76/1,344 (5.6) | 0.0017                     |

was shown in Inje-gun ( $P = 0.012$ ) (Table 2). Park et al. [7] and Kang et al. [8] previously reported that the EPR was highest in 5-year-olds, and Song et al. [9] reported that the EPR was particularly high in over 6-year-olds. In the present study, 7-year-olds showed the highest EPR compared with younger children in general (Table 2). However, the age group with the highest EPR differed between cities: 5-year-olds in Chuncheon-si, 6-year-olds in Inje-gun, and 7-year-olds in Paju-si. The reason for this difference is unclear at this point. Nevertheless, it may be assumed that many factors of personal hygiene, such as thumb-sucking. Fingernail trimming are associated with age groups with the level of EPR in each city [9,10], but further analysis of this observation is necessary.

The most important finding in this survey was not the observation that specific age groups showed the highest EPR in different localities, but the observation that enterobiasis was prevalent across all age groups in all surveyed localities. These days, many children are taken to the kindergarten during the daytime before entering primary schools. Consequently, *E. vermicularis* infection can easily occur and keep spreading rapidly in kindergartens. This study had 2 limitations. First, the scotch-tape sample collection for *E. vermicularis* was conducted by their parents, untrained personnel, who may not be able to follow exactly the recommended protocols. Second, it is well known that the EPR for *E. vermicularis* increases with repeated scotch-tape tests [11]. The sample collection and test in the present study was conducted only 1 time. Therefore, the actual EPR for *E. vermicularis* may have been higher than the results obtained in the present study. In conclusion, *E. vermicularis* infection is widely prevalent among preschool children in 3 different localities of Korea, Chuncheon-si, Inje-gun, and Paju-si.

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