

Prevalence of *Enterobius vermicularis* among Preschool Children in Muan-gun, Jeollanam-do, Korea

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Abstract: We assessed the prevalence of *Enterobius vermicularis* infection and changes in the egg positive rate (EPR) over 1-year time, using the adhesive cellophane-tape perianal swab method in 2,347 preschool children in Muan-gun, Jeollanam-do, Republic of Korea in 2008 and 2009. The overall EPR for *E. vermicularis* was 4.1% in 2008 and 4.5% in 2009. A study population of 389 children was repeatedly examined for 2 years. Within this group, the EPR in 2009 was twice higher than in 2008, and the EPR of the group of 5-7-year-old children was significantly higher than that of other age groups. Moreover, in the group of 5-7-year-old children in 2009, the rates of positive and negative conversion were significantly higher and lower, respectively, than in other age groups. Conclusively, enterobiasis was prevalent during 2008-2009 among preschool children in Muan-gun, Jeollanam-do, and the increased EPR in 2009 was due to an increase in newly acquired infections among 5-7-year-old children.

Key words: *Enterobius vermicularis*, prevalence, egg positive rate, preschool children, Muan-gun

Enterobius vermicularis is a common intestinal parasite in children worldwide. It is more prevalent in preschool children, who are more active and in more direct contact with each other compared to adults, and are often in overcrowded environments [1,2]. In addition, complete eradication of enterobiasis is difficult due to frequent reinfection, no exact examination techniques, and incomplete eradication among individuals even after treatment [3].

E. vermicularis infection is also widespread among preschool children in the Republic of Korea (Korea), and varies according to the age group and region [4-7]. However, no study on the prevalence of *E. vermicularis* has been conducted in Jeollanam-do, the southwestern province of Korea, and no yearly survey of *E. vermicularis* infection in the same region has been performed among preschool children.

We investigated on the prevalence of *E. vermicularis* infection, including changes in the egg positive rate (EPR), among preschool children in Muan-gun, Jeollanam-do, Korea during the period from 2008 to 2009. A total of 2,347 preschool children,

including 1,159 (28 kindergarten children) in 2008 and 1,188 (26 kindergarten children) in 2009, were examined (Fig. 1). The survey was conducted by the Muan-gun Local Health Service Center as a periodic health check for *E. vermicularis* infection among preschool children. Children voluntarily participated in this survey under permission of parents and teachers. The egg detection for *E. vermicularis* was performed using the cellophane-tape perianal swab method, which was performed by parents between 7 and 9 a.m., according to the instructions provided by the study researchers. Samples were collected by teachers and then transported to the Division of Malaria and Parasitic Diseases, Korea Centers for Disease Control and Prevention, for assessment by qualified technicians via light microscopy. Comparison of categorical variables was conducted via the chi-square test, with statistical significance defined using a 95% confidential interval ($P < 0.05$). All statistical analyses were performed using SPSS software (ver. 17.0K).

The overall EPR for 2 years was 4.4%. The geographic region with the highest EPR in 2008 was Samhyang-eup, and in 2009, it was Hyeongyeong-myeon and Unnam-myeon, and the EPR was similar each year (Tables 1 and 2). The demographic groups with the highest EPR were 5-year-old boys and 6-year-old girls in 2008, and 5-year-old boys and 7-year-old girls in 2009, and the highest EPR was found in the group of 5-year-old children (Table 2). The EPR among preschool children in Muan-gun,

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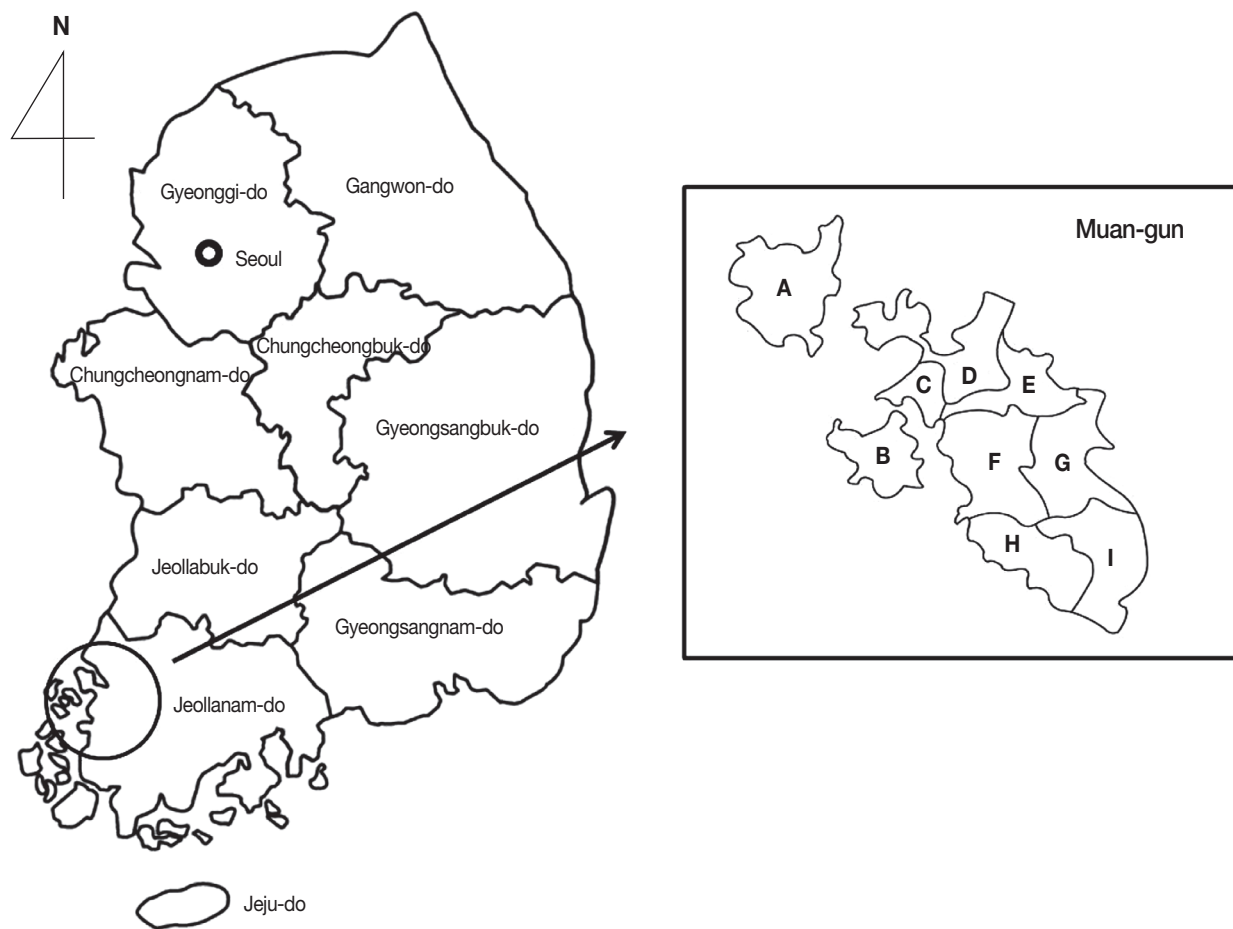


Fig. 1. Areas surveyed for *Enterobius vermicularis* infection in Muan-gun, Jeollanam-do, the southwestern province of Korea.

Table 1. Number of egg-positive children in 2008 and 2009 in 9 regions of Muan-gun, Jeollanam-do, Korea

Mark ^a	Region	No. positive / No. examined (%)	
		2008	2009
A	Illo-eup	1/125 (0.8)	3/112 (2.6)
B	Muan-eup	18/295 (6.1)	20/381 (5.2)
C	Samhyang-eup	4/46 (8.7)	0 (0.0)
D	Hyeongyeong-myeon	5/110 (4.5)	8/119 (6.7)
E	Unnam-myeon	4/88 (4.5)	5/79 (6.3)
F	Cheonggye-myeon	10/323 (3.1)	12/209 (5.7)
G	Mongtan-myeon	0/3 (0.0)	2/71 (2.8)
H	Mangun-myeon	3/69 (4.3)	0/113 (0.0)
I	Haeje-myeon	3/100 (3.0)	4/104 (3.8)
Total		48/1,159 (4.1)	54/1,188 (4.6)

^aThe regions surveyed in this study (in Fig. 1).

Jeollanam-do was lower than that reported in other regional studies [4-7]. In general, it is known that the infection rate determined by a single examination often underestimates the

real rate of infection [8-10]. In the present study, examinations were performed only once a year. All the egg-positive children were medicated twice, with a 2-week interval between each administration, and there was no subsequent re-examination. Therefore, it is possible that the real infection rate was underestimated in our study [8,9]. Further repeated examinations for *E. vermicularis* infection are necessary to acquire an accurate estimation of the true infection rate in the population.

Among the examined population, 389 preschool children were examined twice, once in 2008 and once in 2009. The EPR in 2009 was about double of that in 2008, and was similar for boys and girls each year (Table 3). By the age of the preschool children, the EPR in the 5-7-year-old children was significantly higher than that in the 0-4-year-old children in both 2008 and 2009. These results were consistent with those of a previous report by Lee et al. [6].

Changes in EPR from 2008 to 2009 among these 389 preschool children are presented in Table 4. There was no signifi-

Table 2. Egg positive rate of *Enterobius vermicularis* by age and sex

Age (year)	No. positive/No. examined (%)								
	Boys			Girls			Total		
	2008	2009	Subtotal	2008	2009	Subtotal	2008	2009	Total
< 3	1/52 (1.9)	0/66 (0)	1/118 (0.9)	3/53 (5.7)	0/60 (0)	3/113 (2.7)	4/105 (3.8)	0/126 (0)	4/231 (1.7)
3	1/120 (0.8)	3/83 (3.6)	4/203 (2.0)	0/114 (0)	3/82 (3.7)	3/196 (1.5)	1/234 (0.4)	6/165 (3.6)	7/399 (1.8)
4	4/149 (2.7)	5/151 (3.3)	9/300 (3.0)	6/142 (4.3)	8/133 (6.0)	14/275 (5.1)	10/291 (3.4)	13/284 (4.6)	23/575 (4.0)
5	13/143 (9.1)	11/142 (7.8)	24/285 (8.2)	6/111 (5.4)	9/160 (5.6)	15/271 (5.5)	19/254 (7.5)	20/302 (6.6)	39/556 (7.0)
6	5/71 (7.0)	6/82 (7.3)	11/153 (7.2)	5/78 (6.4)	3/90 (3.3)	8/168 (4.8)	10/149 (6.7)	9/172 (5.2)	19/321 (5.9)
7	2/58 (3.5)	2/82 (2.4)	4/140 (2.9)	2/68 (2.9)	4/57 (7.0)	6/125 (4.8)	4/126 (3.2)	6/139 (4.3)	10/265 (3.8)
Total	26/593 (4.4)	27/606 (4.5)	53/1,199 (4.4)	22/566 (3.9)	27/582 (4.6)	49/1,148 (4.3)	48/1,159 (4.1)	54/1,188 (4.6)	102/2,347 (4.4)

Table 3. Egg positive rate of *Enterobius vermicularis* by sex and age in children examined in both 2008 and 2009

	No. examined	2008		2009	
		No. of positive (%)	P-value	No. of positive (%)	P-value
Total	389	21 (5.3)		46 (11.8)	
Gender					
Male	197	11 (5.5)	0.8699	23 (11.6)	0.926
Female	192	10 (5.2)		23 (11.9)	
Age					
0-4	275	10 (3.6)	0.0169	26 (9.4)	0.0245
5-7	114	11 (9.6)		20 (17.5)	

Table 4. Changes in egg positive rates of *Enterobius vermicularis* by age and sex in children examined in both 2008 and 2009

	Total	P-P (%)	P-N (%)	N-P (%)	N-N (%)	P-value
Total	389	17 (4.4)	4 (1.0)	29 (7.5)	339 (87.1)	
Sex						
Male	197	9 (4.6)	2 (1.0)	14 (7.1)	172 (87.3)	0.9890
Female	192	8 (4.2)	2 (1.0)	15 (7.8)	167 (87.0)	
Age						
0-4	275	7 (2.5)	3 (1.1)	19 (6.9)	246 (89.5)	0.0426
5-7	114	10 (8.8)	1 (0.9)	10 (8.8)	93 (81.6)	

Individually, those who were egg positive in 2008 remained egg positive in 2009 (P-P), those egg positive in 2008 changed to egg negative in 2009 (P-N), those egg negative in 2008 changed to egg positive in 2009 (N-P), and those egg negative in 2008 remained egg negative in 2009 (N-N).

cant difference in the change of EPR during 2008-2009 by sex, but the change of positive-and-positive (P-P) was significantly higher in 5-7-year-old children and the change of negative-and- negative (N-N) was significantly lower in 5-7-year-old children than in 0-4-year-old children (Table 4). In other words, the increase in EPR in 2009 may have been caused by an increasing number of newly acquired infections in the group of 5-7-year-old children. Further serial studies are necessary to compare and investigate the behavior, lifestyle, and hygiene of each age group, especially 4-5-year-old children, to account for the changing rates. This information could help control enterobiasis among preschool children by facilitating standardization of prevention measures and identification of risk factors.

From our data, we conclude that mild *E. vermicularis* infection was prevalent among preschool children in Muan-gun, Jeollanam-do, and that the number of newly acquired infections increased in 2009 among 5-7-year-old children.

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REFERENCES

1. Beaver PC, Jung RC, Cupp EW. Clinical Parasitology. 9th ed. Philadelphia, USA. Lea & Febiger. 1984, p 302-306.
2. Cook GC. *Enterobius vermicularis* infection. Gut 1994; 35: 1159-1162.
3. Lohiya GS, Tan-Figueroa L, Crinella FM, Lohiya S. Epidemiology and control of enterobiasis in a developmental center. West J Med 2000; 172: 305-308.
4. Park JH, Han ET, Kim WH, Shin EH, Guk SM, Kim JL, Chai JY. A survey of *Enterobius vermicularis* infection among children on western and southern coastal islands of the Republic of Korea. Korean J Parasitol 2005; 43: 129-134.
5. Kang S, Jeon HK, Eom K, Park JK. Egg positive rate of *Enterobius vermicularis* among preschool children in Cheongju, Chungcheongbuk-do, Korea. Korean J Parasitol 2006; 44: 247-249.
6. Lee SE, Lee JH, Ju JW, Lee WJ, Cho SH. Prevalence of *Enterobius vermicularis* among preschool children in Gimhae-si, Gyeongsangnam-do, Korea. Korean J Parasitol 2011; 49: 183-185.
7. Kim DH, Son HM, Kim JY, Cho MK, Park MK, Kang SY, Kim BY, Yu HS. Parent's knowledge about enterobiasis might be one of the most important risk factors for enterobiasis in children. Korean J Parasitol 2010; 48: 121-126.

8. Felt SA, White CE. Evaluation of timed and repeated perianal tape test for the detection of pinworms (*Trypanoxyuris microon*) in owl monkeys (*Aotus nancymae*). *J Med Primatol* 2005; 34: 209-214.
9. Fan PC, Chan CH. Consecutive examinations by scotch-tape perianal swabs in diagnosis of enterobiasis. *Gaoxiong Yi Xue Ke Xue Za Zhi* 1990; 6: 647-652.
10. Remm M, Remm K. Effectiveness of repeated examination to diagnose enterobiasis in nursery school groups. *Korean J Parasitol* 2009; 47: 235-241.