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▣ BRIEF COMMUNICATION

Prevalence of *Enterobius vermicularis* Infection among Preschool Children in Kindergartens of Taipei City, Taiwan in 2008

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Abstract: The prevalence of *Enterobius vermicularis* infection among preschool children was reported to be low based on a 5-year screening program in Taipei City, Taiwan. The Taipei City government intended to terminate the *E. vermicularis* screening program among preschool children. Thus, we were entrusted with confirming whether pinworm infections among preschool children in Taipei City had truly declined. From each of 12 administrative districts 2-3 kindergartens were randomly selected for investigation. In total, 4,349 children were examined, of which 2,537 were boys and 1,812 were girls. The cellophane tape adhered to a glass slide was used, and all examinations were done by certified medical technologists. Results indicated that the overall prevalence rate of pinworm infections was 0.62% (27/4,349). Although the infection rate was higher among boys (0.67%, 17/2,537) than in girls (0.55%, 10/1,812), no significant difference was found ($\chi^2 = 0.399$, $P = 0.62$). According to the administrative district, the infection rate ranged from no positive cases of *E. vermicularis* infection in the Xinyi, Zhongzhen, and Wanhua Districts (0%; 0/299, 0/165, and 0/358, respectively), to 0.26% (1/131) in Songshan District, with the highest rate of 1.88% (7/373) in Wenshan District. Because the overall infection rate (0.62%, 27/4,349) in the present study was unchanged compared to that (0.40%, 197/49,541) previously reported in 2005, we propose that regular pinworm screening and treatment programs should be continued in some parts of Taipei City.

Key words: *Enterobius vermicularis*, pinworm, prevalence, preschool children, Taipei, Taiwan

Enterobius vermicularis (pinworm) is the most successful intestinal nematode to thrive among human populations with over 400 million infected people worldwide [1]. The most commonly infected group are schoolchildren living in crowded environments such as summer camps and institutions, with hygiene and exposure being important factors [2]. Female worms deposit their eggs near the anus on the perianal skin. Some of these eggs are detached from the perianal region and lodge on clothing, bedding, and other surfaces. Infection takes place through ingestion or inhalation of infective eggs or retrograde migration of hatched juveniles from the anus to the intestines. Enterobiasis is usually asymptomatic or accompanied by perianal pruritus. However, there can be symptoms of restlessness, loss of appetite, insomnia, and irritability, particularly in children with high parasitic burdens [1,2]. In rare instances, pinworms can cause serious gastrointestinal problems and ectopic infections [3-6]. Diagnosis of pinworm infection is made upon the microscopic detection of eggs. Since only about 5% of eggs turn up in stools, the cellophane tape test should be used for screening instead of stool examinations [1]. While pinworms can be readily treated by mebendazole, a strict regime of treatment needs to be followed to control the parasite because of its ease of transmission and reinfection [7].

Taipei City, which has undertaken an annual mass pinworm screening and treatment program since 1990 [8], had a decreasing prevalence rate among preschool children of 4.3% in 1990 to 0.40% (197/49,541) in 2007 [8,9]. The city government's screening used a traditional method of cellophane tapes, and samples were primarily collected by children's parents. Using this method, the adhesive side of the tape is applied to the perianal region and then folded together for microscopic inspection. However, there is difficulty in identifying eggs due to overlapping tape layers with this method and to parents who might not be familiar with performing the procedure correctly that might have led to false negative results and an underestimation of the infection rate [8-10]. In this study, we investigated the prevalence of pin-

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worm infection among preschool children in kindergartens in Taipei City using the modified cellophane tape method described by Kucik et al. [1].

From each of 12 city districts, 2-3 kindergartens were randomly selected for investigation. In total, 4,349 children were examined between 09:00 and 12:00 in the morning, of which 2,537 were boys and 1,812 were girls. The cellophane tape adhering to glass slides was used, and all examinations were done by certified medical technologists. Parents were notified of the procedure beforehand and were asked not to shower their children or have them defecate in the morning of the examination, with letters of consent sent to be signed and returned before the examinations were undertaken. Collected specimens were screened microscopically for pinworm eggs by at least 3 medical technologists. All of the data were processed by statistical software SPSS version 10.0 (SPSS, Chicago, Illinois, USA). The chi-square test was used for the statistical analysis. *P* value of $\leq$ 0.05 indicated a significant difference between 2 results.

Results indicated that the overall prevalence rate of pinworm infections was rather low (0.62%, 27/4,349) (Table 1). Compared to other countries, our present figure was much lower than that reported in Busan City (8.9%, 13/146) [11], Chungchongnamdo (14.8%, 28/189) [12], and Cheongju City (13.4%, 75/561) [13], Korea, and also in southeastern Estonia (24.4%, 233/954) [14]. In the present study, the *E. vermicularis* infection rate was found to be higher among boys (0.67%, 17/2,537) than in girls (0.55%, 10/1,812), but the difference was not significant (χ^2 = 0.399, *P* = 0.62) (Table 1). This finding was previously reported worldwide [11-14]. Preschool children contact each other more frequently in kindergartens and are also exposed to unsatisfactory sanitary environments [15]. Inadequate personal hygiene can also increase the risk of *E. vermicularis* infection among preschool children, particularly boys. Other factors, including playing on the floor, nail biting, a failure to wash hands before meals, and living in non-apartment dwellings, were also reported to be associated with the prevalence of enterobiasis [16].

Table 1. Prevalence of *Enterobius vermicularis* infection among preschool children in kindergartens of Taipei City in 2008

Category	No. examined	No. positive (%)	Chi-square test	
			χ^2	*P* value
Gender				
Boys	2,357	17 (0.67)		
Girls	1,821	10 (0.55)	0.40	0.62
Administrative district				
Wenshan district	373	7 (1.9)	–	–
Beitou district	608	7 (1.2)	–	–
Nangang district	380	3 (0.79)	–	–
Daan district	401	3 (0.75)	–	–
Neihu district	323	2 (0.62)	–	–
Datong district	473	2 (0.42)	–	–
Shilin district	258	1 (0.39)	–	–
Zhongshan district	318	1 (0.31)	–	–
Songshan district	391	1 (0.26)	–	–
Xinyi district	299	0 (0.00)	–	–
Zhongzhen district	165	0 (0.00)	–	–
Wanhua district	358	0 (0.00)	–	–
Total	4,349	27 (0.62)	–	–

According to administrative districts, the highest rate was found in Wenshan District (1.9%, 7/373), followed by Beitou (1.2%, 7/608), Nangang (0.79%, 3/380), Daan (0.75%, 3/401), Neihu (0.62%, 2/323), Datong (0.42%, 2/473), Shilin (0.39%, 1/258), Zhongshan (0.31%, 1/318), and Songshan Districts (0.26%, 1/391). No positive cases of E. vermicularis eggs were found in samples obtained in Xinyi (0%, 0/299), Zhongzhen (0%, 0/165), or Wanhua Districts (0%, 0/358) (Table 1). Although Jang et al. [8] indicated that families with a low economic status have a higher association with *E. vermicularis* infection among preschool children in Taipei City, the average annual incomes for families in Wenshan and Beitou Districts are not lower compared to those of other districts [8]; it was proposed that parents might overlook the importance of personal hygiene of children, thus resulting in a higher prevalence of *E. vermicularis* infection in both districts.

The pinworm has the largest geographic distribution among human intestinal parasites. A part of the reasons for successful maintenance of its prevalence may include the mildness of symptoms in most infections, leading health officials to often focus their efforts on other relevant parasites instead [1]. However, the importance of pinworm infections among children should not be overlooked. Although the symptoms of infection are often mild, the itchiness and restlessness which children experience from the infections can be discomforting and effect their learning, and the shame of having "worms" can have a negative impact on their mental health. In rare cases, enterobiasis has led to serious consequences such as appendicitis [5], eosinophilic colitis [4,5], intestinal obstruction, intestinal perforation, and ectopic infections [6].

In addition, pinworms have also been suggested as a possible vector for *Dientamoeba fragilis*, a protozoan regarded as a neglected cause of diarrhea [17]. Taipei City Government has performed a long-term pinworm screening and treatment program since 1990, in which all family members of a child determined to have a pinworm infection are informed and assigned to see an appoint-

ed doctor at Taipei Municipal Hospital, and this demarche indeed produced an ideal outcome of decreasing adolescent pinworm prevalence in Taipei City. We still suggest that the city government continue its annual screening program and use the modified cellophane test method used in this study in the future to confirm the accuracy of its annual pinworm screening.

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