

Prevalence of *Enterobius vermicularis* Infection among Preschool Children in Four Kindergartens of Ea Sup District, Dak Lak Province, Vietnam, 2025

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Abstract: Objective: To determine the prevalence of *Enterobius vermicularis* infection among preschool children in four kindergartens in Ea Sup District, Dak Lak Province, in 2025. Materials and Methods: A cross-sectional study was conducted on 320 systematically selected children from four kindergartens (Hoa Ban, Hoa Phuong, Ea Rok, and Cu Kbang) between April and September 2025. Perianal samples were collected using the Graham method, and *E. vermicularis* eggs were identified under light microscopy. Results: The overall prevalence of *E. vermicularis* infection was 13.75%. The highest prevalence was observed at Hoa Ban Kindergarten (17.76%), followed by Cu Kbang (15.69%), Ea Rok (11.11%), and Hoa Phuong (9.26%); however, the differences were not statistically significant ($p > 0.05$). Infection rates were significantly higher among ethnic minority children compared to Kinh children ($p < 0.05$). The prevalence was higher in the 4–5-year-old group, with no significant difference between sexes. *E. vermicularis* infection was associated with behaviors such as toy biting and finger sucking. Conclusion: The prevalence of *E. vermicularis* infection among preschool children in Ea Sup District remains a public health concern. Regular deworming programs and hygiene education in kindergartens should be strengthened to reduce transmission.

Keywords: *Enterobius vermicularis*, pinworm, preschool children, Ea Sup, Dak Lak, Vietnam.

INTRODUCTION

Enterobius vermicularis infection (pinworm infection) is one of the most common intestinal parasitic diseases in humans, particularly among preschool and kindergarten-aged children. Children are the most susceptible group due to collective living conditions, habits such as finger sucking and toy biting, and incomplete personal hygiene awareness [Pham, N. M. 2023]. Although *E. vermicularis* infection rarely causes anemia or severe malnutrition like *Ascaris lumbricoides* or hookworm infections, it significantly affects children's health and development. The infection may lead to perianal itching, sleep disturbances, poor concentration, and even genital tract inflammation or appendicitis due to ectopic migration of worms [Quang, Le. B. 2005].

According to estimates from the World Health Organization (WHO), approximately 200 million people worldwide are infected with *E. vermicularis*, with about 15 million new cases reported annually [WHO Expert Committee on the Control of Schistosomiasis, 2002]. In Vietnam, epidemiological surveys have shown that the prevalence of *E. vermicularis* infection among children ranges from 7.5% to over 40%, depending on geographic region and sanitation conditions [Quang, T. T. 1997; Quang, Le. B. 2005]. Recent studies in Dak Lak Province also indicate that the infection remains prevalent: Van Duy Nhat (2020) reported a 17.62% infection rate among children in

Krong Pak District [Nhat, V. D. 2020], while recorded a prevalence of 26.9% in Lak District [Dang, Le H. *et al.*, 2022].

Ea Sup District is a remote area of Dak Lak Province with challenging socioeconomic conditions. The majority of residents belong to ethnic minority groups, and environmental sanitation as well as children's hygiene practices remain inadequate. However, no studies have been published to date on *E. vermicularis* infection in this locality.

Therefore, this study titled “Prevalence of *Enterobius vermicularis* Infection among Preschool Children in Four Kindergartens of Ea Sup District, Dak Lak Province, Vietnam, 2025” was conducted to determine the current status of pinworm infection among preschool children, a high-risk population and to provide scientific evidence for community-based parasitic disease control measures.

METHODS

Study Subjects:

The study population included preschool children enrolled in four kindergartens, along with their primary caregivers, in Ea Sup District, Dak Lak Province.

Study Period and Location:

The study was conducted from April to September 2025. The research sites were kindergartens located in Ea Rok and Cu Kbang communes, Ea Sup District, Dak Lak Province (formerly Ea Sup District, now Ea Rok Commune, Dak Lak Province). The selected schools included: Hoa Ban Kindergarten (321 children); Cu Kbang Kindergarten (152 children); Hoa Phuong Kindergarten (162 children); Ea Rok Kindergarten (324 children). The total number of children across all four kindergartens was 959.

Study Design: A cross-sectional descriptive study was conducted.

Sample Size: Quantitative sample size was calculated using the standard epidemiological formula

$$n = Z_{1-\frac{\alpha}{2}}^2 \frac{p(1-p)}{d^2}$$

n: minimum required sample size

p: expected prevalence, set at 0.269 based on the study by Le Hai Dang *et al.* (2021), which reported a prevalence of 26.9% [9]

α : type I error probability, set at 0.05

Z: standard normal deviate corresponding to a 95% confidence level ($Z = 1.96$)

d: desired precision (set at 0.05)

By substituting these values into the formula, the calculated sample size was $n = 303$ children. To account for a possible 5% non-response or sample loss, the final required sample size was 319 children. In practice, 320 children were included in the study.

In addition, 320 primary caregivers (corresponding to the selected children) were interviewed directly using a structured questionnaire.

Sampling Technique: A systematic random sampling method was applied.

Sampling Frame: The sampling frame consisted of the complete list of children enrolled in the four kindergartens.

Sampling Unit: Each child in the list and their primary caregiver.

Observation Unit:

The selected children and their corresponding caregivers. With a total of 959 children across the four kindergartens and a required sample size of 320, the sampling interval (K) was calculated as $959/320 \approx 3$. Based on this interval, the number of samples selected from each kindergarten was as follows: Hoa Ban Kindergarten: 107 children; Cu

Kbang Kindergarten: 51 children; Hoa Phuong Kindergarten: 54 children; Ea Rok Kindergarten: 108 children. At each school, a complete list of children was prepared and numbered sequentially. Sampling began with the first child on the list, then every 4th child (after skipping 3) was selected until the target sample size was reached. If a selected child did not meet the inclusion criteria, the next eligible child on the list was selected to ensure the required number of participants per school.

Exclusion Criteria:

Children whose caregivers did not consent to participate or who were absent at the time of sample collection.

Children suffering from infectious or acute illnesses, or who had taken anthelmintic drugs within two months prior to sampling.

Children who had defecated, bathed, or cleaned the anal area before sample collection.

Data Collection Methods:

The prevalence of *E. vermicularis* infection was determined using the Graham technique (perianal cellulose tape method).

Direct interviews were conducted with caregivers to collect demographic information and behavioral data related to children's hygiene and daily habits.

Quantitative data were entered using Excel 2013 and analyzed with Stata 13.0 software.

Frequencies, percentages, and 95% confidence intervals (95% CI) were calculated to describe the prevalence of *E. vermicularis* infection and related characteristics.

Analytical Methods:

The Chi-square test (χ^2) was used to compare prevalence rates between groups.

The Prevalence Ratio (PR) and its 95% CI were calculated to assess associations between potential risk factors and *E. vermicularis* infection.

Ethical Considerations:

All participant information was kept confidential and used solely for research purposes. Participants were informed about the study objectives, and data collection was conducted only after obtaining consent from the caregivers.

Children who tested positive for *E. vermicularis* infection were treated with Albendazole, and

caregivers received counseling on preventive

measures and appropriate child hygiene practices.

RESULTS

Table 1. Prevalence of *E. vermicularis* Infection by Kindergarten

Kindergarten	Number of Samples Examined	Number Positive	Prevalence (%)	p-value
Hoa Ban*	107	19	17.76	—
Cu Kbang	52	8	15.69	0.74
Ea Rok	108	12	11.11	0.17
Hoa Phuong	54	5	9.26	0.15
Total	320	44	13.75	

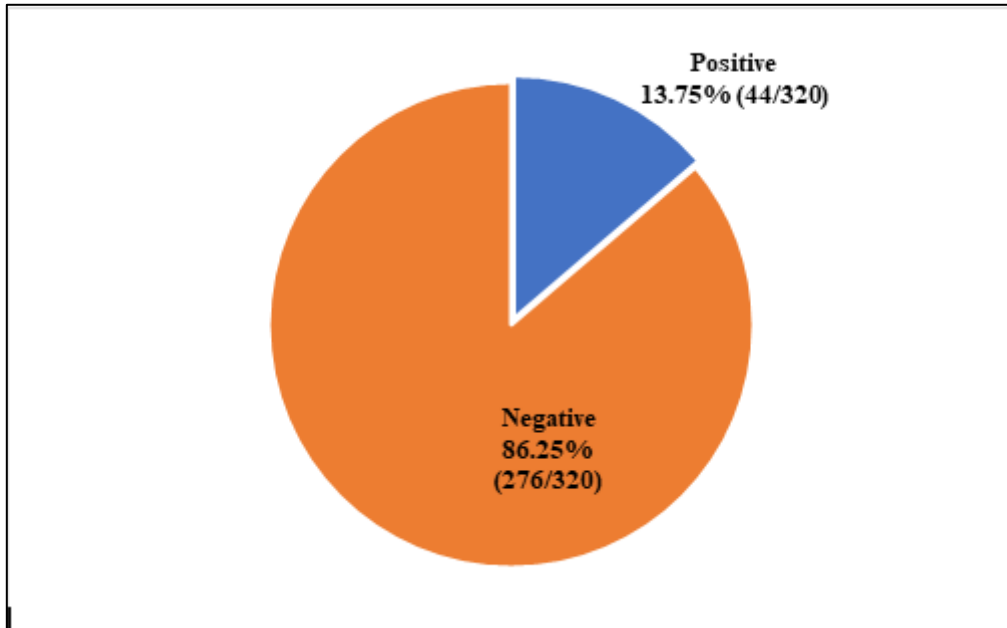


Figure 1. Prevalence of *E. vermicularis* Infection among Children at the Study Sites

The results presented in Table 1 indicate that *E. vermicularis* infection was detected in children from all four kindergartens, with an overall prevalence of 13.75%. The highest prevalence was observed at Hoa Ban Kindergarten (17.76%), followed by Cu Kbang (15.69%), Ea Rok

(11.11%), and Hoa Phuong (9.26%). However, when compared with Hoa Ban Kindergarten (the reference group), the differences in infection rates among schools were not statistically significant ($p > 0.05$).

Table 2. Prevalence of *Enterobius vermicularis* Infection by Demographic Characteristics

Variable		Number Examined	Number Positive	Prevalence (%)	p-value
Sex	Male	163	23	14.11	0.85
	Female	157	21	13.38	
Age	3*	83	13	15.66	0.86
	4	102	15	14.71	
	5	99	11	11.11	
	6	36	5	13.89	
Class level	Nursery*	98	15	15.31	0.89
	Junior	109	16	14.68	
	Senior	113	13	11.50	
Ethnicity	Kinh	177	18	10.17	0.04
	Ethnic minority	143	26	18.18	

The results in Table 2 show that the prevalence of *Enterobius vermicularis* infection was similar between boys (14.11%) and girls (13.38%), with

no statistically significant difference ($p = 0.85$). By age group, the highest prevalence was observed in 3-year-old children (15.66%), followed by those

aged 4, 5, and 6 years (14.71%, 11.11%, and 13.89%, respectively). However, these differences were not statistically significant ($p > 0.05$).

Similarly, infection rates by class level were highest in the Nursery group (15.31%), followed by Junior (14.68%) and Senior (11.50%), with no significant difference compared to the Nursery

group ($p > 0.05$). Notably, ethnic minority children had a significantly higher infection rate than Kinh children (18.18% vs. 10.17%), and this difference was statistically significant ($p = 0.04$). This finding suggests that ethnic minority children represent a higher-risk group, possibly related to poorer sanitation and living conditions.

Table 3. Association between children's habits and *E. vermicularis* infection rate

Factor	<i>E. vermicularis</i> infection (n = 320)		PR KTC 95%	p-value
	Positive (%)	Negative (%)		
Habit of putting toys into mouth	Yes	25 (21.55)	2.31 (1.33-4.02)	0.002
	No	19 (9.31)		
Habit of finger sucking	Yes	26 (27.08)	3.37 (1.94-5.85)	<0.001
	No	18 (8.04)		

The analysis showed that children whose caregivers were farmers had a 2.49-fold higher risk of *E. vermicularis* infection compared with those whose caregivers had other occupations (PR = 2.49; 95% CI: 1.09–5.69; $p = 0.021$). In addition, children with the habit of putting toys into their mouths had a 2.31-fold increased risk of infection (PR = 2.31; 95% CI: 1.33–4.02; $p = 0.002$), and those who sucked their fingers had a 3.37-fold higher risk (PR = 3.37; 95% CI: 1.94–5.85; $p < 0.001$).

These findings indicate that hand-to-mouth behaviors, such as toy mouthing and finger sucking, are significant risk factors contributing to *E. vermicularis* infection among preschool children.

DISCUSSION

Prevalence of *Enterobius vermicularis* infection at the study site

Examination of 320 preschool children using the Graham method revealed an overall *Enterobius vermicularis* infection rate of 13.75%. Although this prevalence is not high compared to previous reports, it remains epidemiologically significant in the context of children living and studying together in a collective environment. The result indicates the persistence of infection sources and favorable conditions for the spread of *E. vermicularis* eggs within preschool settings.

Compared with recent studies conducted in Dak Lak Province, our findings are comparable to that of Van Duy Nhat (2020) in Krong Pak (17.6%) [Nhat, V. D. 2020] and lower than the prevalence reported by Le Hai Dang (2021) in Lak District (26.9%) [Dang, Le H. et al., 2022]. The variations in prevalence among regions may be attributed to several factors, including climatic and environmental conditions, hygiene status in

schools, differences in personal hygiene practices and caregivers' awareness, and the extent of implementation of periodic deworming and health education programs.

Among the four preschools included in the present study, the infection rate ranged from 9.26% to 17.76%, with the highest rate observed in Hoa Ban Kindergarten and the lowest in Hoa Phương Kindergarten. However, these differences were not statistically significant ($p > 0.05$), suggesting a relatively uniform distribution of infection across study sites. This finding reflects that infection sources are sporadically distributed and widespread in the community, rather than being concentrated in a specific area or school.

Analysis of the association between background factors and *Enterobius vermicularis* infection

The analysis showed that the prevalence of *E. vermicularis* infection was comparable between boys (14.11%) and girls (13.38%), with no statistically significant difference ($p = 0.85$). The highest prevalence was observed among children aged 3 years (15.66%), followed by those aged 4, 5, and 6 years, but the differences among age groups were not statistically significant ($p > 0.05$). Similarly, infection rates among children in the nursery (15.31%), kindergarten (14.68%), and pre-kindergarten (11.50%) levels did not differ significantly when compared with the nursery group ($p > 0.05$).

Overall, no significant differences in *E. vermicularis* infection were observed according to age, class level, or gender. This finding is consistent with previous studies by Van Duy Nhat (2020) [Nhat, V. D. 2020; Binh, P. D. 2021]. The regular deworming program implemented across Dak Lak Province includes preschool children,

who receive anthelmintic treatment twice a year. The widespread application of such interventions may have minimized differences between age and class groups, leading to a relatively uniform infection rate across the study population. Additionally, preschool children share similar living, learning, and hygiene environments regardless of gender, which may explain the absence of significant gender-related differences.

Notably, the prevalence of *E. vermicularis* infection among ethnic minority children (18.18%) was significantly higher than that among Kinh children (10.17%) ($p = 0.04$), consistent with the findings of [Trong, P. V., Thanh, D. D. 2016]. This difference may be attributed to socioeconomic and environmental disparities in minority communities, such as limited access to clean water, poor personal hygiene, communal living habits, and inadequate knowledge of helminth prevention. These factors contribute to the persistence and reinfection of *E. vermicularis* within the community.

This finding underscores that although the overall prevalence of *E. vermicularis* infection has decreased due to regular deworming programs, differences related to ethnicity and living conditions remain important epidemiological concerns. Therefore, deworming measures should be integrated with enhanced health education, environmental sanitation improvement, and better living conditions for children in ethnic minority areas to achieve effective and sustainable control of enterobiasis.

Association between children's habits and *Enterobius vermicularis* infection

Certain behavioral habits among children were found to be strongly associated with *E. vermicularis* infection. Specifically, children who habitually put toys into their mouths had a 2.31-fold higher risk of infection compared to those without this habit ($p = 0.002$), while thumb-sucking behavior increased the risk by 3.37 times ($p < 0.001$). These associations were statistically significant and consistent with the findings of [Trong, P. V., Thanh, D. D. 2016; Dang, Le H. et al., 2022].

Behaviors such as thumb-sucking or mouthing toys play an important role in the fecal–oral transmission pathway, as *E. vermicularis* eggs can adhere to fingers, under fingernails, toys, or classroom surfaces. In preschool settings, where children frequently share toys and learning

materials, the likelihood of transmission and reinfection is markedly increased.

CONCLUSION

The results of this study revealed that the prevalence of *Enterobius vermicularis* infection among preschool children in Ea Sup District was 13.75%, which is at a moderate level compared to previous reports. Nevertheless, this rate remains epidemiologically significant, indicating the persistence of infection sources and favorable conditions for the dissemination of *E. vermicularis* eggs within kindergarten and preschool environments.

No statistically significant differences in infection rates were observed across age groups, genders, or school levels, suggesting the effectiveness of the locally implemented periodic deworming program. However, infection prevalence among ethnic minority children was significantly higher than that among Kinh children.

In addition, behavioral factors such as thumb-sucking and mouthing toys were identified as important risk factors that markedly increased the likelihood of infection. These findings emphasize the critical role of the fecal–oral transmission route in the epidemiology of *E. vermicularis* infection among preschool-aged children.

RECOMMENDATIONS

Continue to maintain and expand the periodic deworming program for preschool children at least twice per year, ensuring full coverage across all kindergartens, especially in remote areas and ethnic minority communities.

Conduct regular health education and communication sessions for teachers and parents on the prevention of *Enterobius vermicularis* infection, emphasizing the importance of personal hygiene and discouraging behaviors such as thumb-sucking and mouthing toys among children.

Strengthen school environmental hygiene, ensuring that toys, bedding, and learning materials are cleaned and disinfected regularly to minimize the spread of *E. vermicularis* eggs.

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