



Prevalence and Factors Associated with *Enterobius vermicularis* Infection among Preschool Children in Cu Sue Commune, Dak Lak Province, Vietnam

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Abstract

Objective: This study aimed to estimate the prevalence of *Enterobius vermicularis* infection and identify factors associated with enterobiasis among preschool children attending Cu Sue Preschool, Cu M'gar District, Dak Lak Province, Vietnam.

Materials and Methods: A cross-sectional study was conducted among 392 preschool children enrolled at Cu Sue Preschool between January and October 2021. *Enterobius vermicularis* infection was diagnosed using the Graham adhesive tape technique. Caregivers were interviewed face-to-face using a structured questionnaire to obtain information on sociodemographic characteristics and their knowledge and practices related to the prevention of enterobiasis. Data were analyzed using Stata version 10.0. Associations between potential risk factors and enterobiasis were assessed using Odds ratios (ORs) and 95% confidence intervals (95% CIs) were calculated. Statistical significance was established at $p < 0.05$.

Results: The overall prevalence of *E. vermicularis* infection was 19.9% (78/392). Enterobiasis was significantly associated with several child hygiene behaviors, including mouthing toys, finger-sucking, and failure to wash hands before meals, after defecation, and after playing. Significant caregiver-related factors included failure to clean the child's perianal region in the morning, infrequent cleaning of toys, and irregular fingernail trimming. Furthermore, inadequate caregiver knowledge regarding the transmission, health consequences, and prevention of *E. vermicularis* infection was significantly associated with infection among preschool children ($p < 0.05$).

Conclusions: The prevalence of *E. vermicularis* infection among preschool children at Cu Sue Preschool remained substantial. Poor personal hygiene practices among children and inadequate caregiver hygiene practices were identified as the principal factors associated with infection. Targeted health education interventions, improved personal and environmental hygiene, and routine deworming programs should be strengthened to reduce the burden of enterobiasis among preschool children in this setting.

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Keywords: *Enterobius vermicularis*, enterobiasis, preschool children, associated factors, Graham adhesive tape technique, Vietnam

Introduction

Enterobius vermicularis infection (enterobiasis) is one of the most common intestinal parasitic infections affecting children worldwide, particularly those of preschool age. Because of its direct life cycle, which does not require an intermediate host, and its primary transmission through the fecal–oral route via hand-to-mouth contact following perianal contamination, the infection spreads readily in childcare settings such as daycare centers and preschools. *E. vermicularis* eggs can contaminate clothing,

bedding, toys, and other fomites, facilitating both person-to-person transmission and repeated autoinfection. Persistent enterobiasis may cause perianal pruritus, sleep disturbances, loss of appetite, impaired physical growth, and reduced quality of life in affected children ^[1, 2].

In Vietnam, enterobiasis remains an important public health concern. Reported prevalence rates range from 18.5% to 47.0%, with preschool-aged children representing the population at greatest risk. The occurrence of infection is influenced by environmental sanitation, household hygiene conditions, and the personal hygiene practices of both children and their caregivers. Previous studies have consistently shown that children attending childcare facilities are at a higher risk of infection than those primarily cared for at home ^[1, 2].

In Dak Lak Province, despite the implementation of several national helminth control programs, enterobiasis remains prevalent among preschool children. Previous studies conducted in the province have reported prevalence rates ranging from 19.1% to 80.24%. Infection has been associated with household socioeconomic status, ethnicity, and hygiene-related behaviors of both children and their caregivers ^[3].

Cu Sue Commune, located in Cu M'gar District, is home to a large ethnic minority population. Although living conditions and environmental sanitation have improved in recent years, socioeconomic challenges remain, and awareness of personal hygiene and parasitic disease prevention is still limited. To date, no published study has investigated the epidemiology of *E. vermicularis* infection among preschool children in this community. Therefore, the present study was conducted to determine the prevalence of *E. vermicularis* infection and identify factors associated with enterobiasis among preschool children in Cu Sue Commune, Dak Lak Province, Vietnam. The findings may provide evidence to support the development of locally appropriate prevention and control strategies.

Materials and Methods

Study Population

The study population comprised preschool children enrolled at Cu Sue Preschool, Cu M'gar District, Dak Lak Province, Vietnam, and their primary caregivers.

Inclusion criteria were: (1) children enrolled at Cu Sue Preschool during the study period; (2) written informed consent obtained from parents or primary caregivers for participation in the interview and specimen collection; and (3) children whose parents or caregivers provided written informed consent at the time of data collection.

Exclusion criteria included: (1) incomplete interview

responses; (2) receipt of an anthelmintic drug within the previous two months; and (3) children who had defecated or bathed, including perianal cleansing, before specimen collection.

Study Setting and Period

This study was conducted between January and October 2021 at Cu Sue Preschool, Cu M'gar District, Dak Lak Province, Vietnam.

Study Design and Sampling

A descriptive cross-sectional study with an analytical component was conducted. All eligible preschool children attending Cu Sue Preschool during the study period were invited to participate (total population sampling).

Data Collection

Information on sociodemographic characteristics and caregivers' knowledge and practices regarding the prevention of enterobiasis was collected through face-to-face interviews using a standardized structured questionnaire.

The presence of *Enterobius vermicularis* infection was determined using the Graham adhesive tape technique. Specimens were collected in the early morning before defecation or bathing. A strip of transparent cellulose adhesive tape was firmly applied to the perianal region and then mounted onto a clean glass microscope slide. The slides were transported to the laboratory and examined under light microscopy for the detection of *E. vermicularis* eggs.

Statistical Analysis

Data were entered using EpiData software and analyzed using Stata version 10.0 (StataCorp, College Station, TX, USA). Categorical variables were summarized as frequencies and percentages. Associations between *E. vermicularis* infection and potential risk factors were assessed using odds ratios (ORs) with 95% confidence intervals (95% CIs). Pearson's chi-square test was used to compare proportions. A two-sided *p* value of < 0.05 was considered statistically significant.

Ethical Considerations

The study protocol was reviewed and approved by the Institutional Review Board (IRB) of Tay Nguyen University before study initiation. Written informed consent was obtained from the parents or legal guardians of all participating children after they had received a detailed explanation of the study objectives and procedures. All personal information was kept confidential and used exclusively for research purposes.

Results

Prevalence of *Enterobius vermicularis* Infection

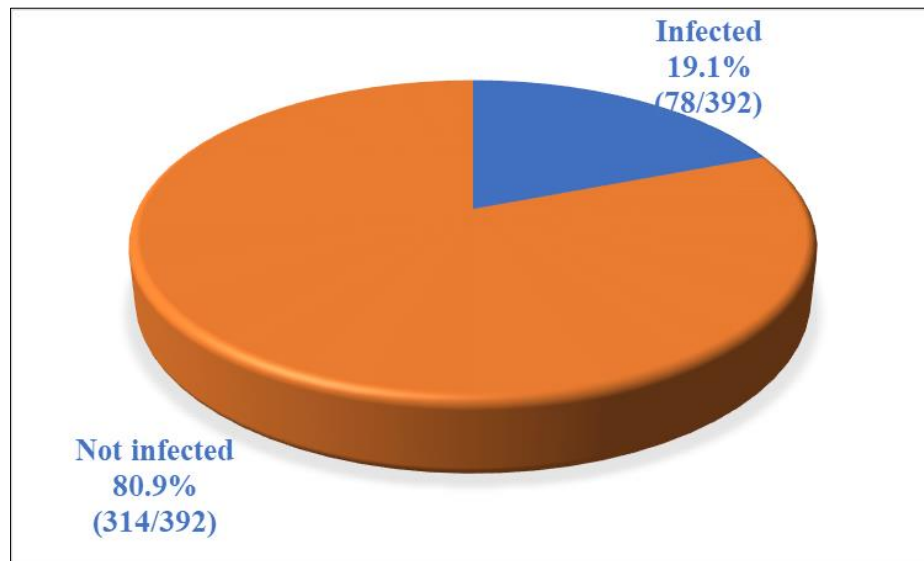


Fig 1: Overall prevalence of *Enterobius vermicularis* infection among preschool children.

The overall prevalence of *Enterobius vermicularis* infection among preschool children was 19.9% (78/392).

Table 1. Sociodemographic characteristics of the study participants.

Table 1: Sociodemographic characteristics of the study participants (N = 392).

Characteristic	Category	n
Sex	Male	204
	Female	188
Ethnicity	Kinh	168
	Ede	224
Preschool grade	Nursery	51
	Kindergarten 1	89
	Kindergarten 2	115
	Kindergarten 3	137
School campus	Main campus	179
	Satellite campuses	213
Relationship of caregiver to child	Biological mother	329
	Other caregiver	63
Caregiver age (years)	>30	123
	≤30	269
Caregiver occupation	Farmer	278
	Other occupations	114
Caregiver education	<Upper secondary school	108
	≥Upper secondary school	284

A total of 392 preschool children were included in the study. The study population consisted of children from two ethnic groups, Kinh (42.9%) and Ede (57.1%). Boys accounted for 52.0% of participants, while girls represented 48.0%. Children from all preschool grades were enrolled, including nursery (13.0%), kindergarten level 1 (22.7%), kindergarten

level 2 (29.3%), and kindergarten level 3 (34.9%). Overall, 45.7% of children attended the main campus, whereas 54.3% attended satellite campuses.

Most caregivers were biological mothers (83.9%), were aged ≤30 years (68.6%), had completed at least upper secondary education (72.4%), and were engaged in farming (70.9%).

Association Between Caregivers' Knowledge and *Enterobius vermicularis* Infection

Table 2: Association between caregivers' knowledge and *Enterobius vermicularis* infection among preschool children.

Caregivers' knowledge		(N=392)		OR (95% CI)	P value
		Infected n (%)	Not infected n (%)		
Transmission routes	Incorrect	37 (25.7)	107 (74.3)	1.55 1.05 – 2.31	0.03
	Correct	41 (16.5)	207 (83.5)		
Health consequences	Incorrect	35 (24.8)	106 (75.2)	1.45 (0.97- 2.15)	0.07
	Correct	43 (17.1)	208 (82.9)		
Preventive measures	Incorrect	45 (24.9)	136 (75.1)	1.59 (1.06 – 2.37)	0.02
	Correct	33 (15.6)	178 (84.4)		

Children whose caregivers had incorrect knowledge regarding the transmission routes of *E. vermicularis* were more likely to be infected than those whose caregivers had correct knowledge (OR = 1.55, 95% CI: 1.05–2.31, $p = 0.03$). Similarly, inadequate knowledge of preventive measures was

significantly associated with infection (OR = 1.59, 95% CI: 1.06–2.37, $p = 0.02$). In contrast, caregivers' knowledge of the health consequences of enterobiasis was not significantly associated with infection among children (OR = 1.45, 95% CI: 0.97–2.15, $p = 0.07$).

Table 3: Association between children's hygiene-related behaviors and *Enterobius vermicularis* infection.

Children's hygiene-related behaviors		(N=392)		OR (95% CI)	P value
		Infected, n (%)	Not infected, n (%)		
Mouthing toys	Yes	40 (25.5)	117 (74.5)	1.58 1.06- 2.34	0.02
	No	38 (16.2)	197 (83.8)		
Finger-sucking	Yes	44 (26.0)	125 (74.0)	1.71 1.4 – 2.55	0.01
	No	34 (15.2)	189 (84.8)		

Children who habitually mouthed toys had a significantly higher likelihood of *E. vermicularis* infection than those without this behavior (OR = 1.58, 95% CI: 1.06–2.34, $p =$

0.02). Likewise, finger-sucking was significantly associated with infection (OR = 1.71, 95% CI: 1.14–2.55, $p = 0.01$).

Table 4: Association between caregivers' hygiene practices and *Enterobius vermicularis* infection among preschool children.

Caregivers' hygiene practices		(N=392)		(N=392)	P value
		Infected, n (%)	Not infected, n (%)		
Handwashing before meals	No	59 (23.2)	195 (76.8)	1.43 0.91 – 2.24	0.11
	Yes	19 (13.8)	119 (86.2)		
Handwashing after playing	No	32 (26.7)	88 (73.3)	1.57 1.06 – 2.34	0.02
	Yes	46 (16.9)	226 (83.1)		
Morning perianal cleansing	No	51 (24.9)	154 (75.1)	1.72 1.13 – 2.62	0.009
	Yes	27 (14.4)	160 (85.6)		
Toy cleaning frequency	Infrequent (>2 weeks)	64 (22.5)	220 (77.5)	1.74 1.02 – 2.96	0.03
	Regular (≤2 weeks)	14 (13.0)	94 (87.0)		
Fingernail trimming frequency	Infrequent (>2 weeks)	46 (25.4)	135 (74.6)	1.67 1.12 – 2.51	0.01
	Regular (≤2 weeks)	32 (15.2)	179 (84.8)		

Several caregiver hygiene practices were significantly associated with *E. vermicularis* infection. Children whose caregivers did not encourage or assist handwashing after playing had a higher risk of infection than those who did (OR = 1.57, 95% CI: 1.06–2.34, $p = 0.02$). Failure to clean the child's perianal region in the morning was also associated with an increased risk of infection (OR = 1.72, 95% CI: 1.13–2.62, $p = 0.009$). Infrequent cleaning of toys (>2 weeks between cleanings) was significantly associated with infection (OR = 1.74, 95% CI: 1.02–2.96, $p = 0.03$), as was infrequent fingernail trimming (>2 weeks between trimmings) (OR = 1.67, 95% CI: 1.12–2.51, $p = 0.01$). In contrast, handwashing before meals was not significantly associated with *E. vermicularis* infection (OR = 1.43, 95% CI: 0.91–2.24, $p = 0.11$).

Discussion

Characteristics of the Study Population and Prevalence of *Enterobius vermicularis* Infection

This study included 392 preschool children attending Cu Sue Preschool in Cu M'gar District, Dak Lak Province, Vietnam. The majority of participants belonged to the Ede ethnic group (57.1%), while Kinh children accounted for 42.9%. The sex distribution was balanced, and most caregivers were biological mothers (83.9%), had completed at least upper secondary education (72.4%), and were engaged in farming (70.9%). These findings reflect the demographic and socioeconomic characteristics of the study area.

The overall prevalence of *E. vermicularis* infection was 19.9%. This prevalence is comparable to that reported by Phan Van Trong and Dang Dinh Thanh among preschool children in Krong Ana District, Dak Lak Province (19.1%)

[3], but considerably lower than those reported in previous studies conducted in Dak Lak (37.2%–80.2%) [4, 5] and in other regions of Vietnam, including Nam Dinh (35.2%) [6], Thai Binh (37.7%–54.7%) [7], and Ho Chi Minh City (30.7%) [8].

The relatively lower prevalence observed in the present study may be attributable to the implementation of the national deworming program, under which preschool children have received anthelmintic treatment every six months since 2008, together with improvements in socioeconomic conditions, environmental sanitation, and public awareness of intestinal helminth prevention. Nevertheless, the prevalence of 19.9% indicates that enterobiasis remains a significant public health concern in this community. Therefore, regular deworming should be complemented by health education, improved personal hygiene, and enhanced environmental sanitation to reduce transmission and prevent reinfection.

Factors Associated with *Enterobius vermicularis* Infection

Caregivers' knowledge regarding the transmission routes and preventive measures of enterobiasis was significantly associated with *E. vermicularis* infection among preschool children. Children whose caregivers had incorrect knowledge of transmission routes and preventive measures had 1.55-fold and 1.59-fold higher odds of infection, respectively, than those whose caregivers had correct knowledge ($p < 0.05$). In contrast, caregivers' knowledge of the health consequences of enterobiasis was not significantly associated with infection ($p > 0.05$). These findings are consistent with those reported by Vu Van Thai in Hai Phong, who demonstrated that inadequate caregiver knowledge of transmission routes increased the risk of enterobiasis among children [9]. These results highlight the importance of caregiver education as a key component of enterobiasis control programs.

Behavioral factors among children also played an important role in infection risk. Children who habitually mouthed toys or sucked their fingers had significantly higher odds of *E. vermicularis* infection (OR = 1.58 and 1.71, respectively; $p < 0.05$). These common behaviors facilitate the hand-to-mouth transmission of infective eggs and have been consistently identified as risk factors in previous studies conducted in Dak Lak [3] and Hai Phong [9].

Several caregiver hygiene practices were significantly associated with enterobiasis. Children whose caregivers did not ensure handwashing after playing, failed to perform morning perianal cleansing, cleaned toys infrequently, or trimmed fingernails irregularly were at significantly higher risk of infection than those receiving appropriate hygiene care (all $p < 0.05$). By contrast, handwashing before meals was not significantly associated with infection ($p = 0.11$), possibly because hand hygiene before meals is routinely supervised in preschool settings. These findings are consistent with previous studies conducted in Dak Lak [3], Hai Phong [9], and Thai Binh [7].

Overall, the present findings emphasize that caregiver knowledge and appropriate hygiene practices are critical determinants of *E. vermicularis* infection among preschool children.

In addition to maintaining routine deworming programs, health education interventions targeting caregivers should be strengthened to improve awareness of transmission routes, promote appropriate hygiene practices, and reduce the risk of reinfection.

Conclusions

Among 392 preschool children enrolled in Cu Sue Preschool, Cu M'gar District, Dak Lak Province, Vietnam, the prevalence of *Enterobius vermicularis* infection was 19.9%. No significant differences in infection prevalence were observed according to sex, preschool grade, school campus, caregiver relationship, or caregiver age ($p > 0.05$). However, infection was more common among Ede children and among those whose caregivers had lower educational attainment or were engaged in farming.

Incorrect caregiver knowledge regarding the transmission routes and preventive measures of enterobiasis was significantly associated with an increased risk of *E. vermicularis* infection, whereas knowledge of the health consequences of the disease was not.

Behavioral and hygiene-related factors, including mouthing toys, finger-sucking, lack of handwashing after playing, absence of morning perianal cleansing, infrequent toy cleaning, and irregular fingernail trimming, were significantly associated with *E. vermicularis* infection ($p < 0.05$). These findings underscore the importance of strengthening caregiver health education and reinforcing personal and environmental hygiene practices alongside routine deworming to reduce the burden of enterobiasis among preschool children.

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