

Current Status and Epidemiological Characteristics of Soil-Transmitted Helminth Infections in Ea Ngai Commune, Krong Buk District, Dak Lak Province, Vietnam

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Abstract: Objective: To determine the current status and describe the epidemiological characteristics of soil-transmitted helminth infections among residents in Ea Ngai Commune, Krong Buk District, Dak Lak Province, Vietnam. Materials and Methods: A cross-sectional study was conducted from April to October 2024 on 352 individuals from 132 households selected using a systematic random sampling method. Results: The overall prevalence of soil-transmitted helminth infections at the study site was 27.84%. The prevalence rates of hookworm infection, ascariasis, and trichuriasis were 26.99%, 5.97%, and 1.70%, respectively. Most infections were of light intensity, and single infections accounted for the majority of cases (75.51% of infected individuals). Epidemiological analysis showed that the prevalence among ethnic minority groups (46.79%) was 2.42 times higher than that among the Kinh population (19.34%) ($p < 0.01$). Farmers had the highest infection rate (37.26%), and individuals older than 15 years exhibited a significantly higher prevalence compared with those under 15 years of age ($p < 0.05$). Conclusion: Soil-transmitted helminth infections in Ea Ngai Commune remain a public health concern, particularly hookworm infections. Strengthening health education and communication, improving environmental sanitation, and implementing periodic deworming programs for the community are necessary.

Keywords: Soil-transmitted helminths, hookworm, epidemiology, Dak Lak.

INTRODUCTION

Soil-transmitted helminthiasis is one of the most common parasitic diseases in tropical and subtropical countries, particularly in areas with poor environmental sanitation. The major soil-transmitted helminths include *Ascaris lumbricoides*, *Trichuris trichiura*, and hookworms, including *Ancylostoma duodenale* and *Necator americanus*. According to the World Health Organization, approximately 1.5 billion people worldwide are infected with soil-transmitted helminths, mainly in developing countries [World Health Organization, 2020]. Soil-transmitted helminth infections can lead to various adverse health effects, including anemia, malnutrition, reduced work capacity, and impaired physical and cognitive development [Mai, T. X. *et al.*, 2015].

Vietnam has a hot and humid tropical climate that favors the survival and development of soil-transmitted helminths. Although community-based deworming programs have been implemented, these infections remain prevalent in many rural and mountainous areas [Kim, H. T. *et al.*, 1998]. In Dak Lak Province, recent studies have reported relatively high prevalence rates of soil-transmitted helminth infections, ranging from 29.11% to 37.7%, with hookworm infections being predominant [Trinh, H. V. N. T. *et al.*, 2019].

Ea Ngai Commune, Krong Buk District, Dak Lak Province, is an area with favorable conditions for the transmission of soil-transmitted helminths, including a hot and humid climate, an agriculture-based population, and limited environmental sanitation. However, data regarding the current status of soil-transmitted helminth infections in this locality remain limited. Therefore, the present study entitled “Current Status and Epidemiological Characteristics of Soil-Transmitted Helminth Infections in Ea Ngai Commune, Krong Buk District, Dak Lak Province, Vietnam, 2024” was conducted to provide additional scientific evidence for local disease prevention and control programs.

MATERIALS AND METHODS

Study Population

The study population consisted of residents living in Ea Ngai Commune, Krong Buk District, Dak Lak Province, Vietnam, during the study period.

Inclusion Criteria

- Individuals who had been residing in the locality for at least 6 months.
- Individuals who agreed to participate in the study and provide stool samples for examination.

Exclusion Criteria

- Individuals receiving treatment for severe acute illnesses at the time of the survey.

- Individuals who had taken anthelmintic drugs within 3 months prior to the study.
- Individuals who failed to provide sufficient information or did not submit stool samples for examination.

Study Site and Duration

- Study site: The study was conducted in Ea Ngai Commune, Krong Buk District, Dak Lak Province, Vietnam.
- Study period: From April 2024 to October 2024.

Study Methods

- Study design: Cross-sectional descriptive study.
- Sample size: The sample size was calculated using the following formula:

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

Where:

n: Minimum sample size required to estimate the prevalence of common soil-transmitted helminth infections.

α: Type I error probability; α = 0.05 was selected, corresponding to $Z_{(1-\alpha/2)} = 1,96$.

p: Expected prevalence of soil-transmitted helminth infections; p = 28,43% based on the study by Duong Hoai Nam in 2022.

d: Desired precision (allowable error), set at d = 0,05

Substituting these values into the formula yielded a minimum sample size of 313 individuals. Assuming an exclusion/dropout rate of 12.5%, the estimated number of additional participants required was: $313 \times 12,5\% = 39$ individuals.

Therefore, the final required sample size was: $313 + 39 = 352$ individuals.

Sampling technique: Systematic random sampling was applied.

Sampling frame: List of households in Ea Ngai Commune (1,460 households).

Sampling unit: Household.

Observation unit: Individuals within the selected households.

With a sample size of 352 individuals, approximately 132 households were estimated to be included. The sampling interval *K* was calculated as follows:

$$K = \frac{1460 \text{ households}}{132 \text{ households}} = 11$$

- One household (*i*) was randomly selected from the first 11 households in the list (household number 8 was selected).

- The subsequent households selected for the study had the following sequence numbers in the sampling list: $[8 + 11]$, $[8 + 2 \times 11]$, $[8 + 3 \times 11]$, ... $[8 + 131 \times 11]$.

- At each selected household, four household members were recruited for stool examination.

Laboratory Techniques and Study Variables

- Sample collection: Participants were provided with clean containers and instructed to collect approximately 5 g of stool specimen without soil or sand contamination.

- Diagnostic technique: Stool samples were examined using the Kato–Katz technique according to the protocol recommended by the World Health Organization. Stool specimens were measured using a standard 50 mg template and clarified with cellophane soaked in glycerin and malachite green solution.

- Assessment of infection intensity: The number of helminth eggs counted on each smear was multiplied by a factor of 20 to estimate the number of eggs per gram of feces (EPG).

- Classification of infection intensity: According to WHO criteria, infection intensity was classified as light when EPG ranged from 1–1,999, moderate from 2,000–3,999, and heavy when EPG was $\geq 4,000$.

Data Processing and Statistical Analysis

Data were managed and analyzed using SPSS version 16.0. Statistical analyses included calculation of percentages (%), mean values, comparison of proportions using appropriate statistical tests, and estimation of prevalence ratios (PRs) with 95% confidence intervals (95% CI). Statistical significance was considered at $p < 0.05$.

Ethical Considerations

The study complied with the principles of medical research ethics. Participants were informed about the objectives and requirements of the study and voluntarily agreed to participate. All personal information was kept confidential and used solely for research purposes and community health care improvement.

RESULTS

Prevalence and Intensity of Soil-Transmitted Helminth Infections in the Community

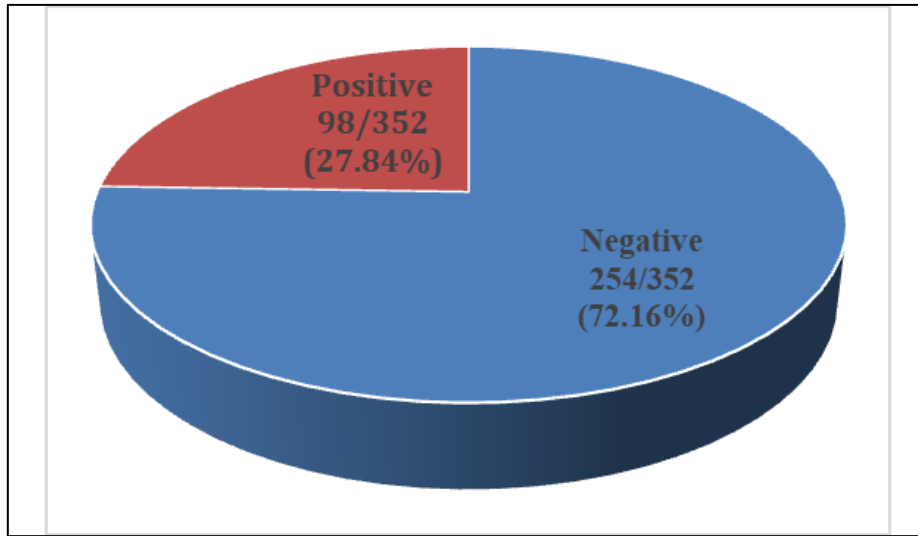


Figure 1: Prevalence of Soil-Transmitted Helminth Infections at the Study Site

The results showed that the prevalence of soil-transmitted helminth infections at the study site was 27.84% (98/352 individuals).

Table 1: Prevalence of Common Soil-Transmitted Helminth Species

Helminth Species	Frequency	Percentage (%)
Ascariasis	21	5.97
Trichuriasis	6	1.70
Hookworm infection	95	26.99

The results in Table 1 show that among the common soil-transmitted helminths, hookworm infection had the highest prevalence (26.99%), followed by ascariasis (5.97%), while trichuriasis had the lowest prevalence (1.70%).

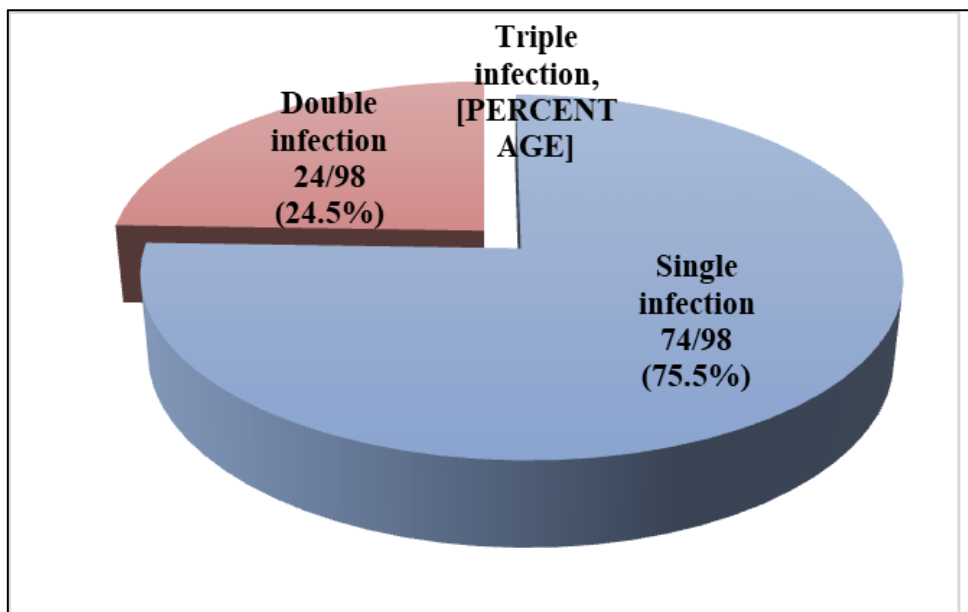


Figure 2: Proportions of Single and Multiple Soil-Transmitted Helminth Infections Among Infected Individuals

The results presented in Figure 2 show that among the 98 individuals infected with soil-transmitted helminths, 75.5% had single-species infections.

Table 2: Intensity of Common Soil-Transmitted Helminth Infections in the Community

Helminth Species	Infection Intensity (eggs/gram of feces)
Ascariasis	36.40
Trichuriasis	12.20
Hookworm infection	73.97

The results in Table 2 indicate that the infection intensity of all soil-transmitted helminths was classified as light according to WHO criteria. Hookworm infection showed the highest infection intensity, with 73.97 eggs per gram of feces.

Table 3: Infection Intensity of Each Helminth Species According to Population Characteristics at the Study Site

Characteristics		Infection Intensity (eggs/gram of feces)		
		Ascariasis	Trichuriasis	Hookworm infection
Sex	Male	21.88	17.51	78.85
	Female	49.97	5.14	68.75
Ethnicity	Kinh	21.92	1.58	49.58
	Ethnic minorities	68.69	3.88	128.36
Occupation	Farmers	54.00	8.00	103.05
	Students	3.55	13.03	26.37
	Other occupations	22.65	23.97	42.42
Age group	< 15 years	0.0	8.61	28.92
	15 - 29 years	38.45	4.36	81.81
	30 - 59 years	55.68	4.64	96.00
	≥ 60 years	30.00	70.66	60.66

The results showed that the intensity of hookworm infection was generally higher than that of ascariasis and trichuriasis across most study groups. Females had a higher intensity of ascariasis than males, whereas males exhibited higher intensities of trichuriasis and hookworm infection. Ethnic minority participants had higher infection intensities for all three helminth species compared with the Kinh population, particularly for hookworm infection.

Regarding occupation, farmers had the highest infection intensities of ascariasis and hookworm infection. By age group, individuals aged 30–59 years showed the highest intensities of ascariasis and hookworm infection, while the ≥60-year age group had the highest intensity of trichuriasis.

Prevalence of Soil-Transmitted Helminth Infections According to Epidemiological Characteristics at the Study Site.

Table 4. Prevalence of Soil-Transmitted Helminth Infections According to Epidemiological Characteristics at the Study Site

Characteristics		Soil-transmitted helminth infections (n = 352)				OR (CI 95%)	Giá trị p
		Positive		Negative			
		n	%	n	%		
Sex	Male	54	29.7	128	70.3	1.2 (0.76-1.93)	0.45
	Female	44	25.9	126	74.1		
Ethnicity	Kinh	51	46.8	58	53.2	3.6 (2.24-6.00)	<0.001
	Ethnic minorities	47	19.3	196	80.7		
Occupation	Students	9	11.1	72	88.9	tham chiếu	
	Other occupations	13	19.4	54	80.6	1.75 (0.79-3.83)	0.16
	Farmers	76	37.3	128	62.7	3.35 (1.77-6.36)	<0.001
Age group	< 15 years	9	11.5	69	88.5	tham chiếu	
	15 - 29 years	26	29.6	62	70.4	2.56 (1.28-5.13)	<0.001
	30 - 59 years	53	35.3	97	64.7	3.06 (1.59-5.87)	<0.001
	≥ 60 years	10	27.8	26	72.2	2.40 (1.07-5.41)	0.03

The results in Table 4 indicate that there was no statistically significant difference in the prevalence of soil-transmitted helminth infections between males (29.7%) and females (25.9%) ($p = 0.45$).

By ethnicity, the prevalence among ethnic minority groups (46.8%) was 3.6 times higher than that among the Kinh population (19.3%), and the difference was statistically significant ($p < 0.001$).

Farmers had the highest prevalence of infection (37.3%), which was 3.35 times higher than that among students ($p < 0.001$). The prevalence among individuals with other occupations (19.4%) was 1.75 times higher than that among students; however, this difference was not statistically significant ($p = 0.16$).

The prevalence of infection increased with age. Compared with the <15 years age group, the prevalence was 2.56, 3.06, and 2.40 times higher in the 15–29 years, 30–59 years, and ≥ 60 years age groups, respectively. All differences were statistically significant ($p < 0.05$).

DISCUSSION

Prevalence and Intensity of Soil-Transmitted Helminth Infections at the Study Site

The stool examination results using the Kato–Katz technique in 352 study participants showed that the prevalence of soil-transmitted helminth infections was 27.84%. Among the detected helminth species, hookworm infection had the highest prevalence (26.99%), followed by ascariasis (5.97%) and trichuriasis (1.70%).

Comparison with previous studies revealed that the prevalence observed in the present study was considerably lower than that reported by Dinh Thi Thanh Mai in Hai Phong [Mai, D. T. T. 2017] and Nguyen Xuan Thao in Dak Lak [Thao, N. X. *et al.*, 2015]. This difference may be associated with improvements in socioeconomic conditions, environmental sanitation, and the effectiveness of periodic community-based deworming programs in recent years. Notably, the survey was conducted approximately six months after the most recent community deworming campaign, which may have contributed to the reduced prevalence recorded in this study.

However, the distribution pattern of helminth species in the present study remained similar to findings from studies conducted in the Central Highlands and Dak Lak Province [Thao, N. X. *et al.*, 2015], in which hookworm infection

predominated, whereas ascariasis and trichuriasis showed lower prevalence rates. This finding suggests that the natural environment, climatic conditions, and living habits in the area continue to favor the development and transmission of hookworms.

Our findings are also consistent with recent studies conducted in the Central Highlands, such as the study by Ho Vi Nu Thuc Trinh in Dak Lak [Trinh, H. V. N. T. *et al.*, 2019], indicating that although the prevalence of soil-transmitted helminth infections has shown a decreasing trend, hookworm infection remains the predominant helminth species within the community.

Among the 352 examined individuals, 21.02% were infected with a single helminth species and 6.82% were infected with two helminth species simultaneously; no cases of triple infection were detected. Among positive cases, single infections accounted for the majority (75.51%), whereas multiple infections accounted for 24.48%. These findings suggest that polyparasitism is currently less common than in previous years, possibly due to the effectiveness of community intervention measures and periodic deworming programs, which reduce both the parasite burden and the simultaneous transmission of multiple helminth species.

Regarding infection intensity, all detected infections were classified as light according to World Health Organization criteria [Vietnam Ministry of Health, 1998]. Hookworm infection had the highest mean infection intensity (73.97 eggs per gram of feces), followed by ascariasis (36.40 eggs/gram) and trichuriasis (12.20 eggs/gram). Higher infection intensities were observed among males, ethnic minority populations, farmers, and working-age adults, particularly for hookworm infection and ascariasis. These findings may be associated with occupational exposure to contaminated soil, barefoot walking habits, and limited sanitation conditions. In contrast, trichuriasis intensity was higher among individuals aged ≥ 60 years, possibly due to cumulative long-term exposure and inadequate personal hygiene practices. Nevertheless, all study groups exhibited only light infection intensity, which is consistent with the current declining trend in infection intensity within the community and similar to the findings reported by Y Wem and colleagues (2016) [Wem, Y. *et al.*, 2016].

Prevalence of Soil-Transmitted Helminth Infections According to Epidemiological Characteristics at the Study Site

The study results showed no statistically significant difference in the prevalence of soil-transmitted helminth infections between males and females ($p > 0.05$). This finding is consistent with the study conducted by Dinh Thi Thanh Mai in Hai Phong [Mai, D. T. T. 2017]. This suggests that sex may no longer be a major risk factor for soil-transmitted helminth infections in the current context, where living conditions and exposure patterns between males and females are not markedly different.

According to ethnicity, the prevalence of soil-transmitted helminth infections among ethnic minority groups was significantly higher than that among the Kinh population (46.79% vs. 20.47%), with a statistically significant difference ($p < 0.01$). This result is consistent with the findings of Dinh Thi Thanh Mai [Mai, D. T. T. 2017]. The higher prevalence among ethnic minorities may be associated with poorer socioeconomic conditions, inadequate environmental sanitation, and occupational and daily-life practices involving frequent contact with contaminated soil.

Regarding occupation, farmers had a prevalence of infection 3.35 times higher than that of students ($p < 0.05$). This finding is consistent with several studies conducted in Dak Lak Province [Trinh, H. V. N. T. et al., 2019; Wem, Y. et al., 2016]. The increased prevalence among farmers may be explained by frequent soil exposure, working in humid environments, and barefoot walking habits, which facilitate hookworm transmission. In contrast, students showed a lower prevalence, likely due to improved hygiene supervision and participation in periodic school-based deworming programs.

According to age group, the prevalence of soil-transmitted helminth infections was lowest in the 2–14-year age group (11.54%), whereas the prevalence in the 15–29-year, 30–59-year, and ≥ 60 -year age groups was 2.56, 3.06, and 2.40 times higher, respectively. These findings are similar to those reported by Dinh Thi Thanh Mai [Mai, D. T. T. 2017] and Y Wem [Wem, Y. et al., 2016]. This difference may be related to occupational activities and prolonged exposure to contaminated soil among adults, particularly in agricultural work. Additionally, children are currently more likely to benefit from regular

hygiene management and periodic school-based deworming programs, resulting in a lower risk of infection.

CONCLUSION

The prevalence of soil-transmitted helminth infections was 27.84%, with hookworm infection being predominant (26.99%), followed by ascariasis (5.97%) and trichuriasis (1.70%).

Single-species infection was the most common pattern, accounting for 21.02% of cases, whereas double infections accounted for 6.82%. No cases of triple infection were detected.

The infection intensities of all soil-transmitted helminths across different age groups, occupational groups, and ethnic groups were classified as light according to WHO criteria. The infection intensities of trichuriasis and hookworm infection were higher in males than in females, whereas ascariasis intensity was higher in females; however, all remained within the light infection category.

Several baseline factors were associated with soil-transmitted helminth infections, including age > 15 years, farming occupation, and belonging to an ethnic minority group.

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