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Factors Associated with Soil-Transmitted Helminth Infections among Residents of Ea Ngai Commune, Krong Buk District, Dak Lak Province, Vietnam

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Abstract: **Background:** Soil-transmitted helminth (STH) infections remain a significant public health concern in many localities of the Central Highlands of Vietnam, particularly in rural areas and among ethnic minority populations. Identifying factors associated with STH infections is essential for developing appropriate intervention strategies. **Objective:** To identify factors associated with soil-transmitted helminth infections among residents Ea Ngai Commune, Krong Buk District, Dak Lak Province, Vietnam, in 2024. **Materials and Methods:** A cross-sectional study was conducted among 352 residents of Ea Ngai Commune, Krong Buk District, Dak Lak Province, Vietnam from April to October 2024. Stool samples were examined using the Kato–Katz technique to determine the prevalence of soil-transmitted helminth infections. Data on knowledge, attitudes, and practices (KAP) regarding STH prevention, as well as environmental sanitation factors, were collected through face-to-face interviews using a structured questionnaire. **Results:** The use of unhygienic latrines, open defecation, frequent soil contact, and the absence of deworming within the previous six months were significantly associated with soil-transmitted helminth infections. **Conclusions:** Strengthening health education and communication activities, improving environmental sanitation, promoting the use of sanitary latrines, and implementing regular deworming programs are necessary to reduce the risk of soil-transmitted helminth infections in the community.

Keywords: Soil-transmitted helminths, associated factors, Ea Ngai, Dak Lak Province, Vietnam.

INTRODUCTION

Soil-transmitted helminth (STH) infections are among the most common parasitic diseases in many developing countries, particularly in tropical and subtropical regions where environmental sanitation remains inadequate. The major causative species include the roundworm *Ascaris lumbricoides*, the whipworm *Trichuris trichiura*, and hookworms (*Ancylostoma duodenale* and *Necator americanus*). STH infections can lead to a wide range of adverse health consequences, including anemia, malnutrition, reduced work capacity, and impaired physical and cognitive development, thereby imposing a substantial public health burden on affected communities [Hong, T. T. *et al*., 2017].

In Vietnam, despite the widespread implementation of helminth control programs and the significant progress achieved in reducing the burden of parasitic diseases, STH infections remain prevalent in several regions, particularly in the Central Highlands, where environmental conditions and local lifestyles continue to facilitate transmission [Chuong, N. V. *et al*., 2007]. Dak Lak Province is characterized by a high proportion of agricultural workers, a warm and humid climate, and a large population of ethnic minority groups, all of which have been identified as factors associated with an increased risk of STH infection. Previous studies conducted in the province have reported a considerable prevalence of STH infections and have demonstrated associations with occupation, educational level, environmental sanitation, and preventive health practices [Thuy, B. C. A. 2019].

A growing body of evidence indicates that the distribution of STH infections is influenced by complex interactions among environmental, socioeconomic, and behavioral factors [Trinh, Ho Vi Nu T. *et al*., 2019]. Identifying factors associated with infection in specific local settings is essential for designing and implementing targeted intervention strategies, thereby enhancing the effectiveness of community-based control programs.

Ea Ngai Commune, located in Krong Buk District, Dak Lak Province, is an agricultural community where a large proportion of residents are engaged in farming activities. Environmental sanitation conditions and preventive practices vary among population groups, potentially affecting the transmission of STH infections. However, information regarding factors associated with STH infections in this community remains limited. Therefore, this study was conducted to identify factors associated with soil-transmitted helminth infections among residents of Ea Ngai Commune,

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Krong Buk District, Dak Lak Province, Vietnam. The findings are expected to provide scientific evidence for the development of locally appropriate control and prevention measures.

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:

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

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 [5].

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 ×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 + 2×11], [8 + 3×11],...[8 + 131×11].
- At each selected household, four household members were recruited for stool examination.

Laboratory Techniques

- 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.

Knowledge, Attitudes, and Practices (KAP) Survey

The Knowledge, Attitudes, and Practices (KAP) questionnaire was developed based on the study objectives and relevant guidelines and reference materials from the World Health Organization (WHO), the National Institute of Malariology, Parasitology and Entomology (NIMPE), the Quy Nhon Institute of Malariology, Parasitology and Entomology (IMPE Quy Nhon), and the Department of Parasitology, School of Medicine and Pharmacy, Tay Nguyen University. The questionnaire consisted of both closed-ended and open-ended questions and was designed to be concise, easy to understand, and appropriate for the characteristics of the study population.

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Prior to the main survey, the questionnaire was pilot-tested through face-to-face interviews with 10 community residents who had characteristics similar to those of the target study population. The pilot study was conducted to assess the clarity, comprehensibility, and feasibility of data collection. Based on the pilot results, the questionnaire was revised, finalized, and subsequently used consistently throughout the formal survey.

Data collection was conducted through direct face-to-face interviews with participants aged 15 years and older using the standardized questionnaire. All interviews were carried out by trained researchers and field investigators who had received prior instruction on the survey procedures and interview techniques.

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

Table 1: Association between Soil-Transmitted Helminth Infection Status and Knowledge of Soil-Transmitted Helminth Infections among Study Participants

Characteristics		**Soil-transmitted helminth infections (n = 296)**				**OR (CI 95%)**	**p-value**
		Positive		**Negative**			
		n	**%**	**n**	**%**		
Knowledge of Health Consequences	No	26	36.11	46	63.89	1.2 (0.68-2.11)	0.62
	Yes	63	31.98	134	68.02		
Knowledge of Causes of Infection	No	21	34.43	40	65.57	1.1 (0.59-1.97)	0.8
	Yes	68	32.69	140	67.31		
Knowledge of Preventive Measures	No	27	33.33	54	66.67	1.0 (0.58-1.77)	0.95
	Yes	62	32.98	126	67.02		

The prevalence of soil-transmitted helminth infections among participants who lacked knowledge of the health consequences, causes of infection, and preventive measures was 36.11%, 34.43%, and 33.33%, respectively. These rates were slightly higher than those observed among participants with corresponding knowledge (31.98%, 32.69%, and 32.98%, respectively). However, the differences were not statistically significant ($p > 0.05$).

Table 2: Association between STH Infection Status and Preventive Practices among Study Participants

Characteristics		**Soil-transmitted helminth infections (n = 296)**				**OR (CI 95%)**	**p-value**
		Positive		**Negative**			
		n	**%**	**n**	**%**		
Drinking untreated water	Yes	29	34.52	55	65.48	1.0 (0.64-1.89)	0.74
	No	60	32.43	125	67.57		
Eating raw vegetables	Yes	72	33.96	140	66.04	1.2 (0.61-2.44)	0.55
	No	17	29.82	40	70.18		
Use of sanitary latrines	No	51	49.06	60	54.05	2.7 (1.59-4.52)	<0.001
	Yes	38	24.05	120	75.95		

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Open defecation near the house	Yes	34	44.74	42	55.26	2.0 (1.17-3.52)	0.02
	No	55	28.50	138	71.50		
Frequent soil contact	Yes	51	41.46	72	58.54	2.0 (1.20-3.37)	0.007
	No	38	26.03	108	73.97		
Regular deworming (6-month interval)	No	74	37.00	126	63.00	2.1 (1.12-4.01)	0.02
	Yes	15	21.74	54	78.26		

The prevalence of soil-transmitted helminth infections was higher among participants who did not use sanitary latrines compared with those who did (49.06% vs. 24.05%), and the difference was statistically significant (OR = 2.7; 95% CI: 1.59–4.52; $p < 0.001$). A higher infection rate was also observed among participants practicing open defecation around the household area compared with those who did not (44.74% vs. 28.50%; OR = 2.0; 95% CI: 1.17–3.52; $p = 0.02$). Similarly, participants with frequent soil contact had a higher prevalence of infection than those without such exposure (41.46% vs. 26.03%; OR = 2.0; 95% CI: 1.20–3.37; $p = 0.007$). In addition, the infection rate was higher among individuals who did not receive regular deworming compared with those who did (37.00% vs. 21.74%; OR = 2.1; 95% CI: 1.12–4.01; $p = 0.02$). In contrast, no statistically significant associations were found between soil-transmitted helminth infection status and the consumption of untreated water or raw vegetables ($p > 0.05$).

DISCUSSION

Among 352 residents who underwent stool examination using the Kato–Katz technique, 98 cases of soil-transmitted helminth (STH) infection were identified, corresponding to a prevalence of 27.84%. In addition, 269 participants aged 15 years and older were interviewed to assess knowledge, attitudes, and practices (KAP) regarding STH prevention, providing a basis for analyzing KAP status and its association with infection status in the study area.

In the analysis of the association between STH infection status and participants' knowledge of STH infections, including awareness of health consequences, causes, and preventive measures, the infection prevalence among groups with insufficient knowledge was comparable to that among those with adequate knowledge. No statistically significant differences were observed ($p > 0.05$).

These findings suggest that knowledge alone does not fully reflect preventive behaviors in practice. Our results are inconsistent with those reported by Nguyen Van Chuong and Nguyen Huu Giao [Chuong, N. V. *et al*., 2017], who found a statistically significant higher risk of STH infection among individuals with poor knowledge of the causes, consequences, and preventive measures. Conversely, our findings are consistent with those of Pham Thi Lan Anh [Anh, P. T. L. 2015], who also reported no statistically significant association between knowledge and STH infection status.

This indicates that improving knowledge is necessary but not sufficient for controlling STH infections. Intervention programs should emphasize the translation of knowledge into appropriate preventive practices to effectively reduce infection risk in the community.

In the analysis of the association between preventive practices and STH infection status, certain behaviors such as drinking untreated water and consuming raw vegetables were associated with higher infection rates compared with their counterparts; however, these differences were not statistically significant ($p > 0.05$). The findings regarding untreated water consumption are consistent with those of Pham Thi Lan Anh [Anh, P. T. L. 2015], suggesting that this factor may not be a major determinant of STH infection in the study area. This may reflect a relatively low level of contamination of water and food sources with helminth eggs.

In contrast, several environmental sanitation and personal hygiene factors showed significant associations with STH infection. Participants living in households without sanitary latrines had a 1.91-fold higher risk of infection compared with those using sanitary latrines ($p < 0.01$), consistent with findings by Pham Thi Lan Anh [Anh, P. T. L. 2015]. Similarly, individuals practicing open defecation around the household area had a 1.57-fold higher risk of infection compared with those using latrines ($p < 0.05$). Such behaviors contribute to environmental contamination with helminth eggs and sustain transmission in the community.

Furthermore, frequent soil contact increased the risk of STH infection by 1.59 times ($p < 0.01$), while lack

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of deworming within the previous six months was associated with a 1.70-fold higher risk compared with regular deworming ($p < 0.05$). These findings are consistent with previous studies [Anh, P. T. L. 2015; Thuy, B. C. A. 2019], highlighting the important roles of soil exposure and periodic deworming in STH prevention.

Overall, the study identified several statistically significant factors associated with STH infection, including the use of unhygienic latrines, open defecation, frequent soil contact, and lack of regular deworming. These factors should be prioritized in community-based intervention programs to reduce the burden of STH infections.

CONCLUSION

Among 352 residents who underwent stool examination using the Kato–Katz technique, the prevalence of soil-transmitted helminth (STH) infection was 27.84%. The KAP survey conducted among 269 participants aged 15 years and older showed that knowledge regarding the causes, health consequences, and preventive measures of STH infections was not significantly associated with infection status ($p > 0.05$). Similarly, no statistically significant associations were observed for the practices of drinking untreated water and consuming raw vegetables. In contrast, the use of unhygienic latrines, open defecation, frequent soil contact, and lack of deworming within the previous six months were significantly associated with STH infection ($p < 0.05$).

Recommendations

The findings suggest that STH control programs should prioritize improvements in environmental sanitation, promotion of behavioral change in personal hygiene practices, and strengthening of regular deworming activities in order to reduce the risk of infection in the community.

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