



Bioscientia Medicina: Journal of Biomedicine & Translational Research

Journal Homepage: www.bioscmed.com

The Correlation of No Footwear Use and Soil Helminth Incidence among Elementary School Children in Musi Rawas, South Sumatera, Indonesia

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ARTICLE INFO

Keywords:

Kid pupils
Worm Infections
Not wearing shoes
Stool examination
Tuah Negeri District

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All authors have reviewed and approved the final version of the manuscript.

<https://doi.org/10.32539/bsm.v5i4.381>

ABSTRACT

Background: Soil-transmitted helminth infection (STH) is a parasite infection that involves humans being infected with roundworms by route of soil contamination. One billion individuals are infected with worms, including 568 million school-age children. Helminthiasis in elementary school-aged children was not documented in Musi Rawas Regency. This study's goal was to identify if not wearing footwear increases the incidence of parasitic infection. **Methods:** The research was a cross-sectional survey, followed by statistical analysis. The study involved elementary school-aged students in Tuah Negeri District, Musi Rawas Regency, in 2021 and at least 200 participants. This study sample consisted of 108 with a purposive sampling method. This study utilized questionnaires and stool examinations using the Kato Katz method. Chi-square and multivariate logistic regression were used for statistical analysis. **Results:** Positive helminth infections amounted to 37,1% of the total (n=108). STH was comprised of 17.6% *Ascaris lumbricoides*, 9.3% *Trichuris trichiura*, and 25.9% hookworms. The finding of this research demonstrated a substantial ($p = 0.000$) relationship between the use of footwear and the advent of parasites. The logistic regression analysis results revealed that the most critical variable influencing the incidence of helminthiasis was not wearing any footwear.

Conclusions: The study's findings suggest a correlation between footwear use and the risk of worm infection; as a result, it was recommended that children be thoroughly educated on personal hygiene, specifically footwear use, when using the bathroom.

1. Introduction

Worm infection, also known as soil-transmitted helminths (STH), is caused by roundworms (*Ascaris lumbricoides*), whipworms (*Trichuris trichiura*), and hookworms (*Ancylostoma duodenale*, *Necator americanus*), which are transmitted through the contaminated soil¹. *A. lumbricoides* is known to cause 807-1,121 million infections, while *T. trichiura* causes 604-795 million². More than 1.5 billion individuals, or 24% of the global population, are infected with intestinal worms, particularly 568 million school-age children who live in regions where this parasite is often

circulated³. Worm infections can affect anyone; however, school-aged children are the most vulnerable to become infected^{4,5}. STH infection occurs in school children who do not wear shoes and wash their hands before eating⁴. Worm infections can impair nutritional status, growth and development processes, and cognitive functions resulting in malnutrition, stunting and anemia^{6,7}.

In Indonesia, the prevalence of helminthiasis in the poor population ranges from 2.5% to 62%⁸⁻¹⁰. STH environmental factors include lavatory type, waste

disposal, garbage disposal, and water system¹¹, while clipping, and shoes¹². Deworming uses single-dose, safety-tested oral anthelmintic pharmaceuticals to decrease both the subtle and overt morbidity involved with worm infections¹³. Musi Rawas Regency has a deworming program that targets all age groups and groupings, with a target number of 3,062 medicine administrations¹⁴. There has been no previous research on the investigation of worm infections in elementary school children in Tuah Negeri District Musi Rawas Regency, nor have there been any publications of intervention program assessment regarding the incidence of worm infections after deworming program.

2. Method

In March 2021, a cross-sectional survey was done in five elementary schools in Tuah Negeri District, Musi Rawas Regency South Sumatra Province. Purposive sampling was used to select 108 individuals from a population of 200 schoolchildren using the two-proportion sample size procedure. Elementary school pupils in Classes 3, 4, 5, and 6 were eligible if their feces were examined and they had not used deworming drugs in the previous six months. Each chosen participant earned parental clearance by providing

personal hygiene includes washing hands, regular nail informed consent and not suffering from diarrhea/dysentery disease. The questionnaire was filled, and stool examination was checked using the Kato Katz technique. Chi-square and Multivariate tests were used for data analysis. The Universitas Sriwijaya Faculty of Public Health issued a Certificate of Research Ethics with 093/UN9.FKM/TU.KKE/2021

3. Result

Positive helminth infections were detected in 37.1% of the population (n=108) (Table 1). STH was composed of 17.6% *A. lumbricoides*, 9.3% *T. trichiura*, and 25.9% hookworms (Table 2). The use of footwear was associated with the prevalence of parasites in a statistically significant ($p = 0.000$) method (Table 3). With an OR value of 7.200, the use of inadequate footwear increased the probability of worm infection by 7.2 times compared to individuals who use footwear. Per the logistic regression analysis results, the significant variable explaining the incidence of helminthiasis was not wearing any footwear (Table 4). The regression equation model ($y = \text{constant} + a_1x_1 + a_2x_2$) was $y = -1.224 + 2.096$, with an OR of 8.184. (CI 3.126-21.428).

Table 1. Participants and parent characteristics in a frequency distribution (n=108).

No	Variable	n	%
1.	Worm Infection		
	a. Positive	40	37.1
	b. Negative	68	62.9
2.	Class		
	a. Class III	2	1.9
	b. Class IV	39	36.1
	c. Class V	26	24.1
	d. Class VI	41	38.0
3.	Gender		
	a. Boy	54	50.0
	b. Girl	54	50.0
4.	Parents Education		
	a. Not attending school	1	9.0
	b. Not completing the elementary school	15	13.9
	c. Graduating the elementary school	25	23.1
	d. Graduated from junior high school	29	26.9

	e. Graduated from senior high school	26	24.1
	f. The under graduated	12	11.1
5.	Age (years old)		
	a. 7	2	1.9
	b. 8	1	0.9
	c. 9	12	11.1
	d. 10	22	25.9
	e. 11	32	30.6
	f. 12	26	26.9
	g. 13	2	1.9
	h. 14	1	0.9
6.	Parents' Occupation		
	a. Farmer	65	60.2
	b. Not-a-farmer	43	39.8
7.	Use of Footwear		
	a. Not wearing	50	46.3
	b. Properly wear	58	53.7

Table 2. Worm types confirmed and the number of cases (n=108)

No	Types of Worms	n	%
1.	<i>Ascaris lumbricoides</i>		
	a. Positive	19	17.6
	b. Negative	89	82.4
2.	<i>Trichuris trichiura</i>		
	a. Positive	10	9.3
	b. Negative	98	90.7
3.	Hookworm		
	a. Positive	28	25.9
	b. Negative	80	74.1

Table 3. The correlation between footwear use and the prevalence of helminth infections (n=108)

Use of footwear	The helminth incidence				Total	p	OR 95% CI (Min-Max)
	Positive		Negative				
	n	%	n	%			
Not wearing	30	27.8	20	18.5	50	46.3	
Properly wear	10	9.3	48	44.4	58	53.7	0.000
	40	37.1	68	62.9	108	100.0	7.200 (2.970-17.456)

Table 4. Results of a multivariate logistic regression analysis between independent variables and worm infection incidence

Independent Variable	Coefficient	p	OR	95%CI
Class	0.340	0.353	1,405	0.685-2.879

Age	-0.344	0.248	0.709	0.395-1.271
Gender	-0.879	0.075	0.415	0.158-1.092
Use of Footwear	2.102	0.000	8.184	3.126-21,428
Parental Education	0.248	0.605	1,281	0.501-3.278
Parents' job	0.154	0.746	1.166	0.461-2.950
Constant	-1.224			

4. Discussion

Three species of STH were found in the study. STH was mainly the roundworms (*A. lumbricoides*), whipworms (*T. trichiura*), and hookworms (*A. duodenale* and *N. americanus*)¹⁵. A schoolchild living in poverty in a developing country's intestinal system is likely to be parasitized by at least one and, in many cases, all three soil-transmitted helminths, resulting in physical, intellectual, and cognitive disorders development¹⁶. Hookworm was the most common infection, with the highest prevalence among farmers' parents. This observation is consistent with the fact that hookworm infections are linked to the fact that barefoot walking is a significant risk factor in the percutaneous transmission of hookworm parasites¹⁷. Nonetheless, the prevalence of hookworm infections in Amazonians is high, and it is linked to open defecation and to live on stilts¹⁸.

Positive helminth infections were found in 37,1% of the respondents. School-children in Kemas Rindo District had 27.1% STH¹⁹, 36.3% at Gandus District²⁰ and 24.5% at Sukawinatan District in Palembang City²¹. Prevalence of Ascariasis was high in poor sanitation communities by 60%, such as among Orang Asli school-children in rural Malaysia, with infection rates remaining mainly since the 1920s²². In Maksegnit and Enfranz Towns, northeastern Ethiopia, the prevalence of *Ascaris lumbricoides* single infection was 16.5% soil-transmitted helminthiasis²³. The environment has a critical factor in shaping the dissemination of helminthiasis²⁴.

Wearing improper footwear increased the likelihood of worm infection by 7.2 times. A study in North Sumatra found a significant association between wearing shoes and helminthiasis infection ($p = 0.004$ and prevalence ratio of 3.195)²⁵. The overall incidence

and unhygienic behaviors revealed suggest the importance of identifying the best solution to address the STH problem in North Sumatra²⁶. In parallel with the increased educational activities, footwear deployment has successfully minimized STH infection in endemic locations²⁷. Children of respondents who wear shoes/slippers outside the house had a significantly reduced prevalence of STH infections (72.8%; 95% CI= 62.6, 80.5 vs. 87.0%; 95% CI= 81.4, 91.1.)²⁸. Accessibility to footwear should be emphasized alongside existing STH strategies to guarantee quality reductions and quicken control and elimination²⁹.

Our study has some limitations. For example, not all children returned their excrement for STH testing; hence, the prevalence reported here may not accurately represent the entire burden of STH in these areas. Second, considering the number of incorrect STH levels, we did not correlate the STH outcomes with individual data. As a result, the relationship between higher incidence and children's habits and knowledge was merely speculation.

5. Conclusions

Positive infections were about 37.1% of the three STH species of *Ascaris lumbricoides*, *Trichuris trichiura*, and hookworms. There was a significant association between no footwear use and soil helminth incidence among elementary school children. Consequently, it was advocated that school children are appropriately trained on personal hygiene, including footwear usage when using the toilet and working on the farm.

6. Acknowledgement

We would like to thank the Health Department of

Musi Rawas Regency, especially the Health Center of Air Beliti, for supporting the study. The study was funded by Unggulan Profesi Research Grant Universitas Sriwijaya (SP DIPA-023.17.2.677515/2021), with the Rector's Decree Number of 0014/UN9/SK.LP2M.PT/2021.

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