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Research Article

The Role of Environmental Sanitation and Personal Hygiene in Soil Transmitted Helminths Infection in School-Age Children in Banjarharjo Sub-district

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ABSTRACT

Helminthiasis in school-age children can impede both physical and cognitive development. Poor personal hygiene practices are associated with various health issues among schoolchildren, including diarrhoea and helminth infections. A healthy environment is crucial for physical and mental well-being, whereas poor sanitation significantly increases the risk of infectious diseases. This study aims to examine the relationship between environmental sanitation, personal hygiene, and soil-transmitted helminth infections among school-age children in the Banjarharjo Sub-district. This analytic observational study employed a cross-sectional design and was conducted in July 2023. Data collection involved administering a personal hygiene and environmental sanitation questionnaire, alongside identifying soil-transmitted helminth (STH) eggs in faeces and nail samples using the MgSO4 sedimentation method. Participants were selected through purposive sampling based on predefined inclusion and exclusion criteria. The study population comprised school-age children from Banjarharjo District, with a final sample size of 58 children from Sindangheula Village and Cikuya Village. Data analysis was performed using the Fisher exact test. The results showed no association between environmental sanitation (faeces p = 0.583; nails p = 1.00) and personal hygiene (faeces p = 1.00; nails p = 1.00) and soil-transmitted helminth infection in both faeces and nail samples (p > 0.05). Therefore, the study found no significant relationship between environmental sanitation, personal hygiene, and soil-transmitted helminth infection among school-age children in Banjarharjo Sub-district.

Keywords: *Environmental sanitation, personal hygiene, school age, soil-transmitted helminths*

INTRODUCTION

Helminthiasis is an endemic, chronic, and zoonotic disease. It is a problem caused by social and economic conditions in Indonesia and around the world. In general, helminths do not always

cause dangerous diseases but can cause severe health problems that are related to social and economic factors (Idayani & Putri, 2022).

According to WHO data, by 2022, more than 1.5 billion people, or approximately 24% of the world's population, were infected with soil-transmitted helminthiasis. Over 267 million preschool children and more than 568 million school-age children live in areas where these parasites can be intensively transmitted, necessitating treatment and preventive measures. Data from the Indonesian Ministry of Health indicates that in 2021, 36.97 million children received preventive deworming medicine (Kementrian Kesehatan RI, 2023; World Health Organization, 2022).

Soil-transmitted helminths (STH) are intestinal nematode worms that infect humans via the fecal-oral route. Common STH species infecting humans include Ascaris lumbricoides, Trichuris trichiura, Necator americanus, Ancylostoma duodenale, and Strongyloides stercoralis. STH remains an endemic infection in many countries, particularly in developing regions with poor environmental sanitation and inadequate hygiene conditions (Idayani & Putri, 2022).

STH infection can be transmitted through human faeces containing helminth eggs or through soil contaminated with these eggs, thus becoming a source of infection. Transmission can also occur through the skin of the feet when individuals walk barefoot on soil contaminated by faeces containing worm eggs. Helminthiasis in school-age children can hinder physical and cognitive growth and development, particularly during crucial stages of their development (Anisa et al., 2018; Irawati et al., 2021).

Personal hygiene involves maintaining cleanliness and health to prevent diseases in oneself and others, both physically and psychologically. Poor personal hygiene can lead to various health issues among schoolchildren, including diarrhoea and helminth infections. Sanitation refers to efforts to monitor and manage physical environmental factors that impact human health, particularly those affecting physical development, health, and survival. A healthy environment is essential for both physical and mental well-being, whereas poor sanitation systems significantly increase vulnerability to infectious diseases. (Kandusu et al., 2019; Silalahi & Putri, 2017).

This study aims to examine the relationship between environmental sanitation, personal hygiene, and soil-transmitted helminth infections among school-age children in the Banjarharjo Sub-district.

MATERIAL AND METHODS

This study was an analytical observational with a cross-sectional design and was conducted after obtaining ethical clearance from the Health Research Ethics Commission of Universitas Muhammadiyah Purwokerto, Number KEPK/UMP/25/VII/2023. Sampling of nails and feces of research subjects and filling out questionnaires (environmental sanitation and personal hygiene) were carried out at SDN Sindangheula 03, Sindangheula Village, and SDN Cikuya 02, Cikuya Village, Banjarharjo Sub-district, Brebes Regency, while STH identification was carried out at the Laboratory of Parasitology, Medical Laboratory Technology, Universitas Muhammadiyah Purwokerto in July 2023.

A total of 58 subjects were involved in this study using the purposive sampling technique. Inclusion criteria in this study included elementary school-aged children in grades 1-6, willingness to be research respondents, and not taking deworming drugs for the previous 6 months. Exclusion criteria in this study included elementary school children who did not collect stool samples or withdrew during the study.

Environmental sanitation data were collected via questionnaires completed by primary school-aged children in Sindangheula and Cikuya Villages, covering aspects such as the availability of clean water, latrines, and waste disposal facilities. Personal hygiene data were also gathered through questionnaires, addressing practices such as hand and foot washing, nail trimming, and footwear use.

Identification of STH Eggs by the $MgSO_4$ Sedimentation Method in Nail Specimens

Hand and toenail specimens were collected using sterilized nail clippers and placed in labeled plastic containers. Residual nail debris was removed with a gauze cloth moistened with sterile distilled water. To process the samples, 10 mL of MgSO4 solution was added to the container with the nail pieces and wet gauze. The mixture was allowed to stand for 5 minutes, after which the gauze and nail pieces were removed from the MgSO4 solution. The MgSO4 solution was then added to a test tube containing the nail pieces and gauze, which was subsequently centrifuged for 3 minutes at 2000 rpm. The supernatant was discarded, and the precipitate was collected. A small portion of the precipitate was placed on a glass slide, covered with a cover slip, and examined under a microscope at 40x magnification. The observations were compared with an intestinal parasite identification guide (Mebiana et al., 2021). Samples were positive for STH eggs when *Ascaris lumbricoides, Trichuris trichiura, Necator americanus, Ancylostoma duodenale,* and *Strongyloides stercoralis* were identified.

Identification of STH Eggs by the $MgSO_4$ Sedimentation Method in Stool Specimens

Stool samples were collected in faecal pots, each labelled for identification. To preserve the samples for examination, 10% formalin was added to each pot. Approximately 1 gram of stool was transferred to a test tube, and 10 mL of MgSO4 solution was added before sealing the tube with parafilm. The mixture was centrifuged at 2000 rpm for 3 minutes. The clear supernatant was discarded, and the remaining precipitate was examined. A drop of the precipitate was placed on a glass slide and covered with a cover slip. The preparations were observed under a microscope at 40x magnification and compared with an intestinal parasite identification guide. Samples were considered positive for STH eggs if *Ascaris lumbricoides, Trichuris trichiura, Necator americanus, Ancylostoma duodenale*, or *Strongyloides stercoralis* were identified.

Data Analysis

Data on environmental sanitation, personal hygiene, and STH infection were analysed by the Fisher Exact test (X^2).

RESULTS AND DISCUSSION

Table 1. Characteristics of research subjects

No	Characteristics of subjects	Frequency (n)	Percentage (%)	Mean $\pm$ SD	Median (Min-Max)
1.	Age (y.o)	58	100	8.40 $\pm$1.059	8 (7-11)
2.	Gender				
	Male	24	41.4		
	Female	34	58.6		
3.	Parents occupation				
	Housewife	34	58.6		

	Farmer	3	5.2
	Marketers	5	8.6
	Entrepreneur	3	5.2
	Labour	13	22.4
4.	Hand washing habits		
	Yes	56	96.6
	No	2	3.4
5.	Habit of taking deworming medication		
	Yes	16	27.6
	No	42	72.4
6.	Nails cutting habbits		
	Yes	43	74.1
	No	15	25.9
7.	Nails biting habbit		
	Yes	21	36.2
	No	37	63.8
8.	The water source is tasteless, odorless, and colorless		
	Yes	55	94.8
	No	3	5.2
9.	Latrine availability		
	Yes	57	98.3
	No	1	1.7
10.	Routine latrine cleaning		
	Yes	56	96.6
	No	2	3.4

Based on Table 1, the mean age of the study subjects was 8.40 ± 1.059 years old, with the youngest being 7 years old and the oldest being 11 years old. The majority were female as many as 34 people (58.6%), parents' occupation as housewives as many as 34 people (58.6%), routine hand washing as many as 56 people (96.6%), did not take deworming drugs as many as 42 people (72.4%), the habit of cutting nails as many as 43 people (74.1%), did not have the habit of biting nails as many as 37 people (63.8%), the water source did not taste, smell, and colour as many as 55 people (94.8%), had the availability of latrines as many as 57 people (98.3%), and routinely cleaned the latrines as many as 56 people (96.6%).

The results indicate that the highest number of respondents aged 7–10 years exhibited good personal hygiene and environmental sanitation practices. Personal hygiene of children aged 7–10 years old is already in the good category; they can maintain their own hygiene, such as cutting nails regularly, washing hands with soap both before and after eating or playing, and using footwear when playing outdoors. However, children aged 7–10 years old are an age group that is vulnerable to infection by parasites, and children at that age like to play outdoors. Therefore, it is necessary for parents to teach their children the importance of maintaining personal hygiene (Idayani & Putri, 2022).

Among the study participants, 34 females (58.6%) were infected with soil-transmitted helminths (STH), compared to 24 males (41.4%). Although boys are generally more exposed to STH due to their outdoor play activities, both genders engage in similar soil-related activities. This suggests that neither sex is inherently more susceptible to STH infection; rather, each gender has distinct contributing factors influencing their infection rates (Mahmudah, 2017; Tapiheru & Zain, 2021).

The study found that the majority of participants' parents, 34 individuals (58.6%), were employed as housewives. The role of parents, particularly mothers, is a significant factor associated

with helminthiasis. There is a correlation between parental awareness and the prevalence of helminthiasis. Increased parental awareness regarding clean and healthy living practices positively impacts children's health education, potentially leading to better prevention and management of helminthiasis (Rahma et al., 2020).

The study results indicated that the majority of children, 56 (96.6%), practiced regular handwashing. Previous research reported that 39 children (88%) exhibited good personal hygiene, while 5 children (11.4%) had poor personal hygiene. Additionally, 42 children (72.4%) had not received deworming treatment in the past 6 months, and 43 children (74.1%) routinely cut their nails at least once a week (Eryani et al., 2014).

Table 2. STH infection in stool and nail specimens

Specimens	STH infection	Frequency (n)	Percentage (%)
Stool	Infected	8	13.8
	Not infected	50	86.2
Nails	Infected	1	1.7
	Not infected	57	98.3

Based to Table 2, 8 children (13.8%) were found to be infected with soil-transmitted helminths (STH) in faecal specimens, while 50 children (86.2%) were not infected. In nail specimens, STH infection was detected in only 1 child (1.7%), whereas 57 children (98.3%) were not infected. The identification of STH eggs in both stool and nail specimens from school-age children in Banjarharjo Sub-district is detailed in Table 3.

Table 3. STH species in stool and nail specimens

Specimens	STH species	Frequency (n)	Percentage (%)
Stool	*A. lumbricoides* egg	8	13.8
Nails	*A. lumbricoides* egg	1	1.7

Based on Table 3, it is known that A. lumbricoides eggs were found in 8 people (13.8%) in faeces specimens, and in nail specimens, as many as 1 person (1.7%). The association between personal hygiene and STH infection in stool specimens of school-age children in Banjarharjo Sub-district is illustrated in Table 4.

Identification of helminth eggs in faeces from 58 samples: 8 (13.8%) of which contained helminth eggs, and in the nails, there was 1 (1.7%) of 58 samples identified as containing helminth eggs. The worm identified in this study was *Ascaris lumbricoides*. This identification was done by the $MgSO_4$ sedimentation method. Female adults of *A. lumbricoides* can lay up to 240,000 eggs every day, which will be carried with faeces. *A. lumbricoides* eggs can survive in soil for 17 months with extreme humidity and temperatures around 25–30 °C. This type of worm most commonly infects humans. The high rate of hand infection by A. lumbricoides is due to the presence of a thick hyaline layer and a rough lumpy layer that serve as a protective barrier for the egg contents (Eryani et al., 2014). Tropical climate conditions are ideal for supporting the development of STH eggs into infective forms (Lukiyono et al., 2020).

STH commonly infects humans through soil, food, or directly through the skin, as well as through eggs carried in the nails. STH can contaminate soil, especially when faeces are disposed of in an open system and do not meet hygienic requirements. STH infecting school-age children results in malnutrition and impaired health due to decreased nutrition. This leads to inhibition of cognitive development and decreased haemoglobin levels, resulting in decreased concentration (Andini &

Utomo, 2018). STH infection can occur if you do not have the habit of washing hands with soap before eating or after activities, do not use sandals when playing and are accustomed to sucking fingers while sleeping or playing, snack in places that do not maintain cleanliness, and the unavailability of clean water sources (Nurfadillah et al., 2021).

Table 4. The association between personal hygiene and STH infection in stool specimens

Personal hygiene	STH infection		Total	P	95% CI
	Infected	Not infected			
Good	4 (15.4%)	22 (84.6%)	26 (100%)	1.000	0.176-3.501
Poor	4 (12.5%)	28 (87.5%)	32 (100%)		

Based to Table 4, among school-age children with good personal hygiene, 4 children (15.4%) were infected with STH, while 22 children (84.6%) were not. Among those with poor personal hygiene, 4 children (12.5%) were infected with STH, and 28 children (87.5%) were not. This indicates no significant association between personal hygiene and STH infection in fecal specimens from school-age children in Banjarharjo Sub-district. The relationship between personal hygiene and STH infection in nail specimens is detailed in Table 5.

Table 5. The association between personal hygiene and STH infection in nails specimens

Personal hygiene	STH infection		Total	P	95% CI
	Infected	Not infected			
Good	0 (0%)	26 (100%)	26 (100%)	1.000	0.910-1.031
Poor	1 (12.5%)	31 (87.5%)	32 (100%)		

Based to Table 5, no school-age children with good personal hygiene were infected with STH, while 26 children (84.6%) with good personal hygiene were not infected. Among children with poor personal hygiene, 1 child (3.1%) was infected with STH, and 31 children (96.9%) were not infected. This indicates no significant association between personal hygiene and STH infection in nail specimens from school-age children in Banjarharjo Sub-district. The relationship between environmental sanitation and STH infection in stool specimens is detailed in Table 6.

There was no significant association between personal hygiene and STH infection in both nail and faecal samples ($p > 0.05$). This lack of association may be attributed to the fact that nails were regularly trimmed and respondents were diligent about handwashing. Despite this, personal hygiene remains an important factor that can influence the prevalence of soil-transmitted helminth infections among elementary school students (Suraini et al., 2018).

Table 6. The association between environmental sanitation and STH infection in stool specimens

Environmental sanitation	STH infection		Total	P	95% CI
	Infected	Not infected			
Good	7 (13.2%)	46 (86.8%)	53 (100%)	0.538	0.160-16.904
Poor	1 (20.0%)	4 (80.0%)	5 (100%)		

Based on Table 6, it is known that school-age children with good environmental sanitation but infected with STH are 7 people (13.2%), while school-age children with good environmental sanitation but not infected with STH are 46 people (86.8%). School-age children with poor environmental sanitation but infected with STH were 1 person (20%), while school-age children with poor environmental sanitation but not infected with STH were 4 people (80%). There was no association between environmental sanitation and STH infection in faecal specimens of school-age children in Banjarharjo sub-district. The association between environmental sanitation and STH infection in nail specimens is illustrated in Table 7.

Table 7. The association between environmental sanitation and STH infection in nails specimens

Environmental sanitation	STH infection		Total	P	95% CI
	Infected	Not infected			
Good	1 (1.9%)	52 (98.1%)	53 (100%)	1.000	0.982-1.058
Poor	0 (0.0%)	5 (100%)	5 (100%)		

According to Table 7, among school-age children with good environmental sanitation, 1 child (1.9%) was infected with STH, while 52 children (98.1%) were not infected. There were no cases of STH infection among children with poor environmental sanitation, and all 5 children (100%) with poor environmental sanitation were not infected. This indicates no significant association between environmental sanitation and STH infection in nail specimens from school-age children in Banjarharjo Sub-district.

Overall, there is no significant association between environmental sanitation and soil-transmitted helminth infection in both nail and fecal samples ($p > 0.05$). This lack of association may be attributed to the generally good environmental sanitation conditions, including access to clean water, effective waste disposal, and regularly cleaned toilets (Nugraha et al., 2019).

While this study found no significant association between environmental sanitation, personal hygiene, and STH infection among school-age children in Banjarharjo Sub-district, it remains important to consistently maintain good personal hygiene and a clean school and home environment to mitigate the risk of helminthiasis.

The strength of this study lies in its comprehensive approach, which included not only faecal samples from schoolchildren but also nail samples, and examined their association with environmental sanitation and personal hygiene. However, the study has some limitations. It did not explore attitudes, knowledge, and behaviours related to helminthiasis among the children, which could have provided additional insights. Additionally, the majority of study participants had trimmed their nails, resulting in a limited number of nail samples with detectable STH eggs.

CONCLUSION AND SUGGESTION

There was no association between environmental sanitation and personal hygiene and soil-transmitted helminth infection in school-age children in Banjarharjo Sub-district. However, it is necessary to improve personal hygiene and environmental sanitation for school-age children, teachers, and parents to avoid the risk of helminthiasis. Also, monitoring of helminthiasis by the Health Office is needed so that they can routinely deworm school-age children to prevent the risk of helminthiasis.

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CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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