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Source of household water as main risk factor of soil-transmitted helminth infections among elementary school pupils in Wamena District, Jayawijaya Regency, Papua

Semuel Sandy[1]* and Tri Nury Kridningsih[2]

ABSTRACT

BACKGROUND

Soil-transmitted helminth (STH) infections are caused by three types of worms: *Ascaris lumbricoides, Trichuris trichiura*, and hookworms. Soil-transmitted helminth infections have significant health and socioeconomic implications for communities in developing countries, particularly in Indonesia. This study aims to determine the prevalence and risk factors of STH infections among elementary school pupils in Wamena District.

METHODS

The study design used was a cross-sectional design involving 317 elementary school pupils. The children were interviewed using a structured questionnaire that included demographic information, hygiene, and environmental sanitation data of the respondents. Stool samples were collected from all consenting participants in sterile plastic containers and were analyzed within 24 hours of collection, using the Kato-Katz method. The data were analyzed using bivariate statistical analysis (Chi-square) and multivariate analysis (logistic regression).

RESULTS

The prevalence of helminthiasis among elementary school pupils was 19.9% (63/317). STH prevalence of mild category was 17.4% (55/317). The risk factors for STH infections among school children were the habit of not washing hands with soap after defecation, with an odds ratio of 5.04 [95% CI (2.22-11.48)], and the source of water for household use, with an odds ratio of 7.22 [95% CI (3.66-14.22)].

CONCLUSION

The prevalence of helminthiasis was found to be 19.9% (63/317), with an STH prevalence of mild category. Risk factors for STH infections included the habit of not washing hands with soap after defecation and the source of water for household use.

Keywords: Risk factors, soil transmitted helminths, elementary school pupils, Wamena

[1]Research Center for Public Health and Nutrition, National Research and Innovation Agency, Jayapura Selatan Papua, Indonesia
[2]Balai Penelitian dan Pengembangan Kesehatan Papua, Papua, Indonesia

***Correspondence:**
Research Center for Public Health and Nutrition, National Research and Innovation Agency
Kawasan Kerja Bersama (KKB) BRIN Jayapura, Jl. Isele Kampung Waena, Distrik Heram, Jayapura Selatan, Papua, Indonesia
Email: mercury.sandy56@gmail.com
ORCID ID: 0000-0002-7300-4761

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INTRODUCTION

Soil-transmitted helminth infections, commonly known as worm infections, are among the most common neglected tropical diseases affecting children in low- and middle-income countries.[1–3] The most common type of worm infection is caused by soil-transmitted helminths. The largest burden of STH infections occurs in populations living in areas with limited access to sanitation and clean water, as well as poor standards of hygiene.[4]

According to data from the World Health Organization (WHO), it is estimated that over 1.5 billion people, or 24% of the world's population, are infected with STH.[5] Additionally, over 260 million preschool-age children and more than 654 million school-age children live in areas where these parasites are transmitted intensively, requiring treatment and preventive interventions. The highest number of STH infections occurs in the Asian region,[5,6] and Southeast Asia has reported the highest prevalence of STH infections in recent decades.[4] The species of STH that infect humans include *Ascaris lumbricoides*, *Trichuris trichiura*, *Necator americanus*, and *Ancylostoma duodenale*. These intestinal nematodes produce thousands of eggs per day, which are then excreted in the feces of infected individuals, contaminating the soil in areas with poor sanitation. STH infections are caused by intestinal nematodes that are transmitted to humans through soil contaminated with feces containing the eggs of *Ascaris lumbricoides, Trichuris trichiura*, and hookworms. These worm eggs enter the digestive tract along with contaminated food and drinking water due to poor environmental sanitation and hygiene practices.[7,8]

Soil-transmitted helminth infections can occur in all age groups, but school-age children are usually the most affected. Infections of *Ascaris lumbricoides* and *Trichuris trichiura* are more common in children aged 5-14 years,[9] with a decrease in infection intensity and frequency during adulthood. This is due to changes in exposure, acquired immunity, or a combination of both. On the other hand, hookworm infections also occur in children, but the intensity and frequency generally remain high in adulthood, even in the elderly.[10]

Soil-transmitted helminth infections in school-age children have a detrimental impact on their growth, intellectual development, and cognitive abilities, which are undergoing rapid and active growth.[11] The impact of STH infections also leads to reduced resistance in children to other diseases and increased vulnerability to nutritional deficiencies, due to low nutrient intake, malabsorption, and blood loss caused by the infection.[12] Worm infections are also a contributing factor to stunting in children. Stunting, or being short for age, is considered a good indicator of chronic malnutrition in children.[13] Children who are stunted are more likely to become short-statured adults. STH infections have been associated with malnutrition, including an increased risk of nutritional anemia, energy-protein deficiency, and growth impairments in children.[14,15]

The results of the 2013 Basic Health Research (Riskesdas) showed that there are still households in Indonesia where the final disposal of feces is not into a latrine or septic tank. The proportion of households practicing open defecation is still quite high. The five provinces with the highest proportion of feces not being disposed into septic tanks are Papua (65.4%), East Nusa Tenggara (65.3%), West Nusa Tenggara (49.7%), West Sumatra (46.1%), Central Kalimantan (44.9%), and West Sulawesi (44.1%).[16] Data from the 2018 Riskesdas stated that the proportion of unsafe household feces management for toddlers in Papua is still relatively high at 67.8%. Unsafe feces management means that feces of toddlers is disposed of anywhere (including trash bins) or that toddlers are cleaned in any place. Meanwhile, the practice of using a latrine for defecation and proper handwashing behavior in Papua is still low, at 55.8% and 26.7%,

respectively.[17] The high proportion of households in Papua practicing open defecation and the lack of access to sanitation facilities contribute to the development and transmission of STH infections in Papua.

The World Health Organization (WHO) targeted the control of STH infections in children to reduce morbidity by the year 2020 through a school-based deworming program. Although the global target was to eliminate morbidity due to STH infections in children by 2020, these infections remain a significant health problem in Indonesia, including Papua Province. The prevalence of worm infections in Indonesia varies between 2.5% and 62%, and has increased in children.[18]

The control of worm infections is carried out through the mass drug administration (MDA) program, which must be continuously implemented until the prevalence decreases below 10%. Mass drug administration for worms is conducted twice a year in areas with high prevalence and once a year in areas with moderate prevalence. The drugs used for MDA of worms are albendazole and mebendazole in the form of chewable tablets. The target age groups for deworming programs are toddlers, preschool-age children, and school-age children. Deworming treatment needs to be accompanied by improved hygiene, sanitation, and healthy behaviors to prevent reinfection.[18]

Papua, as one of the Indonesian provinces, has a tropical climate and humidity that supports the development of STH larvae and the maturation of STH eggs. Socioeconomic factors such as lack of access to clean water sources, poor sanitation, lack of personal and environmental hygiene, education, poverty, barefoot walking habits, and nutritional status may increase the risk of STH infections in this region. Epidemiological data related to STH infections among primary school-age children in Papua, including in Jayawijaya Regency, are still very scarce.

The reported prevalence of STH infections in Papua includes 24.30% in Jayapura Regency and 32.90% in Boven Digoel Regency (Survey Report on Worm Infections by the Environmental Health Control Technical Center - Ambon). Furthermore, in Keerom Regency, the prevalence of STH infections among primary school children in Arso District was 23.2% for ascariasis, 4.9% for trichuriasis, and 7.6% for hookworm infection.[19] The prevalence of helminthiasis in Jayapura City is 50%.[20]

Research on risk factors for STH infections has been extensively conducted in Indonesia, including demographic factors (gender, ethnicity, age, parental education, and occupation), hygiene practices (handwashing habits, footwear use, and playing with soil), and environmental sanitation (availability of toilets at home, flooring type, water sources). These studies have yielded significant results, showing variations in the impact of each risk factor variable.[1,19–21] In contrast, a study conducted by Chadijah et l.[22] reported no significant association of knowledge level, environmental sanitation, and hygiene behavior with helminth infection among school-aged children in Palu. The study conducted by Liena et al.[23] also mentioned that environmental sanitation factors did not have a significant association with STH infection among school-aged children in Moyudan Health Center, Sleman Regency.

Furthermore, assessing the current prevalence and intensity of infection and identifying the associated risk factors of STHs infection is vital to guide implementers, public health planners, stakeholders, and policymakers to plan and design precise intervention strategies to eliminate STHs. Therefore, this study aimed to assess the current prevalence, infection intensity, and identify the associated risk factors for STHs among elementary school pupils of Jayawijaya Regency.

METHODS

Study site

The study was conducted in the Jayawijaya Regency, specifically in the Wamena District.

The selection of the Wamena District as the research location was based on its significance in terms of economic and educational activities within the Jayawijaya Regency. It was considered representative of the population of elementary school pupils in the Jayawijaya Regency.

Research design

The study design was cross-sectional, and the research was conducted from January to December 2021.

Research subjects

The required sample size in research is calculated based on the Lemeshow equation.[24] The prevalence of worm infections in Indonesia is 45-65%.[25] The sample size was calculated using the prevalence of 30.6% for STH infection among elementary school children, as found in the study conducted by Yuwono et al.[26] in Sorong District. The sample size was calculated based on a 30.6% proportion (p=0.306) with a 95% confidence level (1.96) and a margin of error of 5% (d=0.05). The sample size formula used was as follows: $N=Z^2-\alpha*p*(1-p)/d^2$.[24] The calculation resulted in a minimum sample size of 326 samples, to account for non-response rate, an additional 5% of the sample size (16 samples) was added, resulting in a total of 342 samples.[27] The inclusion criteria for the study sample were elementary school pupils in grades 1-6, aged 6-12 years, of both genders. The exclusion criteria were pupils who were unwilling to participate in the interview and provide stool samples. The selection of school locations was done using simple random sampling, by creating a list of schools in the Wamena District. The selection of child samples in schools was carried out using simple random sampling, by creating a list of school-aged children from teachers/school principals.

Data collection

Data collection was conducted using a structured questionnaire to obtain information related to demographic data (gender, age), socio-economic factors (mother's education, mother's employment status), hygiene practices, and environmental sanitation. Face-to-face interviews with schoolchildren and their parents. The interviews were conducted with elementary school children in the presence of their parents or guardians, following prior permission and consent to participate in the research.

Stool sample examination

The stool sample collection technique involved distributing stool containers to all selected school-aged children. The provided stool containers were labeled with the respective student's name and date. Stool samples were processed using a single Kato-Katz smear and examined under a microscope to detect the presence of intestinal helminth eggs. The intensity of infection was quantified as the number of eggs per gram (epg) of stool, following the guidelines established by the World Health Organization.[28] The intensity of STH infection is categorized according to WHO guidelines. The categories of intensity of *Ascaris lumbricoides* infection are mild (1-4,999 epg), moderate (5000-49,999 epg), and severe (>50,000 epg). Categories of degree of *Trichuris trichiura* infection are mild (1-999 epg), moderate (1000-9.999 epg), and severe (>10,000 epg). Categories of degree of hookworm are mild (1–1.999 epg), moderate (2.000–3.999 epg), and severe (≥4.000 epg).[29]

Ethical consideration

This research has obtained ethical approval for health research from the Health Research and Development Agency, Ministry of Health, Indonesia, with the reference number: LB 02.01/2/KE.271/2021.

Data analysis

Descriptive analysis was conducted to depict the characteristics of the study population, including the prevalence of STH infections. The Chi-square test was employed to examine the

relationships between variables. In the univariate analysis, the dependent variable was the prevalence of STH infections, while the independent variables included demographic and socioeconomic factors, hygiene practices, and environmental sanitation. Independent variables with a significant value of $p<0.25$ related to the prevalence of STH infections were included in the multivariate logistic regression analysis to identify risk factors for STH infections. For each statistically significant factor, the Odds Ratio (OR) and 95% Confidence Interval (CI) were calculated through multivariate logistic regression analysis.

RESULTS

The number of samples obtained at the research site was less than the expected minimum sample size of 326 samples, as only 317 samples met the criteria. This was due to many respondents being unwilling to provide stool samples due to feelings of disgust or discomfort, as well as a lack of participation from parents/guardians in the research. Additionally, some students were not present at the research site during the data collection period. An overview of the relationship between risk factors for STH infection can be seen in Table.1.

The Chi-Square test results indicated significant associations between STH infections among school-aged children and various risk factors, including ethnicity, the habit of washing hands with soap after defecation, main water source, and floor type.

Microscopic examination of the morphology and quantitative measurement of STH eggs was conducted using the Kato-Katz method on 317 stool samples collected from elementary school children in the Wamena District of Jayawijaya Regency. The results of the stool sample examination can be seen in Table 2.

The stool examination results indicated that *Ascaris lumbricoides* was the most prevalent type of worm found, with an infection rate of 10.4%. Several other types of worm eggs were also detected in the stool samples, albeit at lower percentages, including *Trichuris trichiura* (1.3%), hookworms (2.2%), *Enterobius vermicularis* (2.2%), and *Hymenolepis nana* (0.3%). Furthermore, the stool samples from the children exhibited cases of multiple infections, with the presence of eggs from *Ascaris lumbricoides, Trichuris trichiura*, hookworms, *Enterobius vermicularis*, and *Hymenolepis nana*. These findings demonstrate variations in the pattern of worm infections among primary school children in Wamena District.

The quantitative examination of STH egg counts using the Kato-Katz method in stool samples was further categorized based on infection intensity using criteria established by the World Health Organization, which includes mild, moderate, and severe infection categories. Table 3 presents the results of the examination on the intensity of STH infections among primary school children in Wamena District, where the infection intensity falls within the categories of mild and moderate intensity.

Further logistic regression analysis revealed that the habit of washing hands with soap after defecation and main water source were significant risk factors for STH infection (refer to Table 4). Interaction tests conducted between each independent variable and the dependent variable did not demonstrate significant associations ($p<0.05$).

DISCUSSION

Microscopic examination of stool samples from primary school-aged children in Wamena District, Jayawijaya Regency, revealed the presence of several types of worms, including *Ascaris lumbricoides, Trichuris trichiura*, hookworms, *Enterobius vermicularis*, and *Hymenolepis nana*. The prevalence of worm infections among school-aged children in this location was 19.9% (63/317), with 17.4% (55/317) attributed to STH. The most commonly found infection in school-aged children in

Table 1. Socio-demographic, hygiene, and sanitation factors associated with soil-transmitted helminth infection in elementary school pupils in Wamena District, Jayawijaya Regency (n=317)

Variable	STH infections status		p-value
	Positive (n =55)	Negative (n=262)	
Demographic characteristics			
Sex			
Male	32 (18.5)	141 (81.5)	0,544
Female	23 (16.0)	121 (84.0)	
Age group (years)			
5 – 8	25 (14.5)	148 (85.5)	0.135 φ
9 – 12	30 (20.8)	114 (79.2)	
Ethnicity			
Papua	20 (30.8)	45 (69.2)	0,001 §φ
Non- Papua	35 (13.9)	217 (86.1)	
Number of household members			
2-4	25 (22.3)	87 (77.7)	0.841 φ
>4	30 (14.6)	175 (85.4)	
Mother's education status			
Low education	36(20.7)	13 8(79.3)	0.083 φ
High education	19(13.3)	124 (86.7)	
Mother's employment status			
Unemployed	29 (23.0)	97 (77.0)	0.030 §φ
Employed	26 (13.6.0)	165 (86.4)	
Hygiene			
Habit of washing hands before eating			
No	3 (20.0)	12 (80.0)	0.499
Yes	52 (17.2)	250 (82.8)	
Habit of washing hands with soap after defecation			
No	17 (48.6)	18 (51.4)	0.001 §φ
Yes	38 (13.5)	244 (86.5)	
Nail clipping habit			
No	15 (21.4)	55 (78.6)	0.307
Yes	40 (16.2)	207 (83.8)	
Finger sucking habit			
No	49 (17.7)	228 (82.3)	0.722
Yes	6 (15.4)	33 (84.6)	
Habit of biting fingernails			
No	49 (18.4)	218 (81.6)	0.276
Yes	6 (12.0)	44 (88.0)	
Wearing shoes/slippers			
No	9 (22.0)	32 (78.0)	0.404
Yes	46 (16.7)	230 (83.3)	
Play with soil/dirt			
No	36 (16.6)	181 (83.4)	0.598
Yes	19 (19.0)	81 (81.0)	
Habit of frequent snacks outside home/school			
No	18 (15.4)	99 (84.6)	0.480
Yes	37 (18.5)	163 (81.5)	
Sanitation			
Latrine type			
Latrines without septic tanks	10 (23.3)	33 (76.7)	0.271
Latrines with septic tanks	45 (16.4)	229 (83.6)	
Main water source			
River water/rain/spring water/lake water/pond water	28 (48.3)	30 (51.7)	0.0001 §
Tap water/well water/bottled water	27 (10.4)	232 (89.6)	
Floor type			
Soil/wooden planks/bamboo	21 (45.7)	25 (54.3)	0.0001 §
Cement/ceramic floors	34 (12.5)	237 (87.5)	
Family members who have experienced worms			
No	48 (16.4)	245 (83.6)	0.112 φ
Yes	7 (29.2)	17 (70.8)	

Data presented as n (%);STH : soil-transmitted helminth; § Bivariate statistical analysis Chi Square test (Significant, p value <0.05); φ Risk factors followed by multivariate statistical analysis logistic regression test (p<0.25)

Table 2. Prevalence of soil transmitted helminth species among elementary school pupils in Wamena District, Jayawijaya Regency (n=317)

Stool examination	Positive (n)	Prevalence (%)
STH infections	55	17.3
Non-STH infections	8	2.5
Total worm infection (STH infections + non-STH infections)	63	19.9
Infection types:		
Mono-infection	52	16.4
Dual-infections	9	2.8
Triple infections	2	2.2
Worm species		
Ascaris lumbricoides	33	10.4
Trichuris trichiura	4	1.3
Hookworm	7	2.2
Ascaris lumbricoides + Trichuris trichiura	7	2.3
Ascaris lumbricoides + hookworm	1	0.3
Ascaris lumbricoides + Enterobius vermicularis	1	0.3
Ascaris lumbricoides + Trichuris trichiura + Hymenolepis nana	1	0.3
Ascaris lumbricoides + hookworm + Enterobius vermicularis	1	0.3
Enterobius vermicularis	7	2.2
Hymenolepis nana	1	0.3

Note : STH : soil-transmitted helminth

Wamena District was caused by *Ascaris lumbricoides*. These findings are consistent with a study conducted by Sandy et al.,[19] among school-aged children in Arso District, Keerom Regency, where the prevalence of STH was reported as 29.9%, with *Ascaris lumbricoides* being the most prevalent at 23.3%. However, these findings differ from a study conducted by Yuwono et al.,[26] in Sorong Regency, West Papua, which reported a prevalence of STH infections among primary school children of 30.6%. The types of worms infecting primary school children in this area include *Ascaris lumbricoides*, *Trichuris trichiura*, hookworms, and *Strongyloides stercoralis*. *Trichuris trichiura* infection was most commonly observed in school-aged children at this location. A study conducted by Salma et al.[30] revealed that 16.5% of school-aged children in Mayamuk Subdistrict, Sorong Regency, were infected with one or more types of STH, including *Ascaris lumbricoides*, *Trichuris trichiura*, hookworms, and *Strongyloides stercoralis*. *Trichuris trichiura* infection was the most prevalent both in single and multiple infections. *Ascaris lumbricoides* infection was more common in children, while hookworm infection predominantly affected adults. *Trichuris trichiura* infection was usually found alongside *Ascaris lumbricoides* infection. However, *Strongyloides stercoralis* infection was not detected, possibly due to the Kato-Katz

Table 3. Intensity of STH infection among elementary school pupils in Wamena District, Jayawijaya Regency (n=317)

Ascaris lumbricoides			*Trichuris trichiura*			Hookworm	
Mild intensity (1–4.999 epg)	**Moderate intensity (5.000 – 49.999 epg)**	**Severe intensity (≥ 50.000 epg)**	**Mild intensity (1–999 epg)**	**Moderate intensity (1.000– 9.999 epg)**	**Severe intensity (≥ 10.000 epg)**	**Mild intensity (1–1.999 epg)**	**Moderate intensity (2.000 – 3.999 epg)**
42 (13.2%)	2(0.6%)	0(0%)	12(3.8%)	0(0%)	0(0%)	9(2.8%)	0(0%)

Note : STH : soil-transmitted helminth

Table 4. Multivariate analysis of logistic regression test of risk factors associated with STHs infection in school-age children in Wamena District, Jayawijaya Regency

Variable	n	*Unadjusted Models*			*Adjusted Models*		
		***Odds Ratio* (OR)**	**95% CI**	**p-value**	***Odds Ratio* (OR)**	**95% CI**	**p-value**
Age group (years)							
5 – 8	173	0.64	0.32-1.29	0.212			
9 – 12	144		1				
Ethnicity							
Papua	65	1.17	0.48-2.81	0.733			
Non- Papua	252		1				
Number of household members							
2-4 people	112	1.74	0.87-3.47	0.117			
>4 people	205		1				
Mother education status							
Low education	174	0.75	0.34-1.67	0.485			
High education	143		1				
Mother's employment status							
Unemployed	126	2.02	0.93-4.38	0.076			
Employed	191		1				
Habit of washing hands with soap after defecation							
No	35	5.19	2.05-13.10	0.0001	5.04	2.22-11.48	0.0001*
Yes	282		1			1	
Family members who have experienced worms							
No	293	1.73	0.59-5.06	0.316			
Yes	24		1				
Main water source							
River water/rain/spring water/lake water/pond water	58	5.20	2.01-14.43	0.0001	7..22	3.66-14.22	0.0001*
Tap water/well water/ bottled water	259		1			1	
Floor type							
Soil/wooden planks/bamboo	46	1.89	0.72-4.91				
Cement/ceramic floors	271		1				

*Multiple logistic regression test (Significant, $p < 0.05$); STH : soil-transmitted helminth

method's limited effectiveness in detecting the eggs of this worm.[1]

The intensity of STH infections among school-aged children in Wamena District was found to be predominantly mild for *Ascaris lumbricoides* at 13.2% (42/317) and moderate at 0.6% (2/317). These findings are consistent with a study conducted by Quiroz et al.,[31] where the majority of STH infections among school-aged children in Colombia were classified as being of mild intensity for *Trichuris trichiura* and hookworms and of mild to moderate intensity for *Ascaris lumbricoides*. Another study by Ayu et al.[32] found a relatively high prevalence of STH infections among school-aged children in Karangasem District, Bali, categorized as mild to moderate intensity. Another study by Pasaribu et al.,[1] indicated mild intensity STH infections among school-aged children in North Sumatra. Although the intensity of STH infections is low,

in the long term, STH infections can have detrimental effects on the health and quality of life of children.[33] The low intensity of STH infections among school-aged children in Wamena District can be attributed to the integrated deworming program conducted by the district health office and community health centers, which includes the administration of anthelmintic drugs in conjunction with filariasis treatment once a year.

The risk factors showing significant associations with STH infections among elementary school pupils include ethnicity, mother's occupation status, handwashing habits with soap after defecation, main water source for household use, and floor type (Table 1). Ethnicity was found to have a significant relationship with STH infections in children, with a higher prevalence among the Papua ethnic group compared to the non-Papua ethnic group. Furthermore, the mother's occupation status was also found to be associated with STH infections, with a higher prevalence among unemployed mothers. The occupation of the parents, particularly those involved in farming, has close contact with the soil, which may be contaminated with STH eggs or larvae. Parents with higher education generally have better knowledge of clean and healthy living behaviors compared to parents with lower education levels. Additionally, educated parents are more likely to understand how to provide proper nutritional intake for their family members.[34]

The risk factor of handwashing habits with soap after defecation showed a highly significant association with STH infections among children. Children who did not practice handwashing with soap after defecation had a higher prevalence of STH infections (Table 1). However, other variables such as handwashing before meals, nail cutting activities, thumb sucking, nail biting, wearing footwear outside the house/while playing, playing on the ground, and buying snacks outside the house/school did not show a significant relationship with STH infections. Intestinal parasites can be transmitted through dirty hands, which serve as a medium for the entry of parasite eggs into the body.[35] The lack of availability of soap may be a reason why children do not wash their hands after defecation. These findings are supported by a study conducted by Ayu et al.[32] among school-aged children in Ngis Village, Karangasem District, Bali. A study on STH infections conducted by Pasaribu et al.[1] in agricultural areas in North Sumatra showed that handwashing after defecation in toilets reduces the risk of STH infection. A different study by Wiryadana et al. [36] on school-aged children in Karangasem, Bali, reported that the habit of handwashing with water and soap did not have a significant association with STH infection.

Data from Riskesdas reported that proper handwashing behavior in Papua is still very low, at only 26.7%.[17] In Jayawijaya District itself, the proportion of correct handwashing behavior is only 18.78%. Efforts to control helminthiasis can be made by improving health promotion through a family-based approach and through school health interventions, emphasizing the importance of handwashing with water and soap at five critical times: before meals, after using the toilet, before food preparation, after handling children's waste, and before feeding children.[18] The risk factor of household environmental sanitation also has an influence on STH infections among children. It was found that the main water source used has a highly significant association with STH infections. Households that use river/rain/spring water as their main water source have a higher prevalence of STH infection (Table 1). Contamination of human and animal feces can pollute water sources through poor environmental sanitation, thereby transmitting STH eggs and larvae.[37] These findings are consistent with a study by Konstantin et al.[38] in Maluku, which found a bivariate association between water sources and STH infections among school-aged children in Aru Island, Maluku. A study by Sugianto et.al.[39] on school-aged children in Antiga, Bali also reported an association between water sources and STH

infection. According to data from the Central Statistics Agency, in urban areas, approximately 86.18% of the population has septic tank toilets, 5.38% have pit latrines, and 8.44% dispose of their feces into rivers/open fields/gardens/other areas. In contrast, in rural areas, 7.84% of the population has septic tank toilets, 16.5% have pit latrines, and 75.51% dispose of their feces into rivers/open fields/gardens/other areas. This indicates that sanitation in Jayawijaya District is still very minimal because a significant percentage of the population does not have proper septic tank disposal for feces.[40]

The risk factor of the type of house flooring is also significantly associated with the transmission of STH infections, with children living in houses with dirt/wood/bamboo floors having a higher prevalence of STH infections (Table 1). Data from the Central Statistics Agency indicates that the indigenous population of Jayawijaya District still maintains strong customs and culture. This can be seen from the significant number of indigenous Papuan people who still live in traditional houses such as *honai* houses. Generally, *honai* houses have thatched or grass roofs and are approximately 2.5 meters tall. The walls are made of wood and have a single small door but no windows, providing protection against the cold mountain air in Papua.[40] The flooring of *honai* houses, which consists of wooden planks or soil with the addition of dry grass or straw, can increase the risk of STH transmission. This is because the presence of planks and dry grass/straw can create a damp environment underneath, which has the potential for the development of STH eggs and larvae.

This study has several limitations, including the insufficient participation of children and parents in the research. Data collection on household environmental sanitation observations could not be conducted due to the ongoing COVID-19 pandemic at the time of data collection. The clinical implications of helminth infections have long-term effects, including decreased cognitive abilities, anemia, nutritional status, and stunting in children. This study was conducted to provide data on the prevalence of STH infections among school-aged children in Wamena District, emphasizing the need for the health department to continue implementing deworming programs and educating the community about the importance of healthy and hygienic behaviors, as well as environmental sanitation.

Evaluation of deworming programs can be carried out by conducting STH infection examinations among school-aged children to ensure the availability of prevalence data. In the future, studies on the impact of helminth infections on anemia, cognitive abilities, nutritional status, and stunting among school-aged children, as well as examinations of environmental sanitation related to water sources and fecal contamination, should be conducted. In efforts to control helminth infections, a holistic and sustainable approach is essential. This includes education on hygiene practices, improving sanitation, regular health monitoring, and awareness campaigns involving the community and local authorities. With these measures, it is expected that the prevalence and negative impact of helminth infections on children in Wamena District, Jayawijaya Regency can be reduced.

In future research, there are several important directions to explore regarding soil-transmitted helminth (STH) infections among elementary school pupils in Wamena District, Jayawijaya Regency, Papua. Firstly, the role of water sources as a main risk factor for STH infections should be investigated further. Evaluating the effectiveness of interventions to improve water supply systems or implement water treatment methods in reducing STH infection risk would be essential. Promoting hygienic practices among school pupils through behavior change interventions, such as proper handwashing, footwear usage, and minimizing contact with contaminated soil, should also be explored. Assessing the impact of these interventions on reducing STH infection rates would guide the development of effective health

education programs. Lastly, investigating the role of environmental sanitation, such as improved sanitation facilities, in reducing STH transmission would be significant for prevention and control efforts.

CONCLUSION

The prevalence of helminthiasis among school-aged children in Wamena District is in the mild category. The intensity of STH infections in school-aged children is also classified as being in the mild category. The risk factors associated with STH infections among school-aged children in Jayawijaya District are the habit of not washing hands with soap after defecation and the source of water for household use.

CONFLICT OF INTEREST

No conflict of interest

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AUTHOR CONTRIBUTIONS

SS and TNK were the main contributors in writing the article. SS and TNK jointly designed the study, conducted data analysis, and drafted the research article. All authors have read and approved the final manuscript.

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