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Research Article

WATER SOURCE AS THE MAIN RISK FACTOR OF SOIL-TRANSMITTED HELMINTHS INFECTION ON PRIMARY SCHOOL STUDENTS IN ANTIGA VILLAGE, BALI

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ABSTRACT

Objective: This study aims to find out the main risk factor of soil-transmitted helminths (STH) infection, so the results of this study can be used to determine the right steps in STH education and eradication.

Methods: This study uses a cross-sectional analytic design. The sample consists of 105 primary school students at "Sekolah Dasar Negeri (SDN) 3" Antiga Village, Bali, using total sampling techniques. To collect data, modified Kato-Katz technique and questionnaire are used. The data then analyzed using logistic regression in the Statistical Package for the Social Sciences version 23 software.

Results: The prevalence of STH infection in "SDN 3" Antiga is 14.3%. Three students infected by *Ascaris lumbricoides* (20%), eight students infected by *Trichuris trichiura* (53.3%), and four students infected by mix infections (26.7%). The main risk factor of STH infection is the water source from a river (P = 0.001; odds ratio [OR] = 7.875; 95% confidence interval [CI] 2.311–26.836).

Conclusion: Of 105 participants, 15 students (14.3%) had STH infection. The highest prevalence of helminths egg found was *Trichuris trichiura*. The main risk factor of STH infection in this study is the source of water, which is from a river nearby (P = 0.001, OR 7.875, CI 95% 2.311–26.836).

Keywords: Water resource, Risk factors, Soil-transmitted helminths, Primary school students.

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INTRODUCTION

Helminth infection is one of the most common infections in developing countries that cause a global burden that surpasses another disease such as malaria and tuberculosis [1]. Helminth infection is based on the infection by one or more parasitic intestinal worms, such as roundworms (*Ascaris lumbricoides*), whipworms (*Trichuris trichiura*), or hookworms (*Necator americanus* and *Ancylostoma duodenale*) [2]. Indonesia, a country with a tropical climate, is a very suitable place for soil-transmitted helminths (STH) growth. A study conducted in Indonesia concluded that the highest prevalence of STH infection is *A. lumbricoides* (30.4%) [3]. The risk group of STH infection is primary school students, which affect mostly school-age children from 1 to 14 years old [4]. In 2009, 31.8% of primary school students in Indonesia have been infected by STH at least once [3]. According to statistical analysis in Sri Lanka, risk factors of STH transmission are lowland, low education level, low sanitation, and children whose mothers are infected with STH [5,6]. STH infection is a significant factor of developmental delay in children. Rather than death, STH infection causes malabsorption, diarrhea, and iron-deficiency anemia [7]. The goal of this study is to find out the prevalence and the main risk factor of STH infection in primary schoolchildren. To the best of our knowledge, there are no other similar studies conducted.

METHODS

The design of this study is analytic cross-sectional. The technique of total sampling is practiced with feces samples taken from 112 primary school students of "Sekolah Dasar Negeri (SDN) 3" Antiga Village, Bali. This study protocol was approved by the Committee of Ethical Research of Udayana University. The parents of the enrolled subjects or their legal guardians provided written informed consent to be included in this study. Subjects should fulfill the inclusion and exclusion criteria. The feces examination was conducted in the Parasitology Laboratory of Udayana University in Bali.

This study uses primary data, which means it is obtained from a direct interview with all of the respondents. Data obtained include risk factor of STH infection in primary school students. Feces samples were collected with sterile pot (30 ml) which has been labeled with the identity of each student. Fecal examination under the microscope is done with a modified method of Kato-Katz which has been practiced widely to diagnose STH infection.

Data obtained from the interview and fecal examination will be analyzed with the Statistical Package for the Social Sciences version 23. The analysis method used is double logistic regression, which was performed in two steps; the first step was to decide the risk factors with an analysis of Chi-square result and the second step was to find out the signification rate and odd ratio between variables, which will be accounted for the most determining risk factors in STH infection.

RESULTS

This study is carried out from April to October 2018 in primary school "SDN 3" Antiga Village, Bali. Data obtained using questionnaire sheets and feces samples. A total sample of students in "SDN 3" Antiga participating in this study is 112 students. Because some students do not collect their feces, the sample is reduced to 105 students.

According to Table 1, male participants are 50 students (47.6%) and female participants are 55 students (52.4%). Distribution of the highest number of participants in the fifth grade is 24 students (22.9%) and the lowest number of participants in the fourth grade is 12 students (11.4%). Infection rate of STH in "SDN 3" Antiga is 15 students (14.3%) out of 105 respondents and among them, *A. lumbricoides* infection is found in 3 students (20%), *Trichuris trichiura* infection is found in 8 students (53.3%), and mixed infection of *A. lumbricoides* and *Trichuris trichiura* is found in 4 students (26.7%). Infection of hookworm; *Necator americanus* and *A. duodenale* are not found within the samples.

Bivariate analysis in every risk factor variable to STH infection is done one by one to determine the significance rate in relation to its effect on infection of STH. Cutoff the number of a variable in multivariate analysis is P < 0.25. In Table 2, it is shown by analysis multivariate that the source of river water (P = 0.001) is the ultimate factor in STH infection, followed by the disobedience of taking anthelmintic drugs (P = 0.143), drinking unboiled water (P = 0.145), and leaving food uncovered at home (P = 0.175).

According to the multivariate logistic regression in Table 3, risk factor significances in infection of STH are the source of river water (P = 0.003; odds ratio [OR] = 7.353). Among these 15 positive STH infected respondents, seven respondents do use and eight respondents do not use the river as their main source of consumed water and other daily needs.

In determining risk factors that play the biggest role in STH infection, every variable in multivariate analysis is observed one by one and excluded starting from the biggest p number, and then, the variable is examined for any change in OR. If the change is <10, then the variable can be excluded from multivariate analysis. This multivariate analysis is done until one variable with the smallest p factor is left or with other words, the most contributing factor of STH infection. If the variable excluded causes change of OR >10, then the variable is included again and considered as a disturbing variable. The final result of this multivariate analysis is done after excluding the variable one by one is the source of river water (P = 0.001, OR = 7.875, confidence interval [CI] = 95% 2.311–25.836).

Table 1: Characteristics of respondent

Characteristics	Frequency (%)
Gender	
Male	50 (47.6)
Female	55 (52.4)
Primary school grade	
Grade 1	16 (15.2)
Grade 2	18 (17.1)
Grade 3	19 (18.1)
Grade 4	12 (11.4)
Grade 5	24 (22.9)
Grade 6	16 (15.2)
Infection of STH	
Positive	15 (14.3)
Negative	90 (85.7)
Type of STH (n=15)	
Ascaris lumbricoides	3 (20)
Trichuris trichiura	8 (53.3)
Hookworm	0
Mixed infection	4 (26.7)

STH: Soil-transmitted helminth, n: Number of infected students

Table 2: Bivariate analysis result

Variables	p	Information
Gender	0.522	No
Water availability	0.564	No
Source of water	0.001	Multivariate test
Water condition	0.564	No
Own toilets	>0.999	No
Place to defecate	>0.999	No
The routine of cutting nails	0.512	No
Biting nails	0.277	No
The habit of washing hands	0.909	No
Nail condition	0.379	No
Boil the drinking water	0.145	Multivariate test
Cook the food	0.262	No
Wash the fruits	0.261	No
Covering food	0.175	Multivariate test
Consume anthelmintic drugs	0.143	Multivariate test
Playing on soil	0.424	No
Using sandals	0.705	No

Cutoff (p<0.25)

Table 3: Multivariate analysis result

Variable	Infection of STH		p	Crude OR (95% CI)
	Positive	Negative		
Source of water*				
River	7	9	0.003*	7.353
Not river	8	91		(2.014–26.848)
Boil the drinking water				
Yes	14	71	0.162	0.207
No	1	19		(0.023–1.885)
Covering food				
Yes	12	83	0.462	1.920
No	3	7		(0.337–10.937)
Consume anthelmintic drugs				
<1 time every year	7	60	0.233	2.108
>1 time every year	8	30		(0.619–7.179)

*Main risk factor. P=0.05. STH: Soil-transmitted helminth, CI: Confidence interval, OR: Odds ratio

DISCUSSION

According to the study done to primary school students of "SDN 3" Antiga Village, Bali, it is found that the prevalence of students infected by STH is 14.3%. This result of this study is not as high as the prevalence of STH infection in a study conducted by Annisa and Anwar, in primary high school "SDN 200," Palembang City. Annisa and Anwar stated that 29 students (27.1%) from a total sample of 107 students are infected by STH [8]. Compared to the previous study with participants including primary school students of "SDN 1" Sulangai, district of Badung, and primary school students in "SDN 1" Blandingan, district of Bangli, Bali, by Larassanthi concluded the prevalence to be six point two percent, which is lower than the prevalence of this study [9]. The other study conducted in "SDN 3" Gegelang, not far away to Antiga, by Wiryadana *et al*. showed the prevalence to be 31.7% which is a higher number compared to this study [10].

The high prevalence number of helminths eggs found in farmer's hands means that STH is spreading through dirty hands and low hygiene, also means that living in agriculture region is one of the significant contributing factors to the high prevalence of spreading STH through hands while washing hands with soap do not inhibit the transmission of STH [11]. Other factors are the contact of feet with soil. This is shown with the using of footwear and giving education to society will lower the STH reinfection rate significantly [12]. In a study by Wiryadana *et al*. stated that the main risk factor of STH infection is not knowing how to use the toilet or does not have any private toilet (P = 0.0001; OR = 3.37; 95% CI 1.07–10.37) [10].

Factors that according to the studies before contribute to STH infection do not apply to this study because the hand hygiene and habit of washing hands, and routine of cutting nails in this study do not show any significance to STH infection. Besides, using footwear is also not a significant contributing factor because of 11 students that do not wear footwear whenever going outside (P = 0.705), only two are positively infected with STH. "Does not know how to use the toilet or not owning a private toilet" also cannot be determined or is excluded from risk factor because each student in this study has a toilet on their own and the toilets are used as well.

Source of water from this river is the dominant risk factor of STH infection; this sentence is later strengthened by an interview with the head of the village that claimed that the river directly flows from a mountain that could be said as the source of water for the people of Antiga. Using the water on a daily basis by some of the households makes the spreading

of STH a lot faster. The statement is also supported by systematic study review by Strunz *et al*. that explained about low hygiene on source of water increased the risk of infection of STH on primary school students in Pacific Islands (OR = 4.93; 95% CI 2.24–10.88) and to children in Venezuela, it is state about high OR number between collecting unhealthy water with infection of *Trichuris trichiura* (OR = 1.12; 95% CI 1.09–1.15) [13]. However, this study contradicts another study by Gulliver *et al*., which stated that household wears, number of children, and the source of water not contributing to infection of STH [11].

CONCLUSION

The number of STH infection in 105 students in "SDN 3" Antiga that contributed to this study is 15 students, with a prevalence of 14.3%. The highest prevalence of helminths egg found is *T. trichiura*. The risk factor of STH infection that contributed the most on students of "SDN 3" Antiga, Bali, Indonesia, is the source of water which is from a river nearby (P = 0.001, OR 7.875, CI 95% 2.311–26.836).

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The authors report no conflict of interests.

AUTHORS' CONTRIBUTIONS

Sugianto conceived and designed the study and drafting the article. Sudarmaja supervised the study and revised it critically. Swastika analyzed, interpreted the data, and revised it. Sukarno analyzed, interpreted the data, and revised it. All authors gave final approval of the version to be published.

COMPETING INTEREST

The authors report no conflicts of interest in this work.

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