



SOIL TRANSMITTED HELMINTHS INFECTION IN ELEMENTARY SCHOOL STUDENTS IN HIGHLAND AND LOWLAND AREAS OF GIANYAR REGENCY

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Abstract

Soil-Transmitted Helminths (STH) Infection is a worm infection which is transmitted through soil. STH is still a public health problems around the world, including Indonesia. The tropical climates of Indonesia is a suitable environment for viability of STH. The prevalence of STH in Bali since 2003-2007 reached 40.94%-92.4%. The altitude of an area may affect the rate of STH infection. The rate of STH infection is higher on population in highland area compared to lowland area. This study aimed to identify risk factors of STH infection in elementary school students in highland and lowland area in Gianyar Regency. This study used cross sectional analytic design and was conducted in 2016. The total samples of this study were 104 students which were consisted of 53 students in highland area and 51 students in lowland area. The samples were collected using cluster random sampling technique. The specimens were examined using Kato-katz method. The results showed that the prevalence of STH infection in elementary school students in highland area (28.31%) was higher than in lowland area (1.96%). In lowland area, the risk factor could not be clearly identified because there was only one student with a positive STH infection. Meanwhile, the identified dominants risk factors which influence STH infection in highland area were habit of washing hands using soap (AOR=24.99), fingernails cleanliness (AOR= 13.19) and parents income (AOR=18.83).

Introduction

Soil-Transmitted Helminths (STH) infection is still a public health problem around the world. Major STH species which can infect human includes *Ascaris lumbricoides*, *Trichuris trichiura*, *Necator americanus*, and *Ancylostoma duodenale* (Bethony *et al*, 2006). WHO estimates that more than 1.5 billion (24%) of the world population are infected with STH, with the highest number in school age children which reached 600 million children (WHO, 2015).

Indonesia, which had tropical climate, is a suitable environment for helminth viability. STH infection in Indonesia in 2000-

2004 reached 33.0%-46.8%, with the highest prevalence was among school age children which reached 60%-80% (Minister of Health, 2006).

STH infection could be influenced by environmental and personal hygiene behavior factors such as habit of not washing hand with soap, fingernail cleanliness, habit of playing on the soil, owning of a toilet, house floor condition, and clean water availability. People who lived in highland have a higher rate of STH infection, particularly in rural area compared to lowland area (Sutanto, 2008).

Elementary school children in Bali in 2003-2007 found that the prevalence of STH

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infection reached 40.94%-92.4%, namely 94% in Blahkiuh Village, 84% in area around the town, and 15% in Panjer. Then in 2004, the prevalence in 13 elementary schools in Badung, Denpasar, and Gianyar reached 58.3%-96.8%.

Gianyar had topographical condition which was divided into two different characteristic, namely highland area in the north and lowland area in the south. Tegallang Subdistrict and Sukawati Subdistrict were the highest and the lowest part of Gianyar Regency, respectively. According to above data, we were interested in conducting a study which aimed to identify risk factors of STH infection in elementary school in highland and lowland areas of Gianyar Regency.

Method

This was an analytic observational study with cross-sectional design. The research was conducted in public elementary school in Taro Village and Ketewel Village from January to May 2016. The samples were all elementary school children from 3rd, 4th, and 5th grade in both village who fulfilled sample inclusion criteria. The inclusion criteria were agreeing to participate in the research and had not consume antihelminthic drug in the last three months. The exclusion criteria were: sick and absent children during the study. The samples were determined using cluster random sampling technique. The acquired samples were 104 students, consisting of 53 students from highland area and 51 students from lowland area.

The data were collected using fecal examination and questionnaire filled by the students. The questionnaire consisted of 20 question items regarding personal hygiene behavior and house environment condition. Feces sample was collected for 3 consecutive days with hope that the feces could be sufficient. The feces was then injected with formalin 10%. Fecal examination was performed at Parasitology Laboratory of Faculty of Medicine Udayana University using Kato-Katz method.

Data analysis consisted of univariate, bivariate, and multivariate analysis. Univariate analysis was performed to describe the data in frequency distribution tables. Bivariate analysis was carried out to determine the relationship between two variables using chi square test.

Multivariate analysis was to determine the dominant factor using multiple logistic regression test.

Results and Discussion

The respondents numbered 104 students, consisting of 53 students from highland area and 51 student from lowland area. Most of the respondents were male (55.77%) and the rest were female (44.23%). Most of the respondents were from 6 Taro Public Elementary School (27.88%) and in term of grade, most of them were from 4th and 5th grade (33.65%).

Table 1 showed that the prevalence of STH infection in elementary school children in highland area (28.31%) was higher than lowland area (1.96%). In term of species, *Ascaris lumbricoides* and *Trichuris trichiura* were more commonly found in highland area, reaching 7.55% and 22.64%, respectively. Mixed infection (*Ascaris* and *Trichiuris*) only occurred in 1 child in each area, corresponding to a prevalence of 1.89% in highland area and 1.96% in lowland area. This showed that the number of mixed infestation was low. This was in accordance with a study by Aryanti (2015) in Pekanbaru which found only 1 student (1.63%) who had mixed infection (*Ascaris* and *Trichuris*).

Ministry of Health of Republic of Indonesia had implemented operational policy to disrupt chain of transmission of helminth infection with a target of STH infection prevalence <20% in 2015. If the prevalence >20%, mass treatment would be conducted. Otherwise, individual treatment will be conducted instead. In this study, the prevalence of STH infection in highland area was still above 20%, therefore mass treatment should be carried out. Meanwhile, the prevalence of STH infection in lowland area was less than 20%, therefore only individual treatment which was performed. This was in accordance with a study by Sutanto (2008), which found that people who lived in highland had higher rate of STH infection compared to lowland residents.

Difference in STH infection prevalence in each area could be caused by differences in natural or geographical condition. Highland area had higher air humidity and firm soil condition due to clay soil composition. Meanwhile, lowland area consisted of loose sandy topsoil and had low air humidity. High

Table 1. Prevalence of STH Infection in Children in Gianyar Regency

STH Infection	Highland Area	Lowland Area
	n(%)	n(%)
<i>Ascaris lumbricoides</i>		
Positive	4 (7.55)	1 (1.96)
Negative	49 (92.45)	50 (98.04)
<i>Trichuris trichiura</i>		
Positive	12 (22.64)	1 (1.96)
Negative	41 (77.36)	50 (98.04)
<i>Ancylostoma duodenale</i> and <i>Necator americanus</i>		
Positive	0	0 (1.96)
Negative	53 (100)	51 (100)
Mixed Infection		
Positive	1 (1.89)	1 (1.96)
Negative	52 (98.11)	50 (98.04)
STH		
Positive	15 (28.31)	1 (1.96)
Negative	38 (71.69)	50 (98.04)
Total	53 (100)	51 (100)

Source: Primary Data

air humidity and firm soil condition in highland area could possibly enabled it to become suitable habitat to develop STH (Sutanto, 2008).

Univariate analysis to identify risk factors of STH infection in each area were shown in Table 2.

Table 2 shows that there were seven different risk factors in each area, namely handwashing habit, fingernail cleanness, owning of toilet, clean water availability, father's occupation, father's education, and parent's income. Among those factors, handwashing habit, toilet ownership, clean water availability, father's occupation, and parent's income showed the highest difference in each area.

In term of handwashing habit, most people in highland area have no habit of washing their hand using soap (56.60%). Meanwhile, in lowland area, most of the people already had habit of handwashing using soap (86.27%). This was caused by availability of handwashing facility such as clean water and soap in each school which were scarcely available in highland area. On the contrary, schools in lowland area had well functioning sink and readily available soap.

Handwashing habit is one of eight indicators of Clean and Healthy Life Behavior (PHBS). In regards to the low level of

handwashing habit in highland area which were caused by problems in supporting facility, this showed lack of attention and awareness from the people in remote area towards the importance of such indicators in supporting public health status, particularly elementary school student. Monitoring of physical, biological, social, and economic environment sanitary could influenced public health status. Good environmental condition must be maintained and developed, while poor environmental condition need to be improved or removed because it could impose public health risks (Mirza, 2014).

In term of owning of toilet, 35.85% students in highland area still did not have toilet, while 100% students in lowland area have it. In term of father's occupation, most students in highland area (64.15%) had their father worked in soil-contact job while most of the students in lowland area (94.12%) did not. In term of parent's income, most of the students in highland area were below regional minimum wage (UMR) (69.81%) while most of the students in lowland area were above regional minimum wage (UMR) (68.63%). UMR determination was based on Gianyar Regency UMR in 2016 which was Rp 1,905,000.-.

The difference between the three

variables could be influenced by difference in level of people's education between the two areas. Generally, the higher someone's education, the better he/she could acquire or receive information. Most people in highland area had low education level, making it difficult for them to obtain better job. With their current job, their wage were also insufficient. Low wage lead to unfulfilled daily requirement, including the need to own a toilet. From the interview, it was known that children in highland who did not have toilet usually defecate at garden, backyard, or river. Meanwhile, several children who have toilet but did not use it properly stated that they were uncomfortable and unaccustomed to defecate in closed space and it was more practical to defecate in the river.

Low level of ownership and utilization of toilet in highland area caused high number of defecation at indiscriminate place (BABS) and would increase chain of STH infection in highland area. Faeces had a prominent role in transmitting STH infection. Insanitary removal of human faeces could contaminate the soil and water source. Availability of toilet which fulfil health requirement would minimize the risk of transmission of alimentary tract infection disease such as helminth infection.

In term of clean water availability, most of people in highland area did not have good clean water source (67.29%) while people in lowland area had it (86.27%). This difference could be attributed to different geographical condition in each area. Highland area is mountainous area which made it difficult to dig well and to be reached by water pipe from municipal water company. Therefore, most of the people in highland area met their daily demand of water from river and rain water. Meanwhile, people in lowland area which resided near the coast or town had no difficulty to dig or drill wells and the water pipe from municipal water company were easy to reach them.

Beside indicator of clean water availability, indicator of water boiling before consumption was also assessed in this study. We found that in both area, most of the respondents already had good behaviour in boiling water before consumption, that is 90.57% in highland area and 92.16% in lowland area. Boiling the water above 100°C would kill

pathogenic microorganism in it. This was in accordance with a study from Ningsih (2014) which found that the factor which affect the growth of bacteria in water was appropriate temperature for pathogenic bacteria growth, which was around 10°C-60°C. Boiling or heating the water until boiling temperature (100°C) for several minutes it would kill the bacteria (pathogen). Therefore, it is important to boil the water before its consumption.

Bivariate and multivariate analysis were performed to identify factors which affect STH infection in highland area. In this stage, only highland area which is assessed because there was only 1 student infected with STH in lowland area which would make one cell with zero value in the cross tabulation. Therefore, the degree of risk factor influence could not be assessed in lowland area, but the the risk factor could be described as shown in Table 2.

From bivariate analysis, variables which were risk factors and have statistically significant influence towards STH infection in highland area were: handwashing habit (OR=8.03; CI=1.81-35.47; p=0.005), fingernail cleanness (OR=4.94; CI=1.26-19.26; p=0.020), playing habit (OR=3.78; CI=1.04-13.66; p=0.040), owning of toilet (OR=4.2; CI=1.22-14.40; p=0.021), mother's occupation (OR=3.43; CI=1.0-11.85; p=0.049), and parent's income (OR=9.13; CI=1.41-59.08; p=0.019). The result of the analysis were shown in Table 3.

Beside presenting the result of bivariate analysis, table 3 also shows the result of multivariate analysis. The result of multivariate analysis showed that elementary school children in highland area who have no handwashing habit would have 24.99 greater risk of STH infection compared to children which had it and it had statistically significant effect (p=0.002; CI=3.12-199.83).

The presence of significant effect of handwashing habit showed that the difference of STH infection rate between the two areas could be caused by difference in handwashing habit. Transmission of helminth infection most commonly occurred through dirty hand and long toenails which could be infested with helminth eggs that could then be ingested when the child is eating. The matter worsen when handwashing behavior before meal was

Table 2. Identification of Risk Factors of STH Infection in Gianyar Regency

Risk Factors	Highland	Lowland
	f(%)	f(%)
Handwashing Habit		
Yes	23 (43.40)	44 (86.27)
No	30 (56.60)	7 (13.73)
Fingernail Cleanness		
Clean	24 (45.28)	26 (50.98)
Dirty	29 (54.72)	25 (49.02)
Playing on the Ground Habit		
No	26 (49.06)	23 (45.10)
Yes	27 (50.94)	28 (54.90)
House Floor		
Cement/ceramic	46 (86.79)	50 (98.04)
Soil	7 (13.21)	1 (1.96)
Toilet Ownership		
Yes	34 (64.15)	51 (100)
No	19 (35.85)	0
Clean Water Availability		
Yes	17 (32.08)	44 (86.27)
No	36 (67.92)	7 (13.73)
Father's Income		
Non Soil Contact	19 (35.85)	48 (94.12)
Soil Contact	34 (64.15)	3 (5.88)
Mother's Income		
Non Soil Contact	29 (54.72)	49 (96.08)
Soil Contact	24 (45.28)	2 (3.92)
Father's Education		
High	7 (13.21)	29 (56.86)
Low	46 (86.79)	22 (43.14)
Mother's Education		
High	5 (9.43)	25 (49.02)
Low	48 (90.57)	26 (50.98)
Parent's Income		
High	16 (30.19)	35 (68.63)
Low	37 (69.81)	16 (31.37)
Total	53 (100)	51 (100)

Source: Primary Data

not habitually performed. Bactericidal and bacteriostatic substances in the soap could kill pathogen adhering in the hand, therefore handwashing behavior is important.

In terms of fingernail cleanness, students who have dirty fingernails have 13.19 times increased risk of STH infection compared to students who have clean fingernails, the effect was statistically significant ($p=0.009$).

The results was in accordance with a study by Junaidi (2014), in work area of Tapalang Community Health Center (Puskesmas) in Mamuju Regency which found that there was a correlation between nail cutting behavior and prevalence of helminth infection in elementary school age children.

The presence of influence from fingernail cleanliness towards STH infection showed

Table 3. Bivariate and Multivariate Analysis of Factors Which Influenced STH Infection in Elementary School Children in Highland area of Gianyar Regency

	STH Infection				Bivariate Analysis			Multivariate Analysis		
Risk Factors	Positive		Negative		OR	95%CI	P	AOR	95%CI	P
	f	%	f	%						
Handwashing Habit										
No	13	43.33	17	56.67	8.03	1.81-35.47	0.005	24.99	3.12-199.8	0.002
Yes	2	8.7	21	91.30				ref		
Fingernail Cleanness										
Dirty	12	41.38	17	58.62	4.94	1.26-19.26	0.020	13.19	1.91-91.01	0.009
Clean	3	12.5	21	87.5				ref		
Playing on Soil Habit										
Yes	11	40.74	16	59.26	3.78	1.04-13.66	0.040			
No	4	15.38	22	84.62						
House Floor										
Soil	3	42.85	4	57.15	2.12	0.41-10.79	0.358			
Cement	12	26.09	34	73.01						
Owning of Toilet										
No	9	47.37	10	52.63	4.2	1.22-14.40	0.021			
Yes	6	17.65	28	82.35						
Clean Water Availability										
No	9	25.0	27	75.0	0.16	0.17-2.14	0.437			
Yes	6	35.29	11	64.71						
Father's Occupation										
Soil Contact	12	35.30	22	64.70	2.90	0.71-11.77	0.130			
Non Soil Contact	3	15.79	16	84.21						
Mother's Occupation										
Soil Contact	10	41.67	14	58.33	3.43	1.0-11.85	0.049			
Non Soil Contact	5	17.24	24	82.76						
Father's Education										
Low	13	28.26	33	71.74	0.98	0.16-5.82	0.986			
High	2	28.57	5	71.43						
Mother's Education										
Low	14	29.17	34	70.83	1.64	0.16-16.10	0.6650			
High	1	20.0	4	80.0						
Parent's Income										
Low	14	37.84	23	62.16	9.13	1.41-59.08	0.0191	18.83	1.50-235.9	0.023
High	1	6.25	15	93.75				ref		

Source: Primary Data

that the difference in prevalence between the two areas could be caused clean fingernail cleanness of each areas. Difference of fingernail cleanness between the two areas could be caused by difference in how parents remind their children to cut their fingernail. Most students in highland area were rarely reminded by their parent to cut their fingernail (73.58%),

while most of the students in lowland area were always reminded by their parent to cut their fingernail (90.20%). This showed that short and clean fingernails could decrease the risk of STH infection because the egg and larva could not be left behind in the area between the fingernails. The fingernails were suggested to be cut regularly to prevent helminth transmission

from hand to mouth.

In supporting the increase in implementation of Clean and Healthy Life Behaviors (PHBS), particularly handwashing using soap and fingernail cutting behavior, beside the presence of supportive facilities, teacher's skill and knowledge played a major role in motivating their student to implement that behavior. Teachers were considered second parent which could form children personality during their time at school. A study by Solehati (2015), regarding role of education towards teacher's knowledge and skill and elementary student's personal hygiene in Bandung showed that there was a significant difference in average teacher's knowledge and skill and student's personal hygiene before and after period of intervention. Average student's personal hygiene behavior before intervention towards the teacher was 77.78% and the number increased to 89.54% after intervention. This indicated that clean and healthy life behavior (PHBS) in elementary school student could be improved through teacher's role.

In terms of parent's income, students with parent's income less than regional minimum wage (UMR) have 18.33 times increased risk of STH infection compared to students whose parent's income is greater than UMR, and the difference was statistically significant ($p=0.023$).

The influence of parent's income towards STH infection in highland area showed that the difference of prevalence in each area could be influenced by difference in parent's income. Correlation between parent's income and STH infection could be seen from ability to seek for healthcare facility according to level of income. The result of Susenas 2001 stated that the higher a person's income, the larger the percentage of expenditure to non-food item, including healthcare. Therefore, the high number of STH infection in elementary school student in highland area could be caused by parent's low ability to acquire healthcare service because of low income.

In multivariate analysis, the value of R^2 was 0.3968 which meant that 39.68% of STH infection occurrence in elementary school student in highland area were influenced by those three factors and the rest were influenced by other factors. In Karanganyar which found

that difference in STH infection in elementary school in underdeveloped village and developed village was influenced by habit of not washing their hand with soap before meals and dirty fingernail.

Therefore, in order to decrease risk of STH infection, a good combination between economic social environment, physical environment, and people's knowledge is required. Economic social environment could support physical environment (provision of supporting facility for handwashing). Good physical environment combined with good people's knowledge would lead to good personal hygiene behavior which could decrease the risk of STH infection.

Conclusion

This study showed that in lowland area, only description of risk factor could be obtained because there was only 1 case of infection. Meanwhile, there were several statistically significant risk factors of STH infection in elementary school student in highland area, namely lack of toilet ownership, soil contact occupation of the mother, low parent's income, habit of not washing hand, habit of playing on soil, and dirty fingernail.

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