Soil-transmitted helminth and its associated risk factors among school-aged children

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Abstract. Soil-transmitted helminth is still prevalent among developing region population consisting of three helminthic species infection, Ascaris, hookworm, and Trichuriasis. Poor personal hygiene, poor environmental sanitation, low social economy, and population density are associated with the infection. Our study aimed to determine any significance among purposed risk factor of STH infection. This study was an analytical survey with cross sectional design. The number of samples is 39 student of 101747 Public Elementary School located in Klumpang Kebun Street, Klumpang Kebun Village, Hamparan Perak District, Deli Serdang who are determined based on inclusion and exclusion criteria. The data of personal hygiene, environmental sanitation and socio-economic was obtained by filling in the questionnaire. STH infections data was examined by the Kato-Katz method. Thus, bivariate statistical analysis is established to view the risk factors that play a role in the transmission of STH. Among 39 school age children studied, an overall STH prevalence of 25.6% was found. Questionnaires showed good personal hygiene 74.4%, good environment 77% and high income 53.8%. Also, bivariate analysis showed the strong relationship between the STH risk factor and its infections consisting of personal hygiene (p = 0.000, 95% CI 3.762 - 181.066) and environmental sanitation (p = 0.000, 95% CI 4.367 - 206.071). The significant association of proposed risk factor and STH infection must have led to a specific intervention performed by any official institution including government.

1. Introduction
Globally, the neglected intestinal parasitic infections (IPIs) such as Soil-Transmitted Helminth (STH) and protozoa infections have been recognized as one of the most significant causes of illnesses and diseases, especially among disadvantaged communities. With an average prevalence rate of 50% in the developed world and almost 95% in developing countries, it is estimated that IPIs result in 450 million illnesses [1]. According to WHO report in 2018, more than 1.5 billion people, or 24% of the world’s population, are infected with STH infections worldwide. Infections are widely distributed in tropical and subtropical areas, with the greatest numbers occurring in Sub-Saharan Africa, the Americas, China and East Asia [2]. Globally, an estimated 820 million people are infected with Ascaris lumbricoides, 460 million with Trichiuris trichiura, and 440 million with hookworms [3].

Based on data according to the survey result of the Ministry of Health, the prevalence of STH infections in Indonesia is between 10%–85.9% especially in groups with poor sanitations [4]. The
north sumatera province itself is one of the top ten provinces that has a high worm infection rate and is ranked third (60.4%) in Indonesia [5]. Over 267 million preschool-age children and over 568 million school-age children live in areas where these parasites are intensively transmitted and are in need of treatment and preventive interventions [2]. In Indonesia, de-worming of children in primary school age is still a public health problem because of the high prevalence of infection is at approximately 45%-65%, yet it could rise to about 80% in areas where sanitation is poorly given [6-7]. The children-age group is at risk for IPIs infection because the majority of children's activities are on the ground and the river. So, as a result, the contact with contaminated soil containing hookworm larvae and eggs of roundworms (Ascaris lumbricoides) and whipworm (Trichiuris trichiura) could occur. Poor personal hygiene, poor environmental sanitation, low social economy, and population density will lead to an increase in worm infection transmitted through the ground [8-9].

STH infection is found mainly in areas with warm and moist climates where sanitation and hygiene are poor, including those in temperate zones during warmer months. Worm infection that is transmitted through the ground is stated as a neglected tropical disease (NTD) by the World Health Organization (WHO) for this disease received less attention by health policy makers and they inflict tremendous disability and suffering yet can be controlled or eliminated. The risk of acquiring STH infection and higher prevalence cannot be attributed to just one factor but is due to the coexistence and amalgamation of various biological, social, behavioral and environmental factors like poverty, substandard living conditions and lack of personal hygiene, both at the individual and the community level. Studies in other tropical countries have postulated that the environment and behavior of residents influence the rates of infection [10-12]. There are three proposed-risk factors might associate with STH infections particularly among the school-aged population. Therefore, we want to reveal any significance risk factor with STH incidence.

2. Method

2.1. Study population
The type of observational study used in this research is a descriptive analytic study with cross sectional design. This research was conducted in March - December 2016 in primary school 101747 Village Klumpang Kebun Sub-District Hamparan Perak Regency Deli Serdang. Inclusion criteria for the sample are: elementary school students grade 3-6 who are willing to follow the research and obtaining parental consent. While the exclusion criteria are primary school students suffering from systemic disease, did not fill out the questionnaire completely, has received deworming medicine during the last six months and the students who are not cooperative.

2.2. Questionnaire
Before the commencement of the study, an oral briefing explaining the objectives of the study was given to the participants, and a voluntary written informed consent was taken from each participant. The questionnaire contained four sections: 1. General data of respondents (i.e., name, gender, age, grade, and address), 2. Personal hygiene, 3. Environmental sanitation, 4. Socio-economic. The questionnaire was designed in Bahasa Indonesia. The socio-economic component was obtained by asking the children's guardian.

2.3. Fecal collection and data analysis
After the consent was obtained and a questionnaire answered, a wide mouth screw capped containers pre-labeled with their names and coded were distributed to each participant. Identification of the worm in the feces used Kato-Katz methods and took place in the parasitology laboratory. Kato Katz slide preparation is examined under a microscope with a magnification of 400 times (40x objective and 10x ocular) to observe the hookworm, roundworm (Ascaris lumbricoides) and whipworm (Trichiuris trichiura). The intensity of soil-transmitted helminth infection is classified according to WHO, based on the number of worm eggs per gram of feces, which was observed on Kato-Katz slide [13].
Since the data are classified into categories or groups, the statistical test is performed by using fisher's exact design. The design used in the bivariate analysis is fisher's exact with 95% confidence interval, whereby if \( p < 0.05 \) means that the result of the statistical calculation is meaningful and if \( p > 0.05 \) means that there is no statistically significant calculation. Our study was performed under the approval of the ethical commission of medical research, faculty of medicine, Universitas Sumatera Utara, Medan, Indonesia.

3. Results and Discussions
A total of 39 students consisting of 18 males and 21 females were included in the study. All participant in the study was stated as eligible since the plastic fecal container containing fecal material was carried out by the participant. STH infection was found in 10 participants including Ascariasis, Trichuriasis, and hookworm infection (Table 1). The demographic data was depicted in Table 2.

In this study, there were 9 (23%) infected and 1 (2.6%) uninfected respondent who had poor personal hygiene. While respondents with good personal hygiene included 28 uninfected (71.8%) and 1 (2.6%) infected children. Besides, from the environmental sanitation, 9 (23%) infected respondents had poor environmental sanitation. Besides, there were 29 (74.4%) infected children with good environmental sanitation compared to 1 (2.6%) uninfected children. Based on the results obtained using Fisher's Exact test \( (p < 0.05) \), there was a strong relationship between personal hygiene and environmental sanitation with the incidence of STH infection. The data from socioeconomic factor showed that 11 (28.2%) uninfected and 7 (18.0%) infected respondents had low socio-economic. Furthermore, 18 (46.2%) respondents who had high socioeconomic were uninfected, and 3 (7.6%) respondents were positively infected by STH. Based on the results obtained using Fisher's Exact test, \( (p > 0.05) \) there is no relationship between socioeconomic with the incidence of infection STH.

| Species                                           | n (%)       |
|---------------------------------------------------|-------------|
| *Ascaris lumbricoides*                           | 0 (0)       |
| *Trichuris trichiura*                            | 7 (70)      |
| Hookworm                                         | 2 (20)      |
| *Ascaris lumbricoides+ Trichuris trichiura+ hookworm* | 1 (10)      |
| Total                                             | 10 (100)    |

| Risk Factors          | STH Infection N (%) | p-value   | OR (95% CI) |
|-----------------------|---------------------|-----------|-------------|
|                       | Negative            | Positive  |             |
| Personal Hygiene      |                     |           |             |
| Poor                  | 1 (2.6)             | 9 (23.0)  | 0.000       | 26.100 (3.762-181.066) |
| Good                  | 28 (71.8)           | 1 (2.6)   |             |                |
| Environment Sanitation|                     |           |             |
| Poor                  | 0 (0)               | 9 (23.0)  | 0.000       | 30.000 (4.367-206.071) |
| Good                  | 29 (74.4)           | 1 (2.6)   |             |                |
| Social-economy        |                     |           |             |
| Low Income            | 11 (28.2)           | 7 (18.0)  | 0.141       | 2.722 (0.822-9.011) |
| High Income           | 18 (46.2)           | 3 (7.6)   |             |                |

A total of 25.6% of the students at SDN 101 747 Klumpang Kebun Village were infected by Soil-Transmitted Helminthes (STH). The results obtained were in line with Indonesian Health Department survey which was conducted in 40 primary schools in 10 provinces and, as a result, the percentage of worm infestation ranged from 2.2%-86.3% [14].
Soil-transmitted helminths live in the intestine, and their eggs are passed in the feces of infected persons. If an infected person defecates outside (near bushes, in a garden, or field) or if the feces of an infected person are used as fertilizer, eggs are deposited on soil. Ascaris lumbricoides and hookworm eggs become infective as they mature in the soil. People are infected with Ascaris lumbricoides and Trichuris trichiura when eggs are ingested. This can happen when contaminated hands or fingers are put in the mouth or by consuming vegetables and fruits that have not been carefully cooked, washed or peeled. Hookworm eggs are not infective. They hatch in soil, releasing larvae (immature worms) that mature into a form that can penetrate the skin of humans. Hookworm infection is transmitted primarily by walking barefoot on contaminated soil. One kind of hookworm (Ancylostoma duodenale) can also be transmitted through the ingestion of larvae [15-17].

The factors that led to a high prevalence of worm infection in elementary school children were associated with a lack of knowledge, attitudes, personal hygiene and environmental sanitation [18-19]. From the data obtained, the highest infection was caused by Trichuris trichiura (70%) followed by hookworm infection (20%) and mixed infections (Ascaris lumbricoides, Trichuris trichiura, and hookworm) by 10%. The results of this study were similar with the one conducted in Palembang, where Trichuris. trichiura infection was the cause of most infections (60%) followed by mixed infections (40%) [20]. The study in Malinau Regency also found that the highest prevalence of helminth species is Trichuris trichiura, (53%) [21]. Besides, neighboring countries such as Malaysia also concluded that Trichuris. trichiura (57.4%) caused most of the infection. These results suggested the shift of STH prevalence which used to be led by Ascaris lumbricoides [22]. The difference contamination of worms eggs in different regions may occur because of the dissimilarity of risk factors in the study site, especially those related to personal hygiene, environmental sanitation and geographical conditions [22-23].

According to the result of variables of personal hygiene, the p value was 0.000, which means there is a significant relationship between personal hygiene status and the presence of STH Infections. A prevalence ratio 26.1 indicates that children who have poor personal hygiene status are 26.1 times more likely have a risk infected by STH than the children who have good personal hygiene status. The results were consistent with research conducted by Rusmanto et al. in the Omben Regency on 57 children. The result showed that 8 (14%) student infected with STH. According to data analysis there are significant relationship between personal hygiene with the incidence STH Infection (p = 0.045) [24]. In the study conducted by Rahmawati et al. in Terong Sawah village, West Lombok they found the prevalence of STH infection among elementary student (81.7%), they found a significant correlation between personal hygiene and STH Infection (p<0.05) [25].

According to the result of variables of environmental sanitation, the p value was 0.000, which means there is a significant correlation between environmental sanitation and the presence of STH Infections. A prevalence ratio 30.0 indicates that children who have poor environmental sanitation status are 30.0 times more likely have a risk infected by STH than the children who have good environmental sanitation status. Regarding environmental sanitation, the data received were similar with previous studies performed by Dina et al. in 100 elementary school students in Palu Island showing the significant correlation between environmental sanitation with the incidence of STH infection (p = 0.043) [26]. Furthermore, the study conducted by Fitri et al. in Tapanuli Selatan Regency showed a strong relationship between environmental sanitation with the incidence of STH infection (p = 0.000) [27].

The intervention to personal hygiene (i.e., washing hands with soap before eating, after defecation, playing with dirt, after playing with soil, footwear when outdoors, opening the shoes when playing outside, nail biting, whether the child's fingernails clean and long, washing fruits before eating, and eating food which has fallen to the ground) and sanitary home environment (i.e., daily source of water, clean water reservoirs, defecating facilities provided, the presence of own latrines, enough water provided in the bathroom, soap supply in the toilet and home floor materials) have been shown in the several studies to be highly effective in reducing the prevalence of STH infections among children [28-31]. Based on systemic review and meta-analysis study conducted by Strunz et al. in, they
conclude that WASH (water, sanitation, hygiene) access and practices are generally associated with reduce odds of STH infection [32].

Based on the socioeconomic data, the results of this study were in line with study conducted by Sandy et al. in Keerom Regency, Papua (p > 0.05), showing that the relationship of socio-economic risk factors (education, occupation, and income) and worm infection was not significant since parents with higher education levels would have a better knowledge in terms of clean and healthy living behavior compared with those with low levels of education. The education level of parents played a role in growth, development and the establishment of hygiene behavior in children. If a mother has a good education, especially about the health, she will certainly understand and know how to provide good nutrition for her family. [8] A similar study conducted by Ahmed et al. in primary school, Pahang Malaysia concluded that education and income of parents (father and mother) is not associated with the incidence of infection. [33] Furthermore, another study conducted by Limbanadi et al. in 2013 also showed the absence of a relationship between socioeconomic worm infection, based on the obtained p-value of 0.523 [34].

4. Conclusion
The study showed that soil transmitted helminthes were prevalent among the school children with most of the infections caused by Trichuris trichiura. Furthermore, personal hygiene and environment sanitation were statistically associated with soil transmitted helminthes infections. Therefore, the findings showed that much work remains to be done to improve the health of the students. Measures improvement of socioeconomic status, sanitation, and health education to promote awareness about health and hygiene together with periodic mass deworming are better strategies to control these infections. With effective control measures in place, these communities (especially children) will have a greater opportunity for a better future in terms of health and educational achievement.

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