Factors of soil-transmitted helminths infections in children who live in the surrounding of the final disposal landfill of Sukawinatan, Palembang

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Abstract. Soil-Transmitted Helminths (STH) is a group of nematodes that infect people and transmitted through soil media. STH occurs especially among pre-school and school-aged children, and commonly related to environmental sanitation and personal hygiene. The study objected to determine the factors related to the incidence of STH in children 5-15 years who lived surrounding the Sukawinatan district of Palembang city. The observational analytic using the cross-sectional design, consisted of 110 subjects sampled by consecutive sampling. Data on environmental sanitation and personal hygiene were obtained by questionnaires, while infection status using the Kato-Katz faecal technic. The results were analyzed using Chi-square test (α = 0.05), showed that 24.5% of population where infected with STH. A number of 1-24-2 children were infected with hookworm-Ascaris lumbricoides-Trichuris trichiura infection, respectively. Based on statistical test results, the association of STH infection with variables were: waste disposal (p = 0.268), water facilities (p = 1.000), sewage disposal (p = 0.224), latrine (p = 0.021), hand washing prior to meal (p = 0.001), hand washing after defecate (p = 0.028), use of footwear (p = 0.013), and nail hygiene (p = 1.000). Concluded that the significant factors related to STH were use of latrine, hand washing behaviour, and use of footwear. Further research will be necessary to successfully eliminate this neglected tropical disease.

1. Introduction
Soil-Transmitted Helminths (STH) has globally infected an estimated 438.9 million-819.0 million-464.6 million people, with hookworm-Ascaris lumbricoides-Trichuris trichiura respectively [1]. The vast majority of STH infections occurred in poor countries where access to sanitation and clean water are limited, as well as low personal hygiene [2]. Southeast Asia is an area of the country with the highest prevalence of STH infections during the first four decades [3]. In 2014, approximately 269 million preschool children thought to be infected STH in 102 countries [4-6].

The prevalence of STH in Indonesia is ranging between 60%-90% depending on condition of environmental sanitation [7-11]. In South Sumatra province, prevalence of STH at the primary school were of 38.8%-40.3%-41.0% infection of hookworm-Ascaris lumbricoides-Trichuris trichiura STH are found in areas with the community groups with low personal hygiene and less environmental sanitation [12-14]. The environmental factors that comprised with STH are type of use of latrine, sewage disposal,
waste disposal and water supply [2,15]; while the personal hygiene are habits of hand washing, cutting nails regularly, and the use of footwear [6,16].

The area of the final disposal landfill of Sukawinatan are lacking of good sanitation; while the personal hygiene of children who live surrounding the landfill are also deteriorating. This study provided information on the incidence of STH infections in children aged 5-15 years around the landfill Sukawinatan Palembang, and its relationship with environmental factors and the personal hygiene.

2. Methods
This observational analytic with cross-sectional study design was conducted in March until May 2017, located in the Sukawinatan sub district in Palembang South Sumatra province. The population were children aged 5-15 years (N = 110 samples) selected by consecutive sampling, who were not taking any worm medication within 1 month prior to study and willing to become respondents by signing the parents’ approval. Ethical approval obtained from the Ethics Committee of the Faculty of Medicine, University of Muhammadiyah Palembang.

2.1. Measuring instruments
Measuring instrument used in this study was a microscope and questionnaires. Respondents' stools were examined using the Kato-Katz technique, while questionnaires were used to obtain data on environmental sanitation (clean water supply, garbage disposal, sewage disposal, latrines) and personal hygiene (hand washing behaviour with soap before eating, hand washing with soap after defecation, the use of footwear, and hygiene of nails).

2.2. Statistics Analysis
The data obtained were analysed using SPSS program and displayed in tabular form. The relationship between the dependent variable and independent variables were determined by Chi-square test (α = 0.05).

3. Results
The results were the positive STH stool samples’ infection and the analysis of its’ relationship to environmental sanitation and personal hygiene variables.

3.1. Microscopic examination
Picture 1-2-3 showed the STH, in form of eggs and larvae.

Table 1 showed the percentage of STH, which dominantly infected with *Ascaris lumbricoides*, followed by *Trichuris trichiura*, and hookworm.

3.2. Questionnaire
The significant factors of environmental sanitation and personal hygiene with STH infections were the latrines cleanliness, hand washing behaviour, and used of footwear. With the Fischer’ exact test below
0.2, it can be concluded the significant of the relationship between the variables and the STH infections prevalence.

Table 1. The frequency distribution, species of STH, and the percentage (N=110).

| Soil-Transmitted helminth | Infected | Percentage % |
|---------------------------|----------|--------------|
| All STH                   | 27       | 24.5         |
| Hookworm                  | 1        | 0.9          |
| *Ascaris lumbricoide*     | 24       | 21.8         |
| *Trichuris trichiura*     | 2        | 1.8          |

Table 2. The relationship of STH infections with environmental sanitation and personal hygiene factors (N=110).

| Variables                  | Good Infection | Bad Infection | % Ratio | Fisher Test (%) |
|----------------------------|----------------|---------------|---------|-----------------|
| Clean water facilities     | 24             | 71            | 3       | 12              | 1.000 |
| Garbage waste              | 11             | 44            | 16      | 39              | 0.268 |
| Sewers waste               | 13             | 51            | 14      | 32              | 0.224 |
| Latrines cleanliness       | 15             | 65            | 12      | 18              | 2.89  |
| Handwashing Prior to Meal  | 13             | 67            | 14      | 16              | 4.5   |
| Handwashing After Defecation| 17             | 69            | 10      | 14              | 2.9   |
| Using Footwear             | 23             | 82            | 4       | 1               | 14.3  |
| Cutting Nails Regularly    | 25             | 74            | 2       | 9               | 1.000 |

4. Discussions

Worm infections are commonly infecting people whose activity mostly contact with ground, such as children of preschool and school age [5,16]. The symptoms often overlooked because of the slow manifestation and even asymptomatic such as mild abdominal pain, anxiety, nausea, vomiting, diarrhoea, constipation, and loss of appetite [13].

The results showed that environment factors risk to worm parasite infection. Although there was not a significant difference in STH infection prevalence between children who have a good of sewage waste, garbage waste, and clean water facilities; children with bad latrine facilities had almost three-time risk of being infected as compared with children with a good latrine facility. The life-cycle of STH matched the infection density, as the infective form of infection started as eggs which passed from the stools. The participant who was tested positive with infection had a poor latrine condition. The findings in this study are of relevance helminth biology, as they highlight the close relationship between the transmission of STH with infection status [17]. Environment factors plays crucial determinants of the distribution of helminth infections [18].

The results showed that personal hygiene factors doubled the risk to worm parasite infection. Although there was not a significant difference in STH infection prevalence between children who did not cut their nails regularly [19]; children with bad habits while hand washing and using no footwear had almost fifteen-time risk of being infected as compared with children with a good one. Lack of attitude such as forgetting to wear sandals, or failing to wash hands after defecating or before eating; will led to soil transmitted helminth [8]. The result is inconsistent with other study in Malaysia on parasitic disease, where there was no significant difference in personal hygiene with prevalence and intensity with STH infection [20]. Washing hands properly is one of the most effective ways to prevent the spread of disease [21]. Adding soap has been shown to reduce the incidence of parasitic worm infections. The most important moment where the hands should be washed with soap and water is when after defecation, after cleaning a child defecation [2,9].

The use of personal protective equipment such as footwear can break the chain of transmission of soil-transmitted helminth. Walking barefooted can affect the incidence especially in children who often play in the media ground [22,23].

Air pollution in a slum landfill neighbourhood would higher the risk of STH infection. Cockroaches and housefly were found to be a potential physical transmitter and significantly contribute to the spread of food borne parasitic diseases [24]. The potential mechanical vector for
parasite infection as its role in disease transmission should be not being under rated. *A. lumbricoides* eggs on the flies could be carry and spread to other places up to 20 miles to unsanitary sites [25]. Further research regarding vector of mechanical transmission in landfill should be investigated. It becomes urgently for on improving the existing standard of environmental sanitary condition.

5. Conclusions
There is a significant relation of STH to the cleanliness of latrines, the washing hands with soap before eating and after defecation and the use of footwear in the study. Further research should proceed on how to lower the incidence of STH with better environmental sanitation and change of personal hygiene behavior.

6. References
[1] Pullan R L, Smith J L, Jasrasaria R and Brooker S J 2014 Global numbers of infection and disease burden of soil transmitted helminth infections in 2010 *Parasites and Vectors* 7 1–19
[2] Strunz E C, Addiss D G, Stocks M E, Ogden S, Utzinger J and Freeman M C 2014 Water, Sanitation, Hygiene, and Soil-Transmitted Helminth Infection: A Systematic Review and Meta-Analysis *PLoS Med.* 11
[3] Silver Z A, Kaliappan S P, Samuel P, Venugopal S, Kang G, Sarkar R and Ajjampur S S R 2018 Geographical distribution of soil transmitted helminths and the effects of community type in South Asia and South East Asia – A systematic review *PLoS Negl. Trop. Dis.* 12 7–16
[4] Assoum M, Ortu G, Basaño M G, Lau C, Clements A C A, Halton K, Fenwick A and Soares Magalhães R J 2017 Spatiotemporal distribution and population at risk of soil-transmitted helminth infections following an eight-year school-based deworming programme in Burundi, 2007-2014 *Parasites and Vectors* 10 1–12
[5] Alelign T, Degarege A and Erko B 2015 Soil-Transmitted Helminth Infections and Associated Risk Factors among Schoolchildren in Durbete Town, Northwestern Ethiopia. *J Parasitol Res* 2015 641602
[6] Baker J M, Trinies V, Bronzan R N, Dorkenoo A M, Garn J V., Sognikin S and Freeman M C 2018 The associations between water and sanitation and hookworm infection using cross-sectional data from Togo’s national deworming program *PLoS Negl. Trop. Dis.* 12 1–15
[7] Dunn J C, Turner H C, Tun A and Anderson R M 2016 Epidemiological surveys of, and research on, soil-transmitted helminths in Southeast Asia: A systematic review*Parasites and Vectors*9 1–13
[8] Albright J W, Hidayati N R and Basaric-Keys J 2005 Behavioral and hygienic characteristics of primary schoolchildren which can be modified to reduce the prevalence of geohelminth infections: A study in central Java, Indonesia *Southeast Asian J. Trop. Med. Public Health* 36 629–40
[9] Winita R, Mulyati and Astuty H 2012 Upaya Pemberantasan Kecacingan di Sekolah Dasar *Makara* 16 65–71
[10] Novianty S, Dimyati Y, Pasaribu S and Pasaribu A P 2018 Risk Factors for Soil-Transmitted Helminthiasis in Preschool Children Living in Farmland, North Sumatera, Indonesia *J. Trop. Med.* 2018
[11] Wiria A E, Hamid F, Wammes L J, Prasetyani M A, Dekkers O M, May L, Kaisar M M M, Verweij J J, Guigas B, Partono F, Sartono E, Supali T, Yazdanbakhsh M and Smit J W A 2015 Infection with soil-transmitted helminths is associated with increased insulin sensitivity *PLoS One* 10 1–11
[12] Refirman D J 1998 *Faktor Pendukung Transmisi Soil Transmitted Helminths pada Murid Sekolah Dasar di Dua Dusun Kabupaten Musi Banyuasin Sumatera Selatan* (Thesis Universitas Indonesia, Jakarta)
[13] Garzón M, Pereira-da-Silva L, Seixas J, Papoila A L and Alves M 2018 Subclinical enteric parasitic infections and growth faltering in infants in São Tomé, Africa: A birth cohort study *Int. J. Environ. Res. Public Health* 15 1–16
[14] Ong X, Wang Y C, Sithithaworn P, Namsanor J, Taylor D and Laithavewat L 2016 Uncovering the Pathogenic Landscape of Helminth (Opisthorchis viverrini) Infections: A Cross-Sectional Study on Contributions of Physical and Social Environment and Healthcare Interventions
[15] Engering A, Hogerwerf L and Slingenbergh J 2013 Pathogen–host–environment interplay and disease emergence Emerg. Microbes Infect. 2 e5

[16] Mardiana and Djariswamawati 2008 Prevalensi cacing usus pada murid sekolah dasar wajib belajar pelayanan gerakan terpadu pengentasan kemiskinan daerah kumuh di wilayah DKI Jakarta J. Ekol. Kesehat. 7 769–74

[17] Brooker S, Singhasivanon P, Waikagul J, Supavej S, Kojima S, Takeuchi T, Luong T V. and Looareesuwan S 2003 Mapping soil-transmitted helminths in Southeast Asia and implications for parasite control Southeast Asian J. Trop. Med. Public Health 34 24–36

[18] Hotez P J, Brindley P J, Bethony J M, King C H, Pearce E J and Jacobson J 2008 Helminth infections: the great neglected tropical diseases J. Clin. Invest. 118 1311–21

[19] Sofiana L, Sumarni S and Ipa M 2011 Fingernail biting increase the risk of soil transmitted helminth (STH) infection in elementary school children Heal. Sci. J. Indones. 2 81–6

[20] Yusof A M and Isa M L M 2017 Knowledge, Attitude and Practices of Intestinal Helminths and Protozoa Infection Among Parents of School Children In Peripheral School and Urban School Area in Kuantan, Pahang, Malaysia J. Biotechnol. Strateg. Heal. Res. 1 75–82

[21] Acka C A, Raso G, N’Goran E K, Tschannen A B, Bogoch I I, Séraphin E, Tanner M, Obrist B and Utzinger J 2010 Parasitic worms: Knowledge, attitudes, and practices in western côte d’ivoire with implications for integrated control PLoS Negl. Trop. Dis. 4 1–14

[22] Ali R U and Affandi D 2016 Hubungan Personal Hygiene dan Sanitasi Lingkungan dengan Angka Kejadian Kecacingan ( Soil Transmitted Helminth ) Pada Petani Sayur di Kelurahan Maharatu Kecamatan Marpoyan Damai Kota Pekanbaru Din. Lingkung. Indones. 3 24–33

[23] Masaku J, Mwende F, Odhiambu G, Musuva R, Matey E, Kihara J H, Thuita I G and Njomo D W 2017 Knowledge, practices and perceptions of geo-helminthes infection among parents of pre-school age children of Coastal region, Kenya PLoS Negl. Trop. Dis. 11 1–18

[24] Balla H J, Usman Y and Muhammad A 2014 The role of housefly (Musca domestica) in mechanical transmission of intestinal parasites in Maiduguri Metropolis, North Eastern Nigeria. J. Nat. Sci. Res. 4 60–5

[25] El-Sherbini G T and Gneidy M R 2012 Cockroaches and flies in mechanical transmission of medical important parasites in Khaldyia Village, El-Fayoum, Governorate, Egypt J Egypt Soc Parasitol 42 165–74

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