

An overview of Soil-Transmitted Helminth Infections and Personal Hygiene in Stunting Toddlers at the Ngagel Rejo District, East Java, Indonesia

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ABSTRACT

Infections caused by soil-transmitted helminths and stunting in children under the age of five remain a public health concern in low-income countries with inadequate sanitation and hygiene and low levels of education and income, including Indonesia. This research focuses on describing the incidence of soil-transmitted helminth (STH) infection in stunted toddlers based on demographic characteristics, disease history, anthropometric status, and the application of a clean and healthy lifestyle. Research method was descriptive study and carried out in the Ngagel Rejo Public Health Center Surabaya, East Java-Indonesia, on the total population of stunting toddlers (n=23). STH infection data were collected by examining the feces of stunting toddlers using direct's smear method with 10% eosin preparation anthropometric data was collected by measuring height per age using microtoise and demographic data, history of illness, and application personal hygiene were collected by conducting interviews and filling out questionnaires for parents/mothers/caregivers of stunting toddlers. The findings revealed that 30.43 % of stunting toddlers were infected with STH (*A. lumbricoides* and *T. trichiura*), girls were more infected than boys, and the 37 – 48 months age group was the most infected with STH. There is a history of illness in the previous three months in stunting toddlers and a lack of handwashing before eating and after defecating. STH is prevalent in stunted toddlers, and ongoing health promotion is required to break the chain of STH transmission.



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1. INTRODUCTION

Helminth infections are one of the neglected diseases that are often found in areas with low socioeconomic and sanitation hygiene. There are various causes of helminth infection; soil-transmitted helminth/STH is one of the main causes. The global prevalence of STH infection globally reaches 30% of about 1.5 million people. Geographic distribution of this disease on several continents in tropical and subtropical climates such as Africa, China, Southeast Asia, and America [1]. The term STH is associated with the role of soil as a medium for developing the helminth's egg / larval stage to turn into an infective stage. STH species include *Ascaris lumbricoides/A.lumbricoides*, hookworm (*Ancylostoma duodenale/A.duodenale*, and *Necator americanus/N.americanus*), and *Trichuris trichiura/T.trichiura* [2], [3].

Indonesia is a tropical country with low socioeconomic, poor sanitation, and population hygiene, which predisposes to the development of STH infection [4]. The prevalence of helminth infections in Indonesia ranges from 2.5 - 62% and infects people of all ages, even though children are most susceptible to infection [3]. STH patients who defecate on the ground are the source of the infection. The soil will become contaminated with the patient's feces and serve as a breeding ground for STH eggs. The humid and tropical/subtropical climate is ideal for developing worm eggs. STH can be transmitted to other humans through the ingestion of eggs or human skin penetration by infective larvae [5]. Strategies for preventing STH transmission include the practice of clean and healthy living (washing hands before eating and after defecating, wearing footwear, not defecating in any place, drinking boiled water, and availability of clean water for daily needs [1], [6]. In humans, helminth infections in the intestine have a negative effect on mortality, appetite, development, physical ability, school enrolment, and academic intellectual capacity [7].

Toddlers, particularly stunted toddlers, are the most vulnerable to infection. Stunting is defined as a child's height or body length being smaller than their age [8]. Stunting is caused by a nutritional deficiency within the first 1,000 days of life, from a fetus to a two-year-old baby. Stunting is also caused by poor sanitation, a lack of access to clean water, and environmental hygiene. Poor hygiene conditions force the body to fight the source of the disease more aggressively, which inhibits nutrient absorption [9]. Stunting conditions can have various negative consequences that must be dealt with throughout the child's life, the most serious of these consequences is an increased chance of infection and child mortality [10]. Stunting will affect 144 million people worldwide by 2020. Southeast Asia accounted for more than half of the prevalence of stunting (55.9 %) [11]. According to the Ministry of Health's 2020 performance report, the stunting rate in Indonesia reached 11.6 percent, with East Java exceeding the national stunting average of 12.2 % [12].

Stunting toddlers have a weakened immune system and are easily infected. Helminth infection, particularly STH infection, is one infectious disease that afflicts stunted toddlers [13]. Because clinical manifestations will be more severe in hosts with weak immune systems than in hosts with robust immune systems, the risk of morbidity and mortality due to STH infections in stunted toddlers will be higher than in normal toddlers [14]. Stool examination on toddlers to detect STH infection is not a national program in Indonesia, so it is possible that many toddlers, particularly stunting toddlers, have been infected but not detected. Infectious diseases can exacerbate stunted toddlers' malnutrition to the point of death.

According to the information presented above, the researcher intends to describe the infection of STH on stunted toddlers and incidence of STH based on demographic, anthropometric status, history of illness, and personal hygiene behaviors, and sanitation, at the Ngagel Rejo Community Health Center in Surabaya, East Java, Indonesia.

2. MATERIALS AND METHODS

2.1 Research design

The design of this research is a descriptive study that describes socio-economic conditions, education level, history of illness, nutritional pattern, implementation of clean and healthy living behavior, and detection of helminth's infection. The data is gathered in 2 steps:

1. The first step is demographic data, history of illness, and implementation of clean and healthy living behavior was carried out using direct interviews with questionnaires. The interviewees are mothers or caregivers of stunted toddlers.
2. The second step involved measuring anthropometric data (height/age)
3. The third step involved collecting and examining stunted toddlers' feces to detect STH infection.

The study was done on a voluntary basis, with the respondents filling out a form indicating their willingness to participate. The ethics committee of Hang Tuah University Medical School gave its approval to the entire research process.

2.2 Respondents

Respondents of this study are the total population of stunting toddlers at the Ngagel Rejo district, Surabaya, Indonesia, which was about 23 stunting toddlers. Data on stunting toddlers was obtained from the Ngagel Rejo Health Center. The timeline of the research is carried out from August to October 2021.

2.3 Data collection of identity and history of infection for toddlers and mothers

Collection identity and history of illness for toddlers and their mothers through the process of interviewing. Interviews with questionnaires yielded the following information:

1. Stunting toddlers' self-identity (age, gender).
2. A toddler's history of illness, frequency of illness, sanitation, and personal hygiene implementation.

2.4 Anthropometric Evaluation

Anthropometric evaluations were taken in accordance with a standard procedure, equipment, and circumstances. The parameters were measured under standardized conditions by qualified technicians. All the instrumentation was calibrated and validated prior to assessment [15]. A microtoise has been used to determine height to the nearest 0.1 cm [16]. Height according to age describes the chronic condition of nutritional status and has become the standard benchmark for determining stunting or normal conditions. The parameter (height) was measured twice, and a mean value was determined. height-for-age Z-scores were determined using growth standards based on the WHO standard reference. A cut-off of -2 and -3 Z scores for height-for-age and classification as: (1) severely stunted if -3 Z scores; (2) stunted if -3 to -2 Z scores; and (3) normal if -2 to +3 Z scores [15], [17]s.

2.5 Implementation of Sanitation & Personal Hygiene.

Data on the sanitation and application of personal hygiene were gathered through interviews with questionnaires distributed to respondents. This is a closed question with two possible answers: "yes" or "no.". The respondents were asked seven questions, including the mother's soap-washing pattern before attempting to eat and after pooping, toddlers' practice of washing their hands before having eaten and after pooping, the habit of wearing footwear when making activities outside the home, the habit of defecating in the latrine, and the habit of drinking clean water. Water that has been properly cooked/mineral water/refill water.

2.6 Stool Examination

The essential standard for the diagnosis of helminthiasis is established by the discovery of adult worms, larvae, and eggs of helminths in the patient's stool sample [18]. The stool samples were collected by providing a stool tube containing formalin 10 % (preserve the structure of helminths eggs and labeled with the identity

of a stunted toddler, wooden sticks, dark plastic to wrap the stool tube, and instructions to take a stool sample [19]. Stool samples were sent to the bioscience and biology laboratory of the ITS (Institute Technology Sepuluh November) in Surabaya, Indonesia. Helminths are detected using a direct smear technique and 10% eosin preparation [18]. Two different examiners used a microscope with a magnification of ten times to make observations.

3. RESULTS

Respondent data can be classified based on the gender of stunting toddlers, parental education level, and income level of stunting toddlers as follows:

Table 1. Characteristics of Respondents

Description	Σ	%
Gender		
Boys	13	56.52
Girls	10	43.47
Age		
12- 24 months	2	8.69
25 - 36 months	7	30.43
37 - 48 months	10	43.47
49 - < 60 months	4	17.39

Based on the data above, the respondents of stunting toddlers are dominated by boys (56.52%), higher than girls around 43.47%. The highest percentage of respondents' age is in the range of 25 - 48 months (73.45%), and the 12 - 24 months age group has the fewest respondents (8.69%). The data on the results of the examination of stunting toddlers' stool samples is presented in the table below:

Table 2. Stool Examination

Result	Σ	%
Positive	7	30.43
Negative	16	69.57
Total	23	100

It appears that the rate of helminthiasis/ STH infection in stunting toddlers reaches 30.43%. The type of STH found in the respondents revealed that six children (26.8%) were infected with *A. lumbricoides*, and one child (4.35%) was infected with *T. trichiura*. The following table is the results based on the respondent's demographic information and the diagnosis of STH infection:

Table 3. Characteristic Respondents & STH Infection

Demographic Data	STH Infection		No STH Infection		Total	
	Σ	%	Σ	%	Σ	%
Gender						
Boys	3	13.04	10	43.48	13	56.5

Girls	4	17.39	6	26.09	10	43.5
Age						
12 - 24 months	1	4.35	1	4.35	2	8.70
25 - 36 months	1	4.35	6	26.08	7	30.43
37 - 48 months	4	17.39	6	26.09	10	43.48
49 - < 60 months	1	4.3	3	13.04	4	17.39

According to the data in the table, STH infections appear to be more common in girls (17.39%) than in boys (13.04 %). Toddlers aged 37 - 48 months are the age group most infected with STH (17.39 %); meanwhile, the percentage of STH infection is the same across all age groups (4.35%).

Table 4. Anthropometric Examination & STH Infection

Stunting Groups	STH Infection		No STH Infection		Total	
	Σ	%	Σ	%	Σ	%
Severely stunted	1	4.35	2	8.70	3	13.05
Stunted	6	26.08	14	60.86	20	86.95
Normal	0	0	0	0	0	0

Based on the anthropometric assay showed that toddlers with stunted conditions with STH infection reached 26.08%, and severely stunted toddlers with STH infection were 4.35 %. The following table shows data from respondents on the history of infections experienced by toddlers in the previous three months:

Table 5. STH Infection and History of Toddler's Infection

Description		STH Infection		No STH Infection		Total	
		Σ	%	Σ	%	Σ	%
History of illness in toddlers in the last 3 months	Yes	7	30.43	1	4.35	8	34.78
	No	0	4.35	15	65.22	15	65.22
Frequency of illness in toddlers in the last 3 months	Never	1	4.35	14	60.86	15	65.21
	< 3 times	5	21.74	1	4.35	6	26.09
	> 3 times	2	8.70	0	0.00	2	8.70

According to the data in the table, 34.78 % of stunting toddlers have had an infection in the previous three months, and 26.09 % have been sick less than three times in the previous three months. The rest of the group had not been sick in the previous three months. The percentage of stunting toddlers who have not been sick in the previous three months is 65.22 %. There was a history of illness in the last three months in toddlers who contracted STH infection, but only one child who had a history of illness in the last three months was not detected with STH infection. There are five STH-infected toddlers (21.74%) who have been sick less than three times in three months and two STH-infected toddlers (8.70%) who have been sick more than three times in three months. Data regarding the application of the respondent's clean and healthy living behavior are

summarized in the following table:

Table 6. STH Infection, Sanitation, & Implementation of Personal Hygiene

Description		STH Infection		No STH Infection		Total	
		Σ	%	Σ	%	Σ	%
Mother's habit of washing hands with soap before eating	Yes	4	17.39	10	43.48	14	60.87
	No	3	13.04	6	26.09	9	39.13
Mother's habit of washing hands with soap after defecation	Yes	6	26.09	15	65.22	21	91.30
	No	1	4.35	1	4.35	2	8.70
Before eating, toddlers wash their hands with soap.	Yes	3	13.04	9	39.13	12	52.17
	No	4	17.39	7	30.43	11	47.83
After defecation, toddlers wash their hands with soap.	Yes	1	4.35	13	56.52	14	60.87
	No	6	26.09	3	13.04	9	39.13
Toddlers are used to putting on footwear when they go outside	Yes	0	0.00	21	91.30	21	91.30
	No	1	4.35	1	4.35	2	8.70
Using the latrine to defecate	Yes	0	0.00	23	100.00	23	100.00
	No	0	0.00	0	0.00	0	0.00
Consumption of boiled water/ mineral water/ refill water	Yes	0	0.00	23	100.00	23	100.00
	No	0	0.00	0	0.00	0	0.00

According to data on the implementation of personal hygiene, toddlers infected with STH have a pattern of not washing their hands with soap after defecating (26.09%), before eating (17.39%), and mothers or caregivers do not use soap to clean their hands before consuming food or after pooping. (13.04%) and after defecating (4.35%).

4. DISCUSSION

Based on the outcomes of this study, there are 30.43 % stunting toddlers infected with STH/helminthiasis. The most common cause of infection was *A. lumbricoides* (26.8%), followed by *T. trichiura* (4.35%), and hookworm infection was not found in this study. Another study on STH infection in children aged 12-59 months in NTT found a higher incidence rate of 58.8 %, with *A. lumbricoides* (47.4 %), *T. trichiura* (36.8 %), and hookworm (9.2%) [20]. Another study in the Surabaya area with samples of elementary school-age children in grades 1 and 2 found a lower percentage of incidence than this study, with the STH infection rate reaching 13.4 % and all causes being *A. lumbricoides* [21]. The difference in incidence in this study is likely due to the different sample sizes, the study area that affects environmental conditions, different levels of

population density, socioeconomic levels, education levels, and levels of helminth endemicity. Nusa Tenggara Timur is a province in Indonesia with high helminth endemicity with lower levels of sanitation and population hygiene than urban areas on this study; meanwhile, Surabaya was a rural area with a higher population and a lower population endemicity on helminth's infection. Various variables also influence the differences in the STH parasites discovered because the spread of parasites has been a dynamic process that scientists are still debating. Thus, parasite transmission to the next host is a crucial facet of parasite fitness for continued existence, which can be impacted by host/parasite genetic, host immunity response, parasite susceptibility, ecosystem, and parasite incidence rate [22].

STH (Soil-Transmitted Helminth) is a nematode worm that develops into an infective form only in the presence of soil. Infections caused by STH are most common in warm, humid climates with poor sanitation and hygiene [23]. The adult STH worm can be found in the intestines and reproduces to lay eggs. The eggs are passed through within the stool of the host. The STH eggs will contaminate the soil if the host defecates in the soil area. STH eggs that come out with stool are non-infectious stage and take several days or weeks in the soil medium to develop into an infectious stage [7]. There are two types of STH found in this study, *A. lumbricoides* and *T. trichiura*, both of which were transmitted accidentally through hand to mouth or fecal oral. All STH residing in intestinal tracks caused cause inflammation and pathological abnormalities in intestinal tissue. Clinical symptoms vary according to the density of worms in the intestinal tract. Clinical manifestations can be asymptomatic until various symptoms of intestinal disorders appear, such as abdominal discomfort, diarrhea, constipation, anemia, chronic bleeding at the site of adult worm digestive tract attachment, obstruction if the number of worms is large, malnutrition, Loeffler's syndrome (cough, dyspnea, and wheezing complaints due to larval migration), growth and mental retardation [1], [24]. Examination of STH infection and gender of toddlers proved that girls are more likely than boys to be infected with STH. The same result was shown by research, which can probably occur because of the different parenting methods, girls have more outdoor activities and contact with polluted fecal soil, the practice of washing hands after playing on the soil surface, the habit of cutting nails, and other habits related to the application of clean living and health differences between boys and girls [25]. However, the research of shows different outcomes where boys are more infected with helminths than girls. To date, there is no evidence that gender is related to susceptibility or predisposition to STH infection, implying that the difference in results is due to factors other than gender [20].

This study showed that STH is most found in toddlers aged 37 to 48 months (17.39 %) other aged groups. When compared to other age groups, toddlers under the age of 12 months have the lowest incidence of STH. The risk of STH infection increases as a toddler's age exceeds 12 months [20]. This seems to be due to the absence of awareness about the significance of personal and environmental hygiene, which is accompanied by an increase in children's activities outside, increasing the risk of STH exposure. Soil-transmitted helminths infection can infect adults; however, children are more susceptible to helminth infections. Furthermore, poor parental understanding and attention contribute to a higher incidence of intestinal worms in children. Adults, on the other hand, already understand and appreciate cleanliness., resulting in a low number of adult incidents [21]. The anthropometric examination revealed that a total of 30.43% of stunted toddlers have STH infection consisting of 26.08% stunted toddlers and 4.35 % severely stunted toddlers. The emergence of stunting is one of the abnormalities or anomalies in toddler growth. Short stature is a symptom of stunting, which is a chronic malnutrition problem. Stunting patients are more prone to disease, have a lower level of intelligence, and are less productive [17]. The previous study stated that infection of STH (*T.trichiura*) has become one of the stunted predictors on elementary school-aged children in Ethiopia, even though analytical statistics didn't show any significant correlation [26]. Another study showed that school-aged children with STH infection have 1.85 more risks to get malnutrition (particularly stunted) than children without any history of infection.

STH can affect growth and development in children through various mechanisms, including dietary deficiencies due to malabsorption and/or decreased appetite [27].

According to the findings of this study, all toddlers with STH infection have a history of illness in the previous three months (30.43%), even if they have experienced illness frequency more than three times during that time (8.70%). And toddlers who have experienced pain frequency less than three times during that time (21.74 %). Previous research has found that infection and the incidence of stunting in toddlers have a reciprocal relationship. One of the predictors of stunting in toddlers is a history of infectious disease. The infectious process increases metabolic activities, which necessitate more nutritional adequacy than toddlers without infectious diseases history [10]. High nutritional requirements without being accompanied by proper and balanced nutrition will cause malnutrition and stunting in toddlers. Stunting, on the other hand, reduces a toddler's immune response to pathogen exposure, increased susceptibility to infection. STH infections are generally long-term illnesses. Adult STH worms residing in sufferers' intestines will disrupt the absorption of nutrients required by the human body. Long-term malnutrition will result from chronic absorption disorders, and stunted toddlers will be affected more severely than normal toddlers [28]. Helminth's infection may exacerbate host malnutrition due to their physical barrier and/or competitors for food. Children's health, nutritional status, and cognitive growth may be negatively affected by STH infections. Multiple parasitisms and large helminth density can cause a risk of mortality [26].

Evaluation of personal hygiene behaviors implementation showed that the parents of toddlers and stunted toddlers infected with STH do not adopt four STH transmission prevention measures, including mother/caregivers aren't washing their hands with soap after defecating (26.09%) or before they are eating (17.39%), and toddlers do not practice to clean their hands using soap before consuming food (13.04%) and after pooping (4.35%). According to, the habit of mothers/caregivers not washing their hands is the most important risk factor for the spread of STH infection in preschool children in Sumatera Utara [29]. Outcome's research of in Western Uganda revealed that several habits related significantly to STH infection in preschool children, including consuming uncooked or unwashed vegetables and fruits, improper removal of young children's feces, failing to wash hands after defecation, and failing to deworm children regularly [30]. Helminthiasis epidemiology is always related to individual hygiene status [31- 33]. Personal hygiene issues can raise the risk of helminthiasis. However, the individual's hygiene status is primarily influenced by his or her habits, awareness, level of knowledge, and socioeconomic status. Individual hygiene includes the practice of wearing footwear, washing hands with soap, and running water, drinking clean water, and defecating in latrines [22]. One of the factors influencing the occurrence of worms in toddlers is the pattern of parenting and caregivers. And the parents/caregivers' responsibility is to educate and implement clean and healthy behavior patterns; if they teach and implement a clean and healthy lifestyle for their children, the risk of STH infection can be reduced.

5. CONCLUSION

In the work area of the Ngagel Rejo Health Center, the incidence of STH infection in stunted children under the age of five reached 30.43 %, with *A. lumbricoides* and *T. trichiura* being the main causes of infection. This study shows that STH infections are more common in girl respondents, who are between the ages of 36 and 48 months. Many considerations that may contribute to the incidence of STH infection in toddlers include a history of illness and the frequency of illness in the previous three months, stunting conditions, and the practice of clean and healthy living habits (washing hands with soap before eating and after defecating by mothers/caregivers and toddlers). This finding demonstrates the importance of promoting sustainable sanitation and individual hygiene in families with stunted toddlers to break the chain of transmission of intestinal parasite infections. Stunting toddlers who are infected with intestinal parasites require medical

attention to avoid deteriorating nutritional status and aggravating complications.

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