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The Relationship Between Soil Transmitted Helminthes (STH) Infection and Nutritional Status in Students of State Elementary School Number (SDN) 200 Palembang Indonesia

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Abstract

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Background: Infection of *Soil Transmitted Helminthes* (STH) is caused by intestinal nematodes where as in its life cycle, soil is needed as the media for the eggs or larvae to mature into effective forms, most commonly happen to children of school age. This infection is still one of the main problems in public health, including Indonesia. STH infection are widely distributed in tropical and subtropical areas. Lack of personal hygiene, poor environmental sanitation and low socioeconomic status are some factors that plays role in increasing the occurrence of the infection. This infection is also one of the causes responsible for malnutrition in children by decreasing appetite and food intake thus ensued adverse consequences such as declining growth pace, impairment of physical health, and weakening cognitive function. This study was conducted to analyze the association of STH infection with nutritional status of SDN 200 students in Kelurahan Kemas Rindo, Kertapati District, Palembang.

Methods: This study was an analytic observational research with a cross sectional research design. Samples consist of 107 students chosen using proportional stratified random sampling technique. Data was collected by direct interview using questionnaires, measuring body weight and height to obtain nutritional status which then classified using CDC 2000 growth curve while fecal contamination was examined using *Kato Katz* and modified *Harada Mori* methode in the Laboratory of Parasitology Medical Faculty of Universitas Sriwijaya. Data then analyzed using *Chi-square* test.

Results: From 107 students, 27.1% infection of STH was found on 29 students with 6 students (20.7%) infected by *A. lumbricoides* and 23 students (79.3%) infected by *T. trichiura*. Proportion of malnutrition status was found at 43.9%. Statistical test showed a significant association between STH infection and nutritional status ($p=0.036$; OR=3.167; CI 95%: 1.163-15.237).

Conclusion: There was a significant association between STH infection and nutritional status in students of SDN 200 Kelurahan Kemas Rindo Kertapati District Palembang City.

Keywords: STH infection, Nutritional status, Analytic observational, Primary students, Palembang city.

Introduction

Infectious diseases are still one of the main problems in the world, especially in developing countries like Indonesia, such as infectious intestinal worms. This worm infection is transmitted by soil or known as Soil Transmitted Helminthes (STH).¹ This disease belongs to the group of Neglected Tropical Diseases (NTD), which is a group of diseases that still occur in many communities but received less attention.² Types of STH worms that often cause infection include *Ascaris lumbricoides*, *Trichuris trichiura*, and hookworm (*Ancylostoma duodenale* dan *Necator americanus*).³

CDC (2013) shows that the estimated population of the world infected by *A. lumbricoides* ranges from 807 million-1.221 billion people, *T. trichiura* ranges from 604-795 million people, and hookworms range from 576-740 million people.⁴ The high number of such incidents also occurred in Indonesia. In Indonesia, based on data obtained from the Ministry of Health (2009) on the prevalence of STH infection in 2006 spread in 27 provinces was 42.8% with most infections caused by *T. trichiura* (24.2%), *A. lumbricoides* (17.6%), and hookworm (1%).⁵

More than 270 million preschoolers and 600 million school-age children worldwide live in areas with high rates of STH infection.⁶ In South Sumatra, a study conducted on elementary school students in Sukarami Village, Kecamatan Pemulutan, Ogan Ilir District is found in 10% of worms infected students, with 7% in boys and 3% in girls.⁷ Other study at SDN 129 Sematang Borang District Palembang City, which higher is 25.5% infected by the worms with 15.5% in boys and 10% in girls.⁸

Worms infection associated with decreased appetite and food intake that can cause adverse consequences such as declining growth pace, impairment of physical health, decreased activity, weakening cognitive function, to malnutrition in children.^{9,10} Lack of personal hygiene, poor environmental sanitation, low socioeconomic status and high population density are factors contributing to an increase in the incidence of STH infection in primary school students.¹¹

Children are the most common people suffering from worm infection, especially primary school-age children because they often play or contact with the soil that grows and develops the worms. The occurrence of worms in primary school-age children can inhibit the growth and development of physical and cognitive that is in a period of rapid and active growth. At this age the child should get balanced nutrition and quality. If this condition get left for long periods of time, the child may suffer from malnutrition, may even become Protein Energy Loss (PEM). This situation causes disruption to the growth and development of children and the deterioration of the quality of life of children, whereas the children are the potential of human resources in the future and is an investment of the nation that will become the successor of this nation's struggle. Thus, it is necessary to conduct research to know the incidence of STH infections in students of SDN 200 Kertapati District Palembang City and its relationship with nutritional status.

Method

This study was an analytic observational research with a cross-sectional research design. This study was conducted in SDN 200 Kertapati District Palembang City and Laboratory of Parasitology Medical Faculty of Universitas Sriwijaya from August to December 2017.

Population in this study was all student of SDN 200, Kertapati District, Palembang City which amounted to 323 students. Samples consist of 107 students who met the inclusion criteria and pass the exclusion criteria, selected by proportional stratified random sampling technique and simple random sampling.

The dependent variable in this study was nutritional status. The independent variable in this study was age, gender, grade level, parents' occupation, parental education level, parents' income, and STH infection. The data were collected by direct interviews on the subjects using questionnaires, weight and height measurements to obtain nutritional units which were then classified using the CDC 2000 growth curve, and the stool examinations collected were examined using the *Kato Katz* and modified *Harada Mori* methods.

Results

Description of Study Location

SDN 200 was located at Jalan Meranti Sei Buaya RT 35 RW 8, Kelurahan Kemas Rindo, Kertapati District, Palembang City 30258, with a land area of 6,000 m². The number of students in this elementary school was 323 students, male students as many as 171 students and female students as many as 152 students. In addition, teachers in this school amounted to 13 teachers and 1 principal.¹²

This school was above the rice field and has 8 classrooms, 1 teacher room, 1 administrative room adjoined to the principal's room, and 3 bathrooms. One classroom was approximately 4 x 6 m² in size. Almost all the floors and walls in the classroom were still made of wooden planks, except for 3 classrooms located beside the headroom of the school was tiled and stone-walled. This 3 classrooms were provided shoe rack before the entrance, therefore students were required to remove footwear so as not to contaminate the room. This school did not have a schoolyard, so this school never held a ceremony on Monday. Students exercise by utilizing a small land ground located close to residential residents. This school also did not have a canteen, just there was a small wooden stall on the front when entering the school that used as a place to snack students of this school. Around the school there were still many rice fields, large trees, as well as a vast land area overgrown with shrubs. The road to this school was still in the form of clay and pebbles so that during the rainy season often the road becomes wet and slippery.

Socio-demographic Characteristics of Study Subjects

Based on Table 1, it can be seen that from 107 subjects examined were mostly aged 8 and 9 years (21.5% each), more boys (51.4%) than girls (48.6%), most subjects came from Third Class (23.4%), father's occupation from most subjects was farmer/laborer (86.9%), mother's job from most subjects was housewife (98.1%), education level of father or mother most subjects was primary school (63.6% and 69.2%), and 86.0% of parents' income subject included in low category.

Table 1. Distribution of Subjects by Age, Gender, Grade Level, Parents' Occupation, Parents' Education Level, and Parents' Income (n=107)

Characteristics of Subjects	n	%
Age (years)		
6	1	0.9
7	22	11.2
8	23	21.5
9	23	21.5
10	20	18.7
11	13	12.1
12	12	11.2
13	3	2.8
Gender		
Boy	55	51.4
Girl	52	48.6
Grade Level		
II	24	22.4
III	25	23.4
IV	23	21.5
V	22	20.6
VI	13	12.1
Father's Occupation		
Unemployed	0	0.0
Farmer/Laborer	93	86.9
Entrepreneur	14	13.1
Civil Servant	0	0.0
Etc	0	0.0
Mother's Occupation		
Housewife	105	98.1
Farmer/Laborer	0	0.0
Entrepreneur	1	0.9
Civil Servant	1	0.9
Etc	0	0.0
Father's Education Level		
Not Attended School	0	0.0
Primary School	68	63.6
Middle School	26	24.3
High School	13	12.1
College/University	0	0.0
Mother's Education Level		
Not Attended School	0	0.0
Primary School	74	69.2
Middle School	25	23.4
High School	6	5.6
College/University	2	1.9
Parents' Income		
Low	92	86.0
Sufficient	15	14.0

Distribution of STH Infection

Table 2 showed that from 107 subjects, 27.1% were infected with STH.

Table 2. Distribution of Subjects by STH Infection (n=107)

STH Infection	n	%
Positive (+)	29	27.1
Negative (-)	78	72.9
Total	107	100.0

Socio-demographic Characteristics of Positive Subjects Infected with STH

Table 3 showed that the distribution of positive subjects infected with STH was highest in children aged 8 years at 24.1%. Girls (51.7%) were more infected with STH than boys (48.3%). Subjects infected with STH were mostly in grade 3 students (27.6%). Parents' occupation of STH infected subjects was mostly 93.1% father work as farmer/laborer and 100% mother as housewife. The last level of education of parents infected subjects STH both father and mother was primary school that is 79.3% in father and 93.1% in mother. There were 93.1% infected subjects whose parents' income included in low category.

Table 3. Distribution of Subjects Infected with STH by Age, Gender, Grade Level, Parents' Occupation, Parents' Education Level, and Parents' Income (n=29)

Characteristics of Subjects	n	%
Age (Years)		
6	1	3.4
7	4	13.8
8	7	24.1
9	6	20.7
10	3	10.3
11	5	17.2
12	3	10.3
Gender		
Boy	14	48.3
Girl	15	51.7
Grade Level		
II	7	24.1
III	8	27.6
IV	7	24.1
V	4	13.8
VI	3	10.3
Father's Occupation		
Unemployed	0	0.0
Farmer/Laborer	27	93.1
Entrepreneur	2	6.9
Civil Servant	0	0.0
Etc	0	0.0
Mother's Occupation		
Housewife	29	100.0
Farmer/Laborer	0	0.0
Entrepreneur	0	0.0
Civil Servant	0	0.0
Etc	0	0.0

Father's Education Level		
Not Attended	0	0.0
School		
Primary School	23	79.3
Middle School	4	13.8
High School	2	6.9
College/University	0	0.0
Mother's Education Level		
Not Attended	0	0.0
School		
Primary School	27	93.1
Middle School	2	6.9
High School	0	0.0
College/University	0	0.0
Parents' Income		
Low	27	93.1
Sufficient	2	6.9

Type of Worm, Number of Worm Eggs, and Intensity of STH Infection in Subjects

Table 4 showed that the most common type of worm that infected the subjects was *T. trichiura* (79.3%).

Table 4. Distribution of Subjects Infected with STH by Type of Worm (n=29)

Type of Worm	STH Infection (+)	
	n	%
<i>A. lumbricoides</i>	6	20.7
<i>T. trichiura</i>	23	79.3
<i>N. americanus</i>	0	0.0
<i>A. duodenale</i>	0	0.0
<i>S. stercoralis</i>	0	0.0
<i>Trichostrongylus spp.</i>	0	0.0
Total	29	100.0

It was known that the overall intensity of *A. lumbricoides* and *T. trichiura* infections was classified as mild infection, 6 subjects in *A. lumbricoides* and 23 subjects in *T. Trichiura* (Table 5).

Table 5. Distribution of Number of Worm Eggs and Intensity of STH Infection (n=29)

Number of Worm Eggs (Eggs/Gram)	Intensity of Infection	Frequency
<i>A. lumbricoides</i>		
440	Mild	1
980	Mild	1
1960	Mild	1
2180	Mild	1
2460	Mild	1
2520	Mild	1
<i>T. trichiura</i>		
20	Mild	3
40	Mild	1

60	Mild	4
80	Mild	9
100	Mild	2
180	Mild	2
220	Mild	1
420	Mild	1
Total		29

Association between STH Infection and Nutritional Status

It can be seen that from 29 positive subjects infected with STH most had less nutritional status that's equal to 62.1%. From the statistical test using Chi-square, $p=0.037$ ($p<0.05$) and $OR=2.765$ (95% CI: 1.147-6.662) so it can be seen that there was statistically significant relationship between STH infection and nutritional status. The OR value of > 2 indicates that STH infection was a risk factor for poor nutritional status. Students with positive STH infection had a risk of having a nutritional status of less than 2.765 times greater than students with STH-negative infections (Table 6).

Table 6. Association between STH Infection and Nutritional Status (n=107)

STH Infection	Nutritional Status				Total	
	Underweight		Normal		n	%
	n	%	n	%		
Infection (+)	18	62.1	11	37.9	29	100
Infection (-)	29	37.2	49	62.8	78	100
Total	47	43.9	60	56.1	107	100

Chi square test, p=0,05

Discussion

The differences in the prevalence of STH infection in the studies as well as each of the above areas may be influenced by different risk factors in each study site, particularly those related to environmental sanitation, personal hygiene, age, sex, socioeconomic aspects, a person's level of knowledge, food sanitation, water source sanitation, as well as natural or geographical conditions.^{14,18,19} Playing habits and behavior of children were also influence the rates of STH infections. Often children play and interact directly with the ground, such as not wearing footwear when playing, not washing hands after playing and before eating, and long fingernails make parasites such as Soil Transmitted Helminthes (STH) group easily invade into children's bodies, exacerbated by the environment surrounding the classified as slum and densely populated.^{16,19}

In this study, the highest infection was single infection of *T. trichiura* (79.3% of total infected) then followed by single infection of *A. lumbricoides* (20.7%), so it can be said that in this study STH infection was dominated by *T. trichiura* and *A. lumbricoides*. The results of this study were in line with the results of research from Fauzi *et al.* (2013) in which *T. trichiura* infection reached 58,3% (of total infected), while *A. lumbricoides* was 25%.²⁰ However, different results were found in the results of Juwita's (2013) study, in which *A. lumbricoides* infection was more common than *T. trichiura* infection. This can be caused by the influence of temperature difference at the research site. The optimum temperature for the development of worm eggs *A. lumbricoides* and *T. trichiura* was slightly different. *T. trichiura* eggs will mature at an optimum temperature of 30°C,

whereas *A. lumbricoides* eggs will develop optimally at 25° - 30°C.²² In addition, *A. lumbricoides* infection was easier to treat, resulting in more *T. trichiura* infection than *A. lumbricoides*.

Another trigger factor of worm infection is the weather factor. This research was conducted in September to October in Palembang, while in dry season and rainy season which has temperature ± 30°C which is the optimum temperature for *T. trichiura* egg development. The soil in this study area was moist because the location of this research was experiencing rainy season. The rainy season makes the soil become moist and becomes a supporting factor for the development of worm eggs into infective.¹⁸ Samuel's study in Ethiopia (2015) found that *T. trichiura* optimally lives in high humidity, whereas the rates of *A. lumbricoides* and *T. trichiura* infections are low in arid regions.²³

In this study, hookworm (hookworm), strongyloidiasis, and trichostrongylosis were not found. This relates to soil conditions and the number of eggs. *A. lumbricoides* and *T. trichiura* require clay soils to develop, while hookworm and *S. stercoralis* require more loose soil and mixed humus or leaf-covered mud, avoiding direct sunlight, also avoid drying or excessive wet.²² The benefit of hookworm prevalence was between 30-50% in various regions of Indonesia and more common in adults. Higher prevalence was found in plantation areas such as rubber and coffee, and in mining.¹³ The optimum temperature for *N. americanus* was 28 - 32°C, while for *A. duodenale* is slightly lower at 23° - 25°C.²² In addition, the development of these worm eggs to become rhabditiform larvae is quite fast ie 24-36 hours for eggs *A. lumbricoides* and *T. trichiura* can survive for several years.^{22,24} No infection of *S. stercoralis* and *Trichostrongylus spp.* in this study, because of these types of worms were rare infect humans. *S. stercoralis* infection was quite common in primates and dogs, whereas *Trichostrongylus spp.* more commonly found in herbivorous animals (sheep, goats, camels, and others).^{25,26}

The intensity of infection in this study, from 23 subjects infected by trichuriasis and 6 subjects infected by ascariasis, all included mild intensity categories. The category of intensity of this infection was affected by the length and number of worms that infect. The number of worm eggs of STH with the highest degree of mild infection in this study was *A. lumbricoides* infection which was found to be 2.520 eggs per gram of feces, whereas for *T. trichiura* was found 420 eggs per gram of feces. Number of eggs produced by 1 female of *A. lumbricoides* was 100,000-200,000 eggs per day while *T. trichiura* can lay as many as 3,000-20,000 eggs per day, so that *A. lumbricoides* eggs will be found in greater quantities than the number of *T. trichiura* eggs.²²

In this study, STH infection was highest in children aged 8 years (24.1%). The results of this study were similar to studies conducted by Annisa *et al.* (2017) stating that the prevalence of STH infection was higher in children aged 6-12 years, and Eryani *et al.* (2015) who stated that the prevalence of STH infection was highest in children aged 6-8 years.^{27,28} The high contamination of worms in this age group was due to the increase of higher playing activity so that the risk of STH infestation was getting bigger.²⁸

The result showed that the last education level of the parents of the infected subjects, both father and mother, were 79.3% and 93.1%, respectively, so the parents' work, especially father was dominant as farmers/laborers, and 93.1% mother entirely was a housewife. This result in line with previous research on the students of SDN 126 Sematang Borang District Palembang City, it was found that the highest education level of most parents was primary school namely 57.1% for father and 67.9% for mother, whereas most father's job was farmer/laborer (83.6%) and the mother mostly was a housewife (80%).⁸ Parental education was usually associated with knowledge of hygiene and will affect the growth, development, and establishment of child hygiene practices. Lack of education among the elderly, especially mothers, increases the risk of worm infections in children because parents with high levels of education certainly have better knowledge in terms of clean and healthy life behavior compared with those with low levels of education. If a mother has a good

education, especially in the health field, will certainly understand healthy life and know how to provide good nutrition for his family.³²

From 107 subjects, it was found that 43.9% subjects was underweight. This result was similar to Lesmana *et al* (2014) in students in SD di Daerah Pesisir Sungai Kecamatan Tapung Kampar District, Riau, obtained 58.16% of students with good nutritional status and 41,84% of students with underweight nutritional status.³⁵ This was due to the economic level of parents in the school including middle to lower. In general, the parents of students worked as farmers or laborers. Low economic level is one of the factors causing parents can't provide food with balanced nutrition. In addition there are several factors that affect the child's nutritional status, include parental education level, parenting and chronic infections.^{34,35}

Male students with underweight nutritional status were 53.2% and female 46.8%. These results suggest that male students were more likely to have less nutritional status than women. This result was consistent with Nadya's (2016) study which stated that there were more boys (77.8%) with underweight nutritional status than girls (22.2%), but not in accordance with Oktapiani (2013) study which stated that there were more girls with underweight nutritional status than boys.^{7,8} Differences in nutritional status between boys and girls may be due to differences in child's physical activity pattern and body tissue network. Generally boys were more active so they need more energy.³⁶

Several studies have been conducted to look for an association between nutritional status and STH infection. The relationship was complex and may depend on environmental, social and economic influences.¹⁷ Between malnutrition and infectious diseases have a very close reciprocity, making it difficult to identify which of these two states come first.¹⁶ According to Gandahusada (2008) in Ahdal *et al* (2014), infectious diseases such as worms that affect children can disrupt the child's nutritional status due to several things such as decreased appetite of children due to the discomfort experienced so that nutrient input was reduced, whereas children need more nutrients, especially to replace the body tissue damaged by the disease.¹⁶

STH infection was also associated with a decrease in dietary consumption, due to the presence of pro-inflammatory cytokines, indigestion and poor nutrient absorption, which can reduce the child's appetite. Infection of *A. lumbricoides* causes mal-absorption of nutrients, because the worms inhibit the absorption of important substances in food in the intestinal lumen. If this condition occurs in chronic form it can lead to inadequate nutrition intake and cause malnutrition, a condition characterized by malnutrition status. Blood loss due to *T. trichiura* infection can lead to chronic dysentery, iron deficiency, iron deficiency anemia and growth disorders.³⁷

Low family economic factors can also cause less food intake that children need for growth and development that leads to less nutrition and can result in children susceptible to infectious diseases.³⁸ Based on research Harniwita (2008) in Renanti *et al* (2015) in Desa Buluh Cina Kecamatan Siak Hulu, Kampar District showed there was a correlation between parents' income with nutritional status because in limited economic condition hence fulfillment of nutrition in children was also limited.³⁸ According to Sutanto *et al* (2012) in Renanti *et al.* (2015), parents' education level especially mother also influenced to child nutrition because the higher of mother education hence expected higher mother's knowledge about health including nutrition so that children get nutritious food.³⁸

In this study obtained that all the intensity of the infection included in mild category. Reduced nutritional status due to STH infection often occurs in children with severe infection intensity, but even mild intensity infections may interfere with growth in children with vulnerable nutritional conditions. Simarmata *et al.* (2015) finds that the intensity of mild to moderate infections may adversely affected the child's nutritional status.¹⁷

Conclusion

There was a significant correlation between STH infection and nutritional status ($p=0.037$; OR=2.765; 95% CI: 1.147-6.662) and STH infection variable was a risk factor of underweight nutritional status.

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