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Research Article

Soil-Transmitted Helminthes Infection and Nutritional Status of Elementary School Children in Sorong District, West Papua, Indonesia

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ABSTRACT

It is known that soil-transmitted helminths (STHs) infection in children associates with growth and developed restriction in children, which is shown by nutritional status. However, the studies which are investigating this phenomenon is still limited in Indonesia. This recent study aimed to compare students who infected and non-infected with STH towards their nutritional status. An analytic cross-sectional research design was conducted in two elementary school students at Mayamuk sub-district, Sorong district, in January 2020. STHs infection was identified by lugol stained wet mount smear from their stool under a light microscope. Children nutritional status was determined by body mass index based on age. A total of 164 children (67.5%, 164/243) were voluntary to participate by informed consent and eligible. Twenty-seven children (16.5%, 27/164) were infected with one or more STH species of Ascaris lumbricoides, Trichuris trichiura, hookworm, and Strongyloides stercoralis. T. trichiura (81.5%, 22/27) was the most common species found, either in single or mixed infection. Children nutritional status was observed as thinness, normal, overweight, and obese, that was 6.1% (10/164), 75% (123/164), 6.7% (11/164), and 12.2 % (20/164) respectively. STHs infection occurred in children with nutritional status of thinness 3.7% (1/27), normal 74.1% (20/27), overweight 3.7% (1/27), and obese 18.5% (5/27). There was no significant difference between STHs infected children and non-infected children on their nutritional status (p=0.616, Chi-Square test). Thus, it indicated that STHs infection was not only the factor to induce the impairment of nutritional status in children at Mayamuk sub-district. It needs further investigation to clarify the factors which are leading to the thinness, overweight, and obese in Mayamuk children.

Keyword. *Soil-transmitted helminthes infection; nutritional status; children; elementary school, Indonesia*

ABSTRAK

Kecacingan yang ditularkan melalui tanah (infeksi STHs) pada anak telah diketahui mempengaruhi pertumbuhan dan perkembangan pada anak, yang ditunjukkan dengan status gizi. Penelitian yang membahas hal ini masih terbatas di Indonesia. Penelitian ini bertujuan untuk membandingkan anak yang terinfeksi STHs dengan anak yang tidak terinfeksi STHs terhadap status gizinya. Desain penelitian cross-sectional analitik dilakukan pada murid dari dua sekolah dasar pada bulan Januari 2020, di kecamatan Mayamuk, kabupaten Sorong. Identifikasi infeksi STHs menggunakan pemeriksaan mikroskopis dari sediaan tinja anak dengan metode wet mount smear yang tercat oleh larutan lugol. Status gizi anak ditentukan dari indeks massa tubuh menurut usia. Sejumlah 164 anak (67,5%, 164/243) secara suka rela berpartisipasi

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melalui informed consent dan sesuai kriteria. Dua puluh tujuh anak (16.5%, 27/164) terinfeksi oleh satu atau lebih spesies STHs, yakni Ascaris lumbricoides, Trichuris trichiura, hookworm, dan Strongyloides stercoralis. T. trichiura (81.5%, 22/27) merupakan spesies yang paling banyak ditemukan baik dalam infeksi tunggal maupun ganda. Status gizi anak yang didapatkan meliputi status gizi kurang (6,1%, 10/164), normal (75%, 123/164), gizi lebih (6,7%, 11/164) dan obesitas (12,2 %, 20/164). Infeksi STHs terjadi pada anak dengan status gizi kurang sebesar 3.7% (1/27), normal 74.1% (20/27), gizi lebih 3.7% (1/27), and obesitas 18.5% (5/27). Tidak ditemukan perbedaan yang bermakna antara anak yang terinfeksi STH dengan yang tidak terhadap status gizinya (p=0.616, uji Chi-Square). Hal ini menunjukkan bahwa infeksi STH bukan satu-satunya faktor penyebab gangguan terhadap status gizi anak di kecamatan Mayamuk. Kajian lebih lanjut perlu dilaksanakan untuk menentukan faktor penyebab status gizi kurang, gizi lebih, dan obesitas pada anak di kecamatan Mayamuk.

Kata kunci: *Infeksi soil-transmitted helminthes; status gizi; anak; sekolah dasar, Indonesia.*

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INTRODUCTION

Soil-transmitted helminthes (STHs) infection is one of the neglected tropical infectious diseases which commonly occur in low-income countries and rural communities. Helminths that cause STHs infection in humans, are *Ascaris lumbricoides, Trichuris trichiura, Necator americanus* and *Ancylostoma duodenale*[1,2]. Pullan et al estimated that 1.45 billion people worldwide were infected with at least one species of these helminths in Asia[3]. Globally, an estimated disability-adjusted life years (DALYs) contributed by STHs infection was 1.9 milion in 2017[4].

STHs infection is a chronic infection that tends to be asymptomatic, thus it is difficult to assess the morbidity, especially in endemic area[5,6]. Symptoms and signs of STHs infection are anorexia, anemia, dysentery, diarrhea, and intestinal obstruction which can affect the growth and development of the child. The presence of STHs in the small intestine can interferes the absorption of nutrients and cause intestinal bleeding[5–10]. Several studies showed that STHs infection was significantly associated with a decrease of nutritional status indicators involving weight for age and height for age[10,11]. The severity of clinical manifestation is commonly performed by the infection with polyparasitism and heavy intensity of STHs[6,7,12].

STHs infection and stunting in children are public health problems in Indonesia. The national survey showed that the average of STHs infection prevalence of elementary school students between 2000-2011 was 28.7%[13]. Several studies had indicated that STHs infection in elementary school students in rural areas of Indonesia were remained high[14–16]. The World Health Organization (WHO) reports that the cases number of under five year old children who experience wasting and stunting in 2019 were 47 million and 144 million children, respectively, and most of them founded in Africa and Asia[17,18]. Riset Kesehatan Dasar Indonesia showed that the prevalence of wasting and stunting of children in 2018 were 10.2% and 30.8%, respectively[19]. In 2018, twenty out of thirty-four (58.9%, 20/34) provinces of Indonesia were categorized as high stunting prevalence province[20].

West Papua is one of the Indonesian provinces, which is facing these two health problems. A study showed that the STHs infection prevalence of elementary school children in the Sorong ditrict was 30.6%[21]. A National nutritional status survey in 2018 reported that the prevalence of school-age children and adolescents (5-12 year old) with stunting and wasting condition was 22.8% and 6.8%, respectively in West Papua[22]. Until now, it has not yet been studied the phenomenon of STHs infection with nutritional status in West Papua. Our study aimed to compare between children infected and non-infected with STHs towards their nutritional status. It would be meaningful for the control program of STHs infection and stunting.

MATERIALS AND METHODS

Study area and population

The study was conducted in two villages, where are located in Mayamuk sub-district, Sorong, West Papua Province, Indonesia, where the average temperature of area was 27,9^{0}C and the humidity was 83,2%. Geographically, most of the Sorong area, a district, is directly adjacent to Indonesian sea areas. It is bordered by the Pacific Ocean to the North; Seram sea to the South and West; Tambrauw District to the East and Raja Ampat regency to the west. Sorong consists of 30 sub-districts and 115 islands with a total area of 13,075.28 km^2 (Figure 1). Distribution of Gross Regional Domestic Product in 2019 based on sectors comprised of processing industri (42.54%), addition and excavation (15.95%), construction (14.65%), agriculture, forestry, and ficheries (10,11%), and others (16.75%). The main production of the plantation sector in Sorong are coconut, coffee, and cocoa[23].

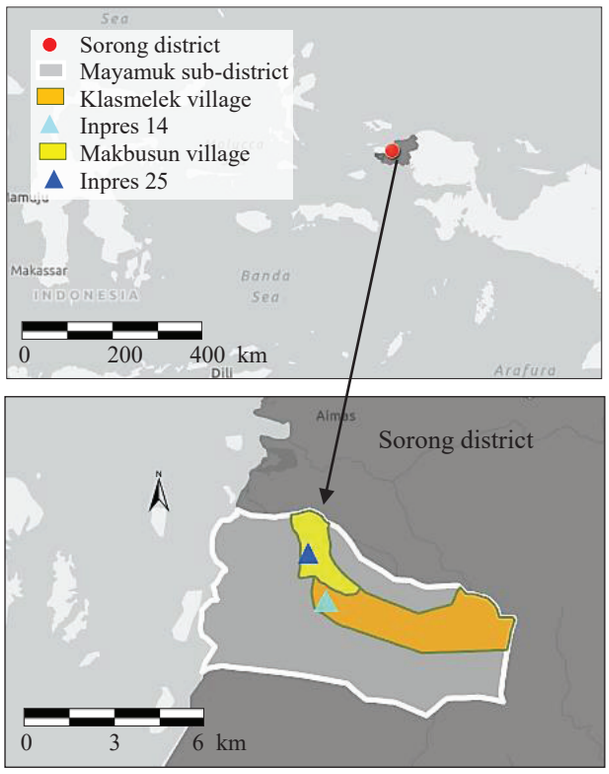

Figure 1. Study sites (source: arcgis.com[24]).

Mayamuk sub-district represents 4.4% (542.2 of 13,693.5 km^2) of the total area of Sorong. Study was implemented in two public elementary schools, namely Inpres 14 and Inpres 25, in January 2020. Inpres 14 is located in Klasmelek village, while Inpres 25 is in Makbusun village. The distance between the two elementary schools is 3.1 kilometers. Makbusun village is located ± 8.5 km from seashore, while Klasmelek village is located ± 10.9 km from it. Plantations, forest areas, and rivers are many in Klasmelek village than in Makbusun village. Total of 3107 people are living in Makbusun village and 674 people are in Klasmelek village.

Sample and data collection

An analytical cross-sectioal study design was conducted. Elementary school students from grade one to grade six from both schools involved in this study. The minimum number of samples was determined by the proportion estimation formula added 10% to anticipate error result and total was 90 samples. A structured questionnaire which included information on general demographic data (name, date of birth, age, gender, and ethnic), history of STHs infection, and anti- helminthic drug was used.

Stool collection and STHs identication

Children who participate in this research were given a stool tube (OneMed, Sidoarjo, Indonesia) which had labeled according to the questionnaire number. They brought the tube back with as much as one knuckle of stool on the next day. The stools in tube were preserved with adding 10% formalin solution and checked the tube number based on the questionnaire data. STHs was identified by using wet-mount smear method stained with 1% Lugol solution under light microscope with 100 and 400 magnifications (Olympus© CX22, Japan). It was repeated four times. Stool examination was performed in the Institute of Tropical Disease, Airlangga University, Surabaya.

Nutritional status measurement

The body mass index according to age (BAZ) score was used to determine nutritional status of children. It is based on the body weight, height, and age. The children body weight and height

were measured to complete their questionnaire form. A calibrated needle scale (OneMed, Sidoarjo, Indonesia) to the nearest 0.1 kg without shoes was used for measuring their body weight, and a microtoise (OneMed, Sidoarjo, Indonesia) to the nearest 0.1 cm which attached to a vertical wall was applied for sizing their height with barefeet. Their age was calculated in full month. Nutritional status was classified as severely thinness (<-3 standard deviation (SD)), thinness (-3 SD to <-2 SD), normal (-2 SD to +1 SD), overweight (+1 SD to +2 SD), and obese (>+2 SD)[25].

Statistical analyzes

Categorical variables were presented by number and percentage, while continuous variable was a mean value. The proportion differences of categoric variables were analyzed by *Chi-Square* test. Mean comparison of continuous variables were carried out by *t-test* analysis on normal distribution data and by *Mann-Whitney* test on abnormal distribution data. A significant comparison or difference was determined by $P<0.05$ value. All statistical analysis of this study was performed in version 22.0 Statistical Package for the Social Science (SPSS) (IBM, Somers, NY).

Ethical clearance

This study was approved by the Health Research Ethics Committee, Faculty of Medicine, Universitas Airlangga in number of 167/EC/KEPK/FKUA/2020.

RESULTS

Interview and anthropometric measurement were conducted into 194 children from two elementary schools, who were voluntary to participate in this study. A total of 164 children (84.5%, 164/194) were included and 30 children were excluded because they were without stools (Figure 2). Most of the children were non-Papuan (79.9%, 131/164) (Table 1).

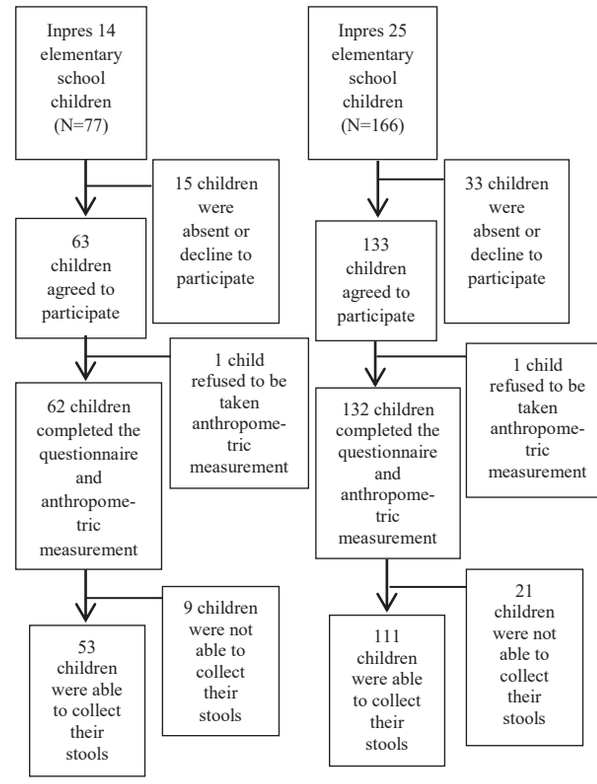

Figure 2. Diagram of participant involvement

Table 1. Demographic characteristic of children in Inpres 14 and Inpres 25 elementary school at Sorong District

Variable	Inpres 14 (n=53) (n, %)	Inpres 25 (n=111) (n, %)	Total (n=164) (n, %)
Age			
6 – 7	13, 24.5	26, 23.4	39, 23.7
8 – 9	22, 41.5	46, 41.4	68, 41.5
10 – 11	16, 30.2	34, 30.6	50, 30.5
12 – 13	2, 3.8	4, 3.6	6, 3.7
>13	0, 0.0	1, 1	1, 0.6
Sex			
Girl	20, 37.7	56, 50.4	76, 46.3
Boy	33, 62.3	55, 49.6	88, 53.7
Ethnic			
Papua	15, 28.3	18, 16.2	33, 20.1
Non Papua	38, 71.7	93, 83.8	131, 79.9

STHs were detected in 27 children stools (16.5%, 27/164). *T. trichiura* was frequently found

(13.4%, 22/164), then followed by *hookworm* (7.3%, 12/164) and *Ascaris lumbricoides* (3.6%, 6/164). Polyparasitized STHs were observed in 12 children stools (44.4%, 12/27) and dominated by *T. trichiura* with *hookworm* infection (50%, 6/12) (Figure 3 and Table 2).

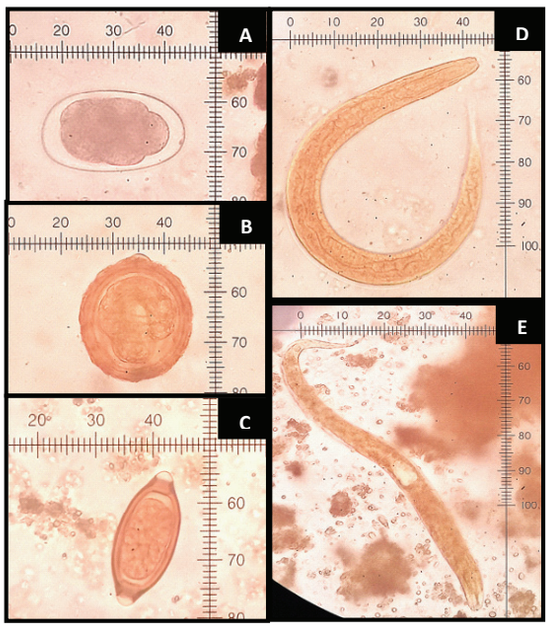

Figure 3. The morphology of soil-transmitted helminthes in children stools were (A) hookworm egg, (B) *A. lumbricoides* egg, (C) *T. trichiura* egg, (D) *S. stercoralis* larva and (E) hookworm larva under light microscope with 400 magnifications. Minimum length is 1 micrometer.

Table 2. Single and mix soil-transmitted helminthes infection cases among 29 infected children in Inpres 14 and Inpres 25 elementary school at Sorong District.

Variable	Inpres 14 (n=12) (n, %)	Inpres 25 (n=15) (n, %)	Total (n=27) (n, %)
Single infection	4, 33.3	11, 73.3	15, 55.6
AL	0, 0.0	1, 6.7	1, 3.7
TT	3, 25	7, 46.7	10, 37
HW	1, 8.3	1, 6.7	2, 7.4
SS	0, 0.0	2, 13.3	2, 7.4
Mix infection	8, 66.6	4, 26.7	12, 44.4
TT + AL	0, 0.0	2, 13.3	2, 7.4
TT + HW	6, 50	0, 0,0	6, 22,2
TT + HW + AL	1, 8.3	2, 13,3	3, 11,1
TT + HW + SS	1, 8.3	0, 0.0	1, 3.7

AL: Ascaris lumbricoides, HW: hookworm, SS: Strongyloides stercoralis, TT: Trichuris trichiura

The majority of children had normal nutritional status (75%, 123/164). However, 41 children showed the abnormal nutriotional status that were 10 children with thinness (6.1%, 10/164), 11 children with overweight (6.7%, 11/164), and 20 children with obese (12.1%, 20/164). Children with thinness in Inpres 25 were higher than in Inpres 14 (7.2%, 8/111 v.s 3.7%, 2/53) (Table 3).

Table 3. Characteristic of antropometric and nutritional measurements in children either with or without STHs infection at two elementary schools in Sorong Distric.

Antropometric and nutritional status	Elementary School						p-valueα
	Inpres 14 N=53			Inpres 25 N=111			
	Positive	Negative	p-valueα	Positive	Negative	p-valueα	
Mean height (cm)	127.8	127.5	0.924	127	130.3	0.188	0.146
Man weight (kg)	27.1	27,6	0.890	27.8	28.3	0.952	0.253
Mean BMI	16.2	16.4	0.632	17	16.3	0.367	0.887
Mean BMI/age (z-score)	-0.1	-0,2	0.482	0.1	-0.2	0.587	0.808
Thinness (n, %)	0, 0	2, 4.9	0.598	1, 6.6	7, 7.2	0.183	0.511
Normal (n, %)	10, 83.4	33, 80.5		10, 66.7	70, 73		
Overweight (n, %)	1, 8.3	1, 2.4		0, 0	9, 9.4		
Obese (n, %)	1, 8.3	5, 12.2		4, 26.7	10, 10.4		

α: Mann-Whitney test used for continous variable with abnormal data; T-test used for continous variable with normal data; Chi-Square test used for categorical data; Positive means children with STHs infection and negative is children without STHs infection

There was not significant difference between children who infected and non-infected with STHs towards their nutritional status (p>0.05, *Chi-square*, test) (Table 4).

Table 4. Comparisson of antropometric measurement in elementary children with and without STHs infection

Antropometric and nutritional status	STH infection Status		p-value
	Positive N=27	Negative N=137	
Mean height (cm)	127.3	129.5	0.299
Mean weight (kg)	27.5	28.1	0.957
Mean BMI	16.6	16.3	0.326
Mean BMI/age (z-score)	0.3	-0.19	0.397
Thinness (n, %)	1, 3.7	9, 6.6	0.616
Normal (n, %)	20, 74.1	103, 75.2	
Overweight (n, %)	1, 3.7	10, 7.3	
Obese (n, %)	5, 18.5	15, 10.9	

α: Mann-Whitney test used for continouse variable with abnormal data; T-test used for continouse variable with normal data; Chi-Square test used for nominal data; Positive means children with STHs infection and negative is children without STHs infection

DISCUSSION

School-age children living in a rural and a tropic area are vulnerable to STHs infection due to their habits and inadequate sanitation. School-age children often play in the ground without using footwear, rarely cut their nails, and do not wash their hands after playing or defication[26,27]. The potential factors for STHs infection in school-age children were due to their low hygiene practice.

A low prevalence of STHs infection was observed in this study (16.5%) based on WHO classification and a decline prevalence compare to previous prevalence in 2017[21]. Both studies were conducted in Mayamuk sub-district with different condition. The previous study was performed in 2017, a year before lymphatic filariasis MDA implementation in Sorong district that is every October since 2018[28], and the recent study was 3 months after administration and two-year implementation of lymphatic filariasis MDA. It seemed that lymphatic filariasis MDA is able to reduce the STHs infection prevalence after 3 months administration and two-year implementation of lymphatic filariasis MDA. Therefore, it might need the follow-up study in order to clarify the effect of lymphatic filariasis-MDA to reduce the STH prevalence.

A single dose of combination diethyl carbamazine (DEC) 100 mg and albendazole (ALB) 400 mg, a lymphatic filariasis MDA, is applied in Indonesia, including Sorong district[29,30]. This combination has been reported that impacted to STHs infection, since the drugs have a broad range of anti-helminthic activity. It reduced 77% hookworm infection using the combination of ivermectine (IVM) and ALB in Côte d'Ivore from 2014 to 2017[31]. Study by Sunish *et al* showed 79% reduction of STHs infection after 7 years administration the combination of DEC and ALB, and the highest reduction was for hookworm infection, followed by ascariasis, and trichuriasis[32]. Our study demonstrated the decline prevalence of STHs infections after 3 months administration and two-year implementation of DEC and ALB, but it was not under 10% of prevalence and it was still 46% reduction. It suggested that the health education to improve the individual hygiene and sanitation needs to be implemented in these areas. It could be considered to administer an additional a single dose of ALB at six months before lymphatic filariasis-MDA in order to eliminate the STHs infection in children.

Infection of *T. trichiura* was highly found in this study, either within mixed, mostly *T. trichiura* with hookworm, or single infection. The previous study conducted in Sorong district reported similar results[21]. Studies in Côte d'Ivoire[31], Tamil Nadu State[32], and Congo[33] resulted a low reduction of trichuriasis compared with hookworm infection and ascariasis after lymphatic filariasis MDA administration by using respectively IVM-ALB, DEC-ALB, and alone ALB. It means that either those combinations or ALB alone by a single dose are not enough effective to eliminate *T. trichiura* infection in human.

The present study found no significant difference between STHs infected children and non-infected children toward their nutritional status. It was similar with the previous studies, which had been conducted by Suraweera *et al.* in

Kandy, Sri Lanka and Kurniati *et al.* in Madura, Indonesia[34,35]. We found that the thinnes children mostly were not infected with STHs infection (see on table 3 and 4). It indicated that nutritional status of children can be influenced by several factors, such as food intake, environment, ages, dietary habit and the type of food consumed, additional STHs infection[36,37]. A study in Surakarta showed that school-age children with stunting were influenced by their poor energy and protein intake. These intakes were significantly related to the level of education and occupations of their mother and family income[38]. The prevalence of undernutrition in children from low socio-economic family was found to be higher than those from middle- to upper- socio-economic family (42.3% vs 19.28%)[39]. The factors that underlie the low nutritional status within low-income family group are poverty, education of mother, number of family member, and also insecurity and safety of the food[39,40]. Recently, the altered gut microbiota is associated with stunting and malnutrition in children[41,42]. Thus, futher investigation is needed to clarify the factors, which contribute to children thinnes, overweight, and obese in Mayamuk sub-district, such as socio-economy, nutritient consumption, education, and gut microbiota, in order to overcome children nutritional status problem.

CONCLUSION

Children either with or without STHs infection did not have a significant difference in their nutritional status in Mayamuk sub-district. STHs infection was not the only factor leading to nutritional status impairment of children in this study. Thus, further research is needed to determine the factors, which affect to thinness, overweight, and obese in children living at Mayamuk sub-district, Sorong district, West Papua province.

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CONFLICT OF INTEREST

All authors stated that there is no conflict of interest exists.

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