



Association of Soil-Transmitted Helminths Infection with Total Serum Immunoglobulin E Levels and Total Eosinophils in Elementary School Students in Medan

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Abstract

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BACKGROUND: Soil-transmitted helminths infection is widespread in tropical and subtropical areas. More than 267 million preschool-aged children and more than 568 million school-age children live in areas where this parasite is transmitted intensively and requires treatment and prevention. People at risk are preschool children, school-aged children, reproductive age women, and adults in certain high-risk occupations, such as tea pickers or miners. Worm infections often infect elementary schoolchildren because at this time, children have many activities and are often in direct contact with a dirty environment so that it can cause children not to pay attention to personal hygiene.

AIM: This study aimed to determine the association of STH infection with total serum IgE levels and eosinophil counts in elementary school students in Medan.

METHODS: This cross-sectional study was conducted on 65 elementary school students at Medan orphanage who met inclusion and exclusion criteria. Examination of STH infection was carried out using Kato-Katz method, and blood tests were performed to assess total serum IgE and blood eosinophils counts. Univariate and bivariate analysis was performed to determine the association of STH infection with total serum IgE levels and eosinophil counts in these students using *Pearson correlation test* and Chi-square.

RESULTS: Of the 65 elementary school students in the orphanage who were willing to have their routine blood and feces checked, 36 boys (55.3%) and 29 girls (44.6%), 39 children were infected with STH (60%). The most common infections were *Ascaris lumbricoides* (26.1%), *Trichuris trichiura* (18.4%), and mixed infections (15.3%) with an average of mild infection intensity. The results of the analysis showed that there was no significant association between STH infection and eosinophils counts ($p = 0.582$, 95% confidence interval, OR 1.3). In addition, there was also no significant association of STH infection with total serum IgE levels ($p = 0.883$, 95% confidence interval, OR 63.6).

CONCLUSION: In this study, there was no association between STH infection with eosinophils counts and total serum immunoglobulin E levels in elementary school students in Medan.

Introduction

Soil-transmitted helminthiasis (STH) is still a public health problem in tropical and subtropical countries, including Indonesia. The prevalence of helminthiasis currently ranges from 20 to 86% with an average of 30%. This infection can affect nutritional status, growth and development processes, and impair cognitive abilities in infected children. Cases of malnutrition, stunting, and anemia can be caused by worms [1]. Most of these infections are caused by roundworms (*Ascaris lumbricoides* and *Strongyloides stercoralis*), whipworms (*Trichuris trichiura*), and hookworms (*Necator americanus* or *Ancylostoma duodenale*) [2]. Worm infections often infect elementary schoolchildren because at this time, children have many activities and are often in direct contact with a dirty environment so that it can cause children not to pay attention to personal hygiene. Aspects of personal

hygiene include cleanliness of nails, hands, and feet. Poor personal hygiene such as playing ground, not wearing footwear when playing, not cutting nails, and not washing hands can cause worm infection or soil-transmitted helminths [3]. Based on a study in Poso, Sulawesi, the level of helminthiasis in children is also related to environmental sanitation. According to a study in Malang Regency, East Java, incidence of helminthic infection in children is also related to individual hygiene level that supported by facilities provided [4], [5]. Maternal or caregiver habits of cutting nails and washing hands are risk factors for soil-borne helminthiasis in preschool children. Washing hands habits of mothers or caregivers are the most influential risk factor for STH infection in preschool children [6]. Similar to other helminthiasis, *Ascaris lumbricoides* induces immune responses, mainly Th2. Elevated IgE and eosinophil titers are common in acute infection, invasion and protection of parasite are regulated by interleukin 10 and other cytokines. Ascariasis may

also be a risk factor for asthma and atopy, possibly through cross-reactivity between parasites, mites, and insect epitopes. Similar to other helminths, hookworm infection is also associated with a polarized Th2 cell response, both systemic and in the intestinal mucosa. High IgE titers, interleukin 5, and eosinophilia are common in acute infection. However, unlike other helminth infections, repeated exposure does not appear to stimulate resistance to reinfection, possibly due to immunological downregulation [7]. Eosinophilia in parasitic infections depends on the host response to parasite development, for example, parasite migration, maturation, and distribution characterized by immune system effector cells in tissues. The mechanism underlying appears to involve release of antibody-induced eosinophil granule proteins or complement and/or reactive oxygen intermediates by activated eosinophils or in association with other innate cells such as neutrophils [8].

Materials and Methods

This cross-sectional study was conducted on 65 elementary school-age children at Medan orphanage who meet inclusion and exclusion criteria. Inclusion criteria were elementary school students in Grades 1–6, willing to bring stool and their guardians filled out informed consent. Exclusion criteria were children who had a history of bleeding, did not take worm medicine in the past 1 month, and had a history of allergies. This study was approved by Health Research Ethics Committee, Faculty of Medicine, University of North Sumatra (NO: 49/TGL/KEPK FK USU-RSUP HAM/2020).

Stool examination was carried out using Kato-Katz method at Parasitology Laboratory of the Faculty of Medicine, University of North Sumatra. Examination of blood eosinophils and total serum immunoglobulin E levels was carried out at Gatot Subroto Laboratory, Medan. Bivariate data were analyzed by Pearson and Chi-square correlation test with 95% confidence interval.

Results

Of the 65 elementary school students in the orphanage who were willing to examine their blood and stool, it was found that average age of the children participating in this study was 11 years old (35.3%). Based on sex, 36 students were boys (55.3%). Based on grades, it was found that 23 students were in Grade 5 (35.3%). The average characteristics of the study subjects are shown in Table 1.

Table 1: Sample characteristics

Characteristics	Frequency	Percentage
Age (years)		
7	9	13.8
8	6	9.2
9	7	10.7
10	9	13.8
11	23	35.3
12	11	16.9
Sex		
Boys	36	55.3
Girls	29	44.6
Grades		
1	9	13.8
2	6	9.2
3	7	10.7
4	9	13.8
5	23	35.3
6	11	16.9
Total	65	100

Table 2 shows that out of 65 elementary school students, 39 children were infected with STH (60%) and 26 children were not infected with STH (40%). This table also showed that 17 students (26.1%) were infected by *A. lumbricoides* with mild intensity, 12 students (18.4%) with *T. trichiura*, and 10 students (15.3%) were infected with mixed infections.

Table 2: Prevalence, total, and intensity of STH infection

STH species	Intensity		
	Mild	Moderate	Severe
	n (%)	n (%)	n (%)
<i>A. lumbricoides</i>	17 (26.1)	-	-
<i>T. trichiura</i>	12 (18.5)	-	-
<i>A. lumbricoides</i> and <i>T. trichiura</i>	10 (15.4)	-	-
Total STH infection	39 (60)		
Total uninfected	26 (40)		

This study found that 13 students (20%) had increased eosinophils counts and were not infected with STH, meanwhile, 22 students (33.9%) had increased eosinophils counts and were infected with STH, with OR = 1.3 (Table 3) with CI 95%. This suggested that students with eosinophilia are 1.3 more likely to be infected with STH than students with normal eosinophil counts.

Table 3: Risk of STH infection by eosinophils counts in elementary school students in Medan

Eosinophil counts	STH infection						OR
	No		Yes		Total		
	n	%	n	%	n	%	
Normal	13	20	17	26.1	30	46.1	1.3
Increased	13	20	22	33.9	35	53.9	
Total	26	40	39	60	65	100	

Table 4 shows that 25 students (38.4%) had normal total serum IgE levels and were not infected by STH, meanwhile, 11 students (16.9%) had normal total serum IgE levels and infected with STH, with OR = 63.6 CI 95%. This suggested that students who had increased total serum IgE levels are 63.6 times more likely to be infected by STH compared to students with normal total serum IgE levels.

Table 4: Risk of STH infection based on total serum IgE levels in elementary school students in Medan

Total serum IgE levels	STH Infection						OR
	Tidak		Ya		Total		
	n	%	n	%	n	%	
Normal	25	38.4	11	16.9	36	55.4	63.6
Increased	1	1.6	28	43.1	29	44.6	
Total	26	40	39	60	65	100	

Results of Pearson correlation with calculated $r = -0.091 < r_{table} 0.316$ shown in Table 5, it can be concluded that there was no correlation of eosinophils counts in elementary school students infected with STH in Medan and $p = 0.582 > 0.05$ was not significant.

Table 5: Association of students infected with STH with eosinophils counts in elementary school students in Medan

Eosinophil counts	STH infection (n = 39)	
	R	p value
	-0.091	0.582

Results of the Pearson correlation with the calculated r value of $0.035 < r_{table} 0.316$ are shown in Table 6. There was no correlation between STH infection and total serum IgE levels in elementary school students infected with STH in Medan and p value was not significant ($p = 0.883$).

Table 6: Association of STH infected students with total serum immunoglobulin E levels in elementary school students in Medan

Serum IgE levels	STH infection (n = 39)	
	r	p value
	0.035	0.883

Discussion

This study showed that a total of 39 (60%) elementary school students in the Medan orphanage were infected with STH. The prevalence of helminthiasis is quite high considering that more than half of the students were infected with STH, which is higher than other studies.

A study conducted in Grobogan on elementary school students found that rate of helminthiasis was 13.7% [9], [10], [11]. Another study in Semarang found that 25 (33.8%) students were infected by worms [8]. The prevalence of STH in elementary school students in Palembang was 29.2%, which 21 samples (80.8%) contained *A. lumbricoides* eggs, 1 sample (3.8%) contained *T. trichiura* eggs, and 4 samples (15.4%) contained hookworm [9]. The absence of hookworm worms may be related to the study location which is located far from beach [10].

Several risk factors may be associated with the prevalence of STH. Facts showed that elementary school-aged children played quite often that can affect incidence of helminth infections. It is very likely that soil in the school yard as a playground for students contains infective worm larvae [11]. This is related to students' habits who do not pay attention to personal hygiene such as playing on the ground without a protective mat, rolling on the ground, holding the ground, and not washing hands after playing. Worm eggs that were initially found in the soil will move to the food consumed by students and can reach food, thus students who do not wash hands before eating after playing in dirty places also increase the prevalence of helminthiasis.

Other study in Binjai reported increased eosinophils counts $>5\%$ by 72.7% in patients with ascariasis, 60% in patients with trichuriasis, and 75% in patients with mixed infections and increased eosinophils counts $>5\%$ in students infected with STH, especially by *A. lumbricoides* and *T. trichiura* [12]. This is due to a large number of elementary school-age children do not know about the importance of personal hygiene, such as often playing with soil media, in humid places, not using footwear, not washing hands immediately after playing, not being diligent in cutting nails, and poor sanitation and environment that can cause students infected with worm eggs. Therefore, it is necessary to provide counseling regarding clean and healthy lifestyles and the provision of worm medicine to elementary school students infected with STH.

A study at elementary school in Manusak Village, East Kupang District, Kupang Regency, East Nusa Tenggara Province, supports these findings found increased total serum IgE levels in 40% of infected students and found a correlation between *A. lumbricoides* infection and total IgE levels ($p = 0.000$) [13]. This study found that out of 39 students infected with STH, 22 (33.85%) students had increased eosinophils counts (eosinophilia) compared to uninfected students, with an OR of 1.3. This suggested that students with eosinophilia are 1.3 more likely to be infected with STH than students with normal eosinophil counts. However, we did not found a correlation between eosinophils counts and STH infection ($r = 0.091$; $p = 0.582$).

The results of this study were supported by several studies reporting that in SDN 50 Kampung Jambak, 43 students (92%) had intestinal worms, and there was a significant difference in eosinophils counts in students infected with worms compared to uninfected students. Another study also found that 18 students (51.4%) infected with STH had eosinophilia [14], [15].

Meanwhile, the results of this study are in contrast to studies that found a significant correlation between parasitic infection and eosinophil levels, and the risk of STH infection causing eosinophilia or increased eosinophil counts in students [16]. Seran also found a significant association between STH infection and eosinophil counts in peripheral blood [17], [18]. In this study, through brief interviews when drawing blood from elementary school students, most of the students did not have allergies history, but this did not rule out the possibility that increased eosinophils counts in this study were caused by allergies or due to ignorance of orphans about allergies and helminthiasis.

Conclusion

In this study, there was no association between STH infection and total serum immunoglobulin E levels

and eosinophils counts in elementary school students in Medan.

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