

Correlation between Soil-Transmitted Helminths Infection and Serum Iron Level among Primary School Children in Medan

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Abstract

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BACKGROUND: The latest estimates indicate that more than 2 billion people worldwide are infected by Soil-Transmitted Helminths (STH). The burden of STH infection is mainly attributed to the chronic effect on health and quality of life of those infected. It is also contributed to micronutrient deficiencies such as iron-deficiency anaemia. The prevalence of worm infection in Public Primary School students in Medan was quite high (40.3%), and 33.3% was anaemic in the latest study.

AIM: To determine the correlation between STH infection with serum iron (SI) level on primary school children, as well as to determine the prevalence of SI level and worm infection, and the type of worm that infects the most of them.

METHODS: This study was conducted in the cross-sectional method. Consecutive sampling technique was used and a total of 132 students age 8-12 years old were included. The study took places in Public Primary School 060925 Amplas, Medan and 101747 Hampanan Perak, Deli Serdang throughout May-October 2016. Fisher Exact test was used to analyse the correlation between STH infection and SI level.

RESULTS: The prevalence of STH infection was 7.6%, and low SI was 11.4%.

CONCLUSION: There was no significant correlation between STH infection and SI level ($P = 0.317$). The prevalence of low SI level was not significantly dependent on STH infection ($RP = 1.877$, 95% CI = 0.481-7.181).

Introduction

Soil-transmitted helminthiasis (STH) is a term by a parasitic nematode that is transmitted to human by faecally-contaminated soil [1]. The latest estimates indicate that more than 2 billion people worldwide are infected. The highest prevalence occurs in areas where sanitation is inadequate, with lacking access to safe and clean water supplies, and low- and middle- income country [1-4].

About 42% of children globally in need of treatment to STH infection are located in the South East Asia Region. About 64% of the children in this area came from India, 15% from Indonesia and 13% from Bangladesh. In Indonesia, the number of pre-

school age children in need to be treated is 17 million, while the number of school-age children is 42 million [1]. The latest research in Medan (North Sumatera, Indonesia) which took place in Amplas shows the prevalence of STH infection in school-age children is still high, which is 40.3% [5].

The burden of STH infection is mainly attributed to their chronic and insidious impact on health and quality of life of those infected rather than to the mortality they cause. Heavy infections impair physical growth and cognitive development and become a cause of micronutrient deficiencies such as iron-deficiency anaemia which lead to poor school performances and absenteeism in children, decreasing work productivity, and pregnancy disturbances [1, 6, 7].

STH infection mainly causes anaemia which is an important nutritional deficiency worldwide. STH infections are well-established contributors to the morbidity associated with it in chronic infections due to the pervasive blood loss caused by the adult worm in human intestine [8].

Anaemia is a global public health problem affecting both developing and developed countries. Anaemia has consequences for human health as well as social and economic development [9, 10]. Anaemia affects 1,62 billion people globally, which is 24.8% of worldwide population. The highest prevalence occurs in preschool-age children where 293 million children affected while the number of school-age children affected estimated to be 305 million [9, 11]. South East Asia region has the greatest number affected from anaemia where 315 million individuals in this region are affected [9].

The most significance causes of anaemia are iron deficiency so that Iron Deficiency Anemia (IDA) and anaemia often used synonymously, and anaemia prevalence has often used as a proxy for IDA [9]. Worldwide, the most important cause of IDA is a parasitic infection caused by hookworms, whipworms, and roundworms, in which intestinal bleeding caused by these worms may lead to occult bleeding in the stool [12].

Iron deficiency leads to Serum Iron (SI) decreasing [13]. A research of SI status in Orang Asli Children living in STH-endemic area results in low SI level [14], and another research in West Malaysia found out haemoglobin, serum ferritin, and serum iron level is decreasing in STH infection [15].

Given the data that the STH infection and SI level are correlated, we conducted research on the correlation between STH infection and the level of SI among the students of Primary School in Medan.

Material and Methods

A cross-sectional study was carried out to evaluate the correlation between STH infection and SI level among Public Primary School students in Amplas, Medan (Figure 1) and Hamparan Perak, Deli Serdang (Figure 2). This study conducted from May to October 2016. A total of 132 children age 8-12 years old were included as subjects in this study, blood samples and stool specimens were collected for examination. The inclusion criteria for the samples were (i) all the students of grade 3, 4, 5, and 6 in Public Primary School 060925 Harjosari, Amplas, Medan and Public Primary School 101747 Klumpang Kebun, Hamparan Perak, Deli Serdang which approved by the parents to be a participant in the study through informed consent that have been given,

(ii) children who acted cooperatively: bringing stool sample and willing to draw the blood, (iii) children who do not have thalassemia, hemophilia, or anemia beside IDA, and (iv) children who have not undertaken antihelminthic for the last 6 months. The sample was excluded if the stool specimens or blood samples are broken. Permission was also taken from the primary school authority.

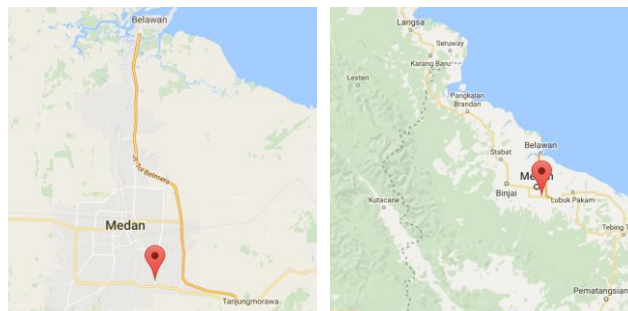


Figure 1: Study Area: Public Primary School 060925, Harjosari, Amplas, Medan

Stool samples were preserved in 10% formalin for transportation. Direct examination and Kato-Katz method were used to detect helminth ova or larvae. Phlebotomy procedure on antecubital vein was performed to each subject to collect 4 ml of blood. The blood was dispensed into dipotassium EDTA anticoagulant bottles. SI levels were measured using Cobas e601 in haematology laboratory. The data were analysed using the Statistical Package for the Social Sciences (SPSS). Fisher Exact test was used to analyse the correlation between the independent variable (STH infection status) and the dependent variable (SI level). The test was considered significant at $P < 0.05$ (Confidence Interval 95%).

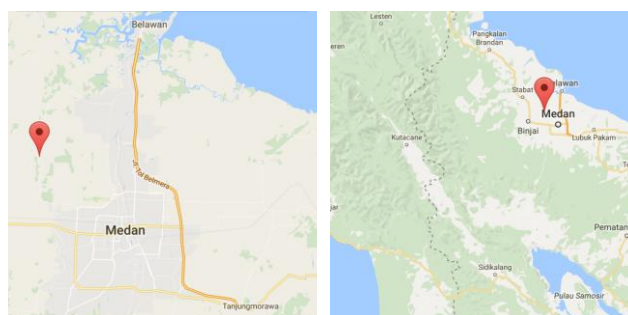


Figure 2: Study Area: Public Primary School 101747, Hamparan Perak, Deli Serdang

Results

Total students from the grade 3, 4, 5 and 6 from both of the Public Primary School that fulfilled the criteria being the study subjects are 132 children. From the 132 children, 60 students are male, and 72 students are female. They mostly are 12 years old

(43/132), with the following details: 5/132 (3.79%) are a 3rd grader, 50/132 (37.88%) are 4th grader, 32/132 (24.24%) are 5th grader, and 45/132 (34.09%) are 6th grader (Table 1).

As seen in Table 1, from the collected and examined stool sample, ten children (7.6%) is STH infected. *Ascaris lumbricoides* infection found in 4/132 children (3%), Hookworm infection in 1/132 child (0.8%), and *Trichuris trichiura* infection in 5/132 children (3.8%). No mixed infections were found in the study.

Low Serum Iron (SI) level (cut-off point: 50 µg/L) were identified in 15/132 children (11.4%). Meanwhile, 117/132 children (88.6%) have normal SI (Table 1).

Table 1: General characteristics of children participated in the study

	(n / %) n = 132
Gender	
Boys	72 / 54.5
Girls	60 / 45.5
Age	
8	4 / 3.0
9	18 / 13.6
10	34 / 25.8
11	33 / 25.0
12	43 / 32.6
Grade	
3 rd	5 / 3.79
4 th	50 / 37.88
5 th	32 / 24.24
6 th	45 / 34.09
STH Infection	
<i>A. lumbricoid</i>	4 / 3.0
Hookworm	1 / 0.8
<i>T. trichiura</i>	5 / 3.8
Serum Iron (< 50 µg/dL)	
Yes	15 / 11.4
No	117 / 88.6

Table 2 presented the levels of Serum Iron and also the prevalence of STH infection among the children according to age and gender. The median SI level was 84.295 µg/dL (IQR 39.65). According to the age, the prevalence of low serum iron was higher among >10 years children compared with ≤10 years children, and the prevalence of STH infection was higher among ≤10 years children compared with >10 years children. Based on the gender, girls had a higher prevalence of low serum iron and STH infection than boys. There was not any significance of the SI level among the ages of the children (t = 0.467; p = 0.926) neither between the gender (t = 0.057; p = 0.203).

Table 2: Levels of Serum Iron among school children according to age and gender (n = 132)

Variable	Serum Iron Mean ± SD	Serum Iron (< 50 µg/dL) n (%)	STH Infection n (%)
Age			
8	85.48 ± 33.53	1 (6.7)	0 (0)
9	76.50 ± 29.03	2 (13.3)	3 (30)
10	85.04 ± 28.67	4 (26.7)	3 (30)
11	91.36 ± 28.20	3 (20.0)	1 (10)
12	90.02 ± 28.36	5 (33.3)	3 (30)
Gender			
Boys	89.18 ± 32.29	6 (40)	4 (40)
Girls	86.15 ± 25.02	9 (60)	6 (60)

As presented in Table 3, the prevalence of

low serum iron was higher among >10 years old children compared with ≤10 years children (53.3% vs. 46.7%; RP: 1.19 CI: 0.46-3.08). There was not any significance correlation between the age and serum iron level (p = 0.72). Likewise, the low serum iron level prevalence was higher among girls compared to boys (60% vs. 40%; RP 1.25 CI: 0.47-3.31) and was not significance correlated (p = 0.65). However, based on the status of STH infection, the prevalence of low serum iron was higher in non-infected children compared with infected children (86.7% vs. 13.3%; RP 1.88 CI: 0.49-7.18). There was no significant difference in the prevalence of low serum iron according to the STH infection (p = 0.31).

Table 3: Univariate analysis of factors associated with Serum Iron level among the Primary School Children in Medan (n = 132)

Variable	No Examined	Serum Iron (< 50 µg/dL) n (%)	RP (95% CI)	P Value
Age				
≤10	56	7 (46.7)	1.19 (95%: 0.46-3.08)	0.72
>10	76	8 (53.3)		
Gender				
Boys	60	6 (40)	1.25 (95%: 0.47 - 3.31)	0.65
Girls	72	9 (60)		
STH Infection				
Yes	10	2 (13.3)	1.88 (95%: 0.49 - 7.18)	0.37
No	122	13 (86.7)		

RP: Ratio Prevalence; CI: Confidence Interval 95%.

In Table 4 of the cross tabulation, subjects with positive STH infection and low serum iron were 20% (2/10) children, subjects with positive STH infection and normal serum iron were 80% (8/10) children. There are 10.7% subjects with negative STH infection, and low serum iron (13/122) and the remaining 89.3% (109/122) subjects had a negative STH infection and normal serum iron. Statistical analysis with Fisher Exact test shows no significance between STH infection status and Serum Iron level among Public Primary School students in Medan (p = 0.317, p > 0.05).

Table 4: Cross tabulation between STH infection and Serum Iron level

STH Infection	Serum Iron level		Total	%
	Low	Normal		
Positive	2	8	10	7.6
Negative	13	109	122	92.4
Total	15	117	132	100

CI 95% p < α = 0.05; p = 0.317.

Discussion

The risk of the STH infected children on having low Serum Iron level was within the following ratio prevalence (RP): 1.877 (95% CI: 0.481-7.181). This did not indicate that children with the positive STH infection have positive relation towards having low serum iron level. The result is different from the

previous study conducted among 281 children in Selangor, Malaysia which showed severe trichuriasis as a positive risk of having low SI level (OR 1.9; 95% CI: 1.01-3.63) although hookworm infection and ascariasis did not turn out to be a risk for the children with positive STH infection on having low SI level [14].

The prevalence of STH infection among the children in this study (7.6%) is lower than the previous study conducted in Medan (40.3%) [5]. Compared to the study conducted in Malaysia, severe trichuriasis is found to be an important contributor of Iron Deficiency Anemia where low serum iron was identified [14]. It is also reported that hookworm infection is shown to cause mechanical laceration and enzymatic damage to the small intestine mucosa, which could cause blood loss [16] in which millions of erythrocytes are eliminated, and the iron could not be reused [17]. However, a study conducted in West Malaysia indicated blood loss due to *T. trichiura* infection which inhabited upper caecum and colon and the presence of *A. lumbricoid* in the duodenum and jejunum which could impair iron absorption demonstrated a significant association with iron status [15].

In this study, we found that there are 10 cases of positive subjects infected with soil-transmitted helminths with mild infection. There was neither any moderate nor heavy infection found among the subjects. This could happen due to the changes in behaviour following the education of personal hygiene and health promotion as prevention to parasite infection, which contributed to the better change of the children habits and health. Besides STH infection, daily iron intake could contribute to the prevalence of low serum iron among the children involved in this study. Unfortunately, this study did not collect the daily iron intake record of the children. Furthermore, technology development also plays a role in the behaviour of the students. We found lots of the students chose to play with their gadget rather than having outdoor physical activities; this, however, reduces their risk to contact with contaminated soil.

In this study, Soil-Transmitted Helminths infection prevalence is 7.6%, and low Serum, Iron level prevalence, is 11.4% to the students of Public Primary School children in Medan. The correlation between STH infection and Serum Iron level shows no significance in the study. Also, our data suggested that the prevalence of low SI level was not significantly dependent on STH infection.

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