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Correlation between Soil-transmitted Helminths and Anemia Incidence in Primary School Children in Talawi, Batubara Regency

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Abstract

BACKGROUND: Prevalence of soil-transmitted helminth (STH) infections is high in developing countries, especially in school children. STH infections can lead to anemia.

AIM: The aim of the study was to observe the correlation between STH infections and anemia cases in primary school children.

METHODS: Analytical observation with a cross-sectional method was carried out by retrieving data from the health service unit in Talawi. Research samples were primary school children, grouped into STH infected and uninfected groups. The data were analyzed using continuity correction and Fisher's exact tests.

RESULTS: From 384 research subjects, 35.9% children were infected with STH and 22.5% of them suffered from anemia. The prevalence of STH infections was consisted of 76.8% *Trichuris trichiura*, 10.9% *Ascaris lumbricoides*, 0.7% hookworms, and 11.6% had mixed infections. Anemia was significantly correlated to STH infections and the intensity of *T. trichiura* infection (odds ratio (95% confidence interval) = 4.5 (2.3–8.6) and 3.6 (1.2–10.9) respectively).

CONCLUSION: Anemia was positively correlated with STH infections and the intensity of *T. trichiura* infection

Introduction

Soil-transmitted helminths (STHs) are groups of nematode worms which infect human from infective eggs of larvae usually found in soil [1]. These infections are very common in the world, especially in developing countries with higher poor communities [2]. In general, STH infections are caused by roundworms (*Ascaris lumbricoides*), whipworms (*Trichuris trichiura*), threadworms (*Strongyloides stercoralis*), and hookworms (*Ancylostoma duodenale* and *Necator americanus*) [1], [2], [3], [4]. In North Sumatra, Indonesia, some studies and reports have reported high helminthiasis cases; Pasaribu (2004) conducted the study in Suka Village, Tigapanah, Karo Regency showed 91.3% of prevalence [5], Jiero *et al*. (2015) did their study in Medan Belawan at two primary schools and reported 65.4% STH infection prevalence [6], then the performance accountability report of North Sumatra government health agency 2017 showed 14.6% helminthiasis prevalence in schoolchildren from 17 regencies [7].

Anemia can be defined as the deficiency in the concentration of hemoglobin and hematocrit or total red blood cells per cubic millimeter. The lower limit of normal level is determined as two standard deviations below the mean of age and gender in normal population [8]. Anemia is often associated with parasitic infections, such as from hookworms, whipworms, and roundworms. Chronic STH infections are contributors to morbidity due to blood loss caused by adult worms in the human intestines [9].

Hookworms contribute to anemia incidence because they cause iron deficiency from chronic blood loss in the intestines. *A. duodenale* and *N. americanus* cause about 0.2 mL and 0.15 mL blood loss per day, respectively. Meanwhile, *T. trichiura* is attached to the mucosal walls in the intestines and compete to absorb blood as well as damage the tissues. *A. lumbricoides* is known to affect nutritional status [10].

The study done by Robertson *et al*. (1992) reported children with *T. trichiura* and hookworms and *T. trichiura* double infections had lower Hb level than uninfected children [11]. In a research done in Manado by Basalamah *et al*. (2013) showed children with worm infections had a very significant effect on Hb level, where infected children had lower Hb level that other children who were not infected [12]. The study done in Ethiopia by Molla and Mamo (2018) showed STHs infected children had a bigger risk of anemia

than children without infections. Anemia had significant correlations with *A. lumbricoides,* hookworms, and mixed infections [13].

This research was done to observe the prevalence of STH infections in Talawi, Batubara regency among primary school children, compare anemia incidence in infected and uninfected children, and evaluate the correlation between helminthiasis infections and anemia.

Methods

This research was an analytical observation with cross-sectional method. The data were retrieved from the public health center (Puskesmas) in Talawi. Inclusion criteria were primary school children in grade I–VI who had completed Kato-Katz and Hb level examinations and lived in Talawi, Batubara regency, North Sumatra. Exclusion criteria were children who had been consuming anthelmintic drugs for the last 3 months or children who had been diagnosed with chronic diseases, such as chronic kidney failure, tuberculosis, malnutrition, malignant diseases, and congenital heart disease. Samples were divided into 2 groups, such as group 1 was for children with positive Kato-Katz analysis, whereas group 2 was for children with negative Kato-Katz result. Hemoglobin level data of each child in each group was recorded and evaluated whether the subject suffered from anemia or not.

Data analysis

Data analysis was done using computerized system SPSS version 22, with 95% confidence interval (CI) and significance level of $p < 0.05$. Data were analyzed descriptively to observe the prevalence of helminthiasis, worm distributions, and nutritional status, also calculate the average Hb level of research subjects. Then continuity correction test was used to obtain the relationships of STH infections, gender, and anemia. While Fisher's exact test was used for the relationship between type and intensity of *A. lumbricoides* and *T. trichiura* infections toward anemia incidence.

Ethical considerations

This study was approved by Health Research Ethics Committee, Medical Faculty, Universitas Sumatera Utara (No.474/KEP/USU/2020).

Results

Characteristic data of research subjects

Based on the data retrieval from the public health center (Puskesmas) in Talawi, there were 3 primary schools with a total of 384 children in grade I (one) to VI (six) as research samples that met the inclusion and exclusion criteria. Among the research subjects, 138 children were infected with STHs and categorized into group 1, while 246 children were uninfected and they were categorized into group 2. The mean age of subjects was at 9 years old. The median of Hb level was 12.25 g/dL and 12.6 g/dL in group 1 and group 2 respectively.

The basic characteristic data of research subjects is shown in Table 1.

Table 1: Subject characteristic data

Characteristic	Group 1 (n = 138)	Group 2(n = 246)
Gender, n(%)		
Male	76 (55.1)	120 (48.8)
Female	62 (44.9)	126 (51.2)
Age, years old		
Median (range)	9 (5–13)	9 (5–14)
Weight, kg		
Median (range)	22 (14–61)	23 (13–47)
Height, cm		
Median (range)	124 (100–150)	125 (98–156)
Nutritional status, n(%)		
Poor nutritional status	35 (25.4)	37 (15)
Good nutritional status	91 (65.9)	190 (77.3)
Overweight	12 (8.7)	19 (7.7)
Hb level, g/dL		
Median (range)	12.25 (9.9–15.1)	12.6 (10.4–14.5)

Helminthiasis prevalence in this study was 35.9% (138/384) with 76.8% (106/138) single *T. trichiura* infection, 10.9% (15/138) single *A. lumbricoides* infection, 0.7% (1/138) single hookworm infection, and 11.6% (16/138) mixed infection of *A. lumbricoides* and *T. Trichiura*. The distribution of helminthiasis infections among the research subjects is shown in the pie chart in Figure 1.

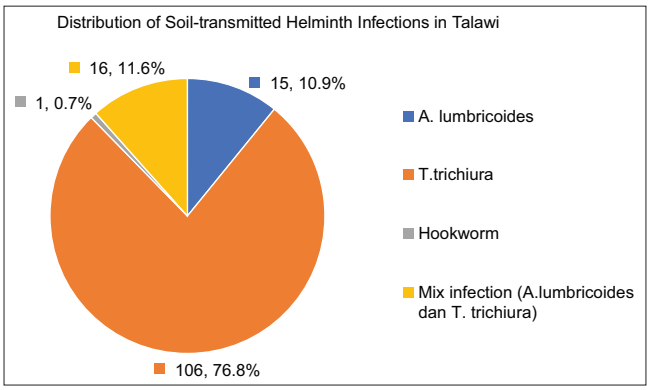

Figure 1: Helminthiasis species distribution in primary school children in Talawi, Batubara Regency, North Sumatra

Correlation between STH infections and anemia incidence

In this research, children with STH infections were found to have a significant relationship statistically

(p<0.05) with anemia incidence when compared to uninfected children, where odds ratio (OR) was 4.5 (2.3–8.6). On the other hand, gender and types of infection, either combined or single infections of *A. lumbricoides* and *T. trichiura*, did not have statistically significant relationships toward anemia.

The intensity of infections in this research was at light to moderate infections, where no heavy intensity of infections was recorded. There was a significant correlation observed between *T. trichiura* infection intensity and anemia with OR 3.6 (1.2–10.9). Unlike *A. lumbricoides* infection, the relationship between this worm infection and anemia was not found as significant. Furthermore, only 1 subject was recorded to suffer from hookworm light infection; hence, no statistical analysis was done. The correlations of STH infections and other risk factors toward anemia incidence can be seen in Table 2.

Table 2: Correlation of STH infections and other risk factors toward anemia

Characteristic	Anemia n (%)	Not anemia n (%)	OR (IK 95%)	p
STH infection,				<0.001*[a]
Positive (138)	31 (22.5)	107 (77.5)	4.5	
Negative (246)	15 (6.1)	231 (93.9)	(2.3–8.6)	
Gender,				0.748[a]
Male (196)	25 (12.8)	171 (87.2)	1.2	
Female (188)	21 (11.2)	167 (88.8)	(0.6–2.2)	
Type of infection,				0.355[b]
Combined (16)	5 (31.3)	11 (68.8)	1–7	
Single (122)	26 (21.3)	96 (78.7)	(0.5–5.3)	
Ascaris lumbricoides infection intensity,				1.00[b]
Moderate (8)	2 (25)	5 (75)	0–9	
Light (23)	6 (26.1)	17 (73.9)	(0.1–6.0)	
Trichuris trichiura infection intensity,				0.043*[b]
Moderate (15)	7 (46.7)	8 (53.3)	3.6	
Light (107)	21 (19.6)	86 (80.4)	(1.2–10.9)	

[a]Continuity correction test, [b]Fisher's Exact test.

Discussion

STH infections are one of the major health concerns in developing countries, especially in regions with warm and humid climate, where sanitation and hygiene tend to be poor [14]. Indonesia is an example of a country with tropical climate; suitable for STH infections. In this research, the prevalence of helminthiasis in primary school children in Talawi, Batubara regency, North Sumatra was at 35.9%. This figure was lower than the previous research done by Pasaribu (2004) in Karo regency and Jiero *et al*. (2015) in Medan Belawan, North Sumatra, in which prevalence was reported at 91.3% and 65.4%, respectively [5], [6]. The decrease in helminthiasis prevalence may be due to the control program initiated by the government in Batubara regency targeting preschool (1–4 years old) and school (5–12 years old) children [15].

The infections were found higher in male (55.1%) than in female (44.9%). A previous study done in Ethiopia by Molla and Mamo (2018) also found higher cases in males [13]. However, the study done by Annisa *et al*. (2018) in Palembang reported more infections in female [16]. These differences in STH infection cases rate were not influenced by gender but by lack of personal hygiene in children [17].

The infection has got some correlations with the decrease in food intake, hence lead to reduction in growth rate, weak physical health and cognitive function, and malnutrition [18], [19]. The study done by Simamarta *et al*. (2015) in Kabanjahe, North Sumatra, showed most children (70%) with STH infections had poor nutritional status [20]. Whereas the study done in Padang by Maharani *et al*. (2015) showed, most STH-infected children had good nutritional status. Therefore, there was no correlation found between STH infections and nutritional status [21]. This relationship was very complex and had a lot of influencing factors, such as environment and socioeconomic status. Another study reported malnutrition to have relationship with moderate and heavy STH infection intensity [22]. In this study, most children with STH infection had good nutritional status, although children with poor nutritional status were excluded from the study. This may happen due to the intensity of infections in this research were light.

The most found helminths found in infected children were single *T. trichiura* infection with prevalence of 76.8%. A previous study done by Pasaribu (2004) and Jiero *et al*. (2015) found *A. lumbricoides* as the highest infection type [5], [6]. This difference may occur due to the treatment for *T. trichiura*, in which several studies reported repeated-dose albendazole administration was recommended [4], [23], [24], [25]. Although albendazole is an anthelmintic with broad spectrums and consumed orally to control helminths in the intestine, *T. trichiura* infections treatment were not as effective as in *A. lumbricoides* and hookworm infections [25]. The study done by Gultom *et al*. (2020) in Batubara regency also showed higher *T. trichiura* infection than any other types of STH infections. The research also showed that the treatment with albendazole for 2 and 3 days consecutively was proven to be better than 1-day treatment for *T. trichiura* infections [23].

Anemia incidence found in children with STH infections was at 22.5%, while only 6.1% was recorded in children without STH infections. There was a significant relationship between STH infection and anemia incidence. This study also showed that STH-infected children had 4.5 times higher risk of anemia than uninfected children. This result was almost similar to the study done by Molla and Mamo (2018), in which anemia was found in 23.4% of STH-infected children and 5.9% in uninfected children. The relationship between helminthiasis infections and anemia was reported to be positive with 3.72 times higher risk of anemia in STH-infected groups [13].

Moderate *T. trichiura* infection intensity showed a significant relationship with anemia in this research, where there was 3.6 times higher risk compared to light intensity. According to the Centers for Disease Control

and Prevention (CDC), anemia could also be caused by *T. trichiura* infection, especially in severe infections [26]. In this research, only light to moderate intensity was recorded. *T. trichiura* infections could cause significant blood loss due to the location of worms in the colon, which could be worse if the infections were together with hookworms [27]. Molla and Mamo (2018) showed heavy intensity hookworm infections had a relationship with anemia [13]. In this research, no statistical test was done to hookworm infections, as only one case was recorded for hookworm infection. Moreover, there was no statistical test conducted between nutritional status and anemia incidence because children with poor nutritional status were excluded from the method.

This research, which compared STH infections and anemia incidence, has never been done in Indonesia, especially in North Sumatra. The outcome of this study can provide inputs to the local public health office to be more aware and prevent STH infections with anemia incidence. This research also provided an overview of high prevalence of *T. trichiura* infections, where repeated-dose anthelmintic was required. Nonetheless, other risk factors may also influence anemia incidence and different types of STH infections may affect anemia incidence too.

Conclusion

This research showed the correlation between STH infections and anemia incidence. Furthermore, moderate intensity of *T. trichiura* infection had higher risk of anemia than light intensity infection.

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