

Association between soil-transmitted helminthiasis and hemoglobin concentration in primary school children

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ABSTRACT

Objectives To determine the association between intestinal helminthiasis and hemoglobin (Hb) concentration and to observe the effect of single dose albendazole treatment on Hb concentration.

Methods An experimental study was carried out from March to July 2002 on primary school children at Suka Village, Tiga Panah Subdistrict, Karo Regency, North Sumatera Province. From 366 children who suffered from helminthiasis, 113 were selected as subjects by simple random sampling. Subjects were treated with a single oral dose of 400 mg albendazole. Hb concentration was examined using the cyanide method twice i.e., prior to and three months after treatment with albendazole.

Results It was found that among 113 subjects, the prevalences of *Ascaris lumbricoides*, *Trichuris trichiura*, and mixed infestation were 18.3%, 40.4%, and 41.3%, respectively, while the prevalence of anemia was 33.0%. There was no significant difference in age, gender, nutritional status, and mean Hb concentration between children suffering from the different types of worm infestation ($P>0.05$). For each type of infestation, there were significant differences in mean Hb concentration and anemia prevalence before and after treatment ($P<0.05$).

Conclusions There was no difference between the Hb concentrations of children suffering from *Ascaris lumbricoides*, *Trichuris trichiura*, and mixed-type worm infestations. Single dose 400 mg albendazole was beneficial in increasing Hb concentration and reducing the occurrence of anemia [**Paediatr Indones 2005; 45:24-30**].

Keywords: helminthiasis, Hb concentration, albendazole treatment, anemia

Intestinal parasitic infection caused by nematodes is one of the main public health problems in developing countries, including Indonesia.¹ Epidemics of these diseases occur more frequently in tropical and subtropical areas. In some cases the disease may also be found in moderate and cold climate areas.² Soil-transmitted helminths (STH) are those which are infectious during their growth inside susceptible soil. The primary worm species in relation to humans are *Ascaris lumbricoides*, *Trichuris trichiura*, and hookworm,³ which have already infected more than a quarter of the world's population.⁴ WHO reported that more than 2 billion people have been infected by STH, of which more than 1 billion by *Ascaris lumbricoides*,^{5,6} 750 million by *Trichuris trichiura*, and 900 million by hookworm.^{2,7,8} *Ascaris lumbricoides* mainly affects children under 10 years of age with the highest prevalence in the 7 to 12 year age group.⁹ Trichuriasis

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Presented at the International Seminar on Parasitology and the 9th Congress of the Indonesian Parasitic Disease Control Association; 2002 Sept 11-12; Bogor, Indonesia.

has the highest prevalence between the ages of 5 and 15 years,² while hookworm infection is most prevalent in children 12 to 17 years old.⁹

The major manifestations of worm infestation are anemia and hypoalbuminemia.^{2,8,10-12} Iron deficiency anemia may occur depending on several factors, such as iron intake, iron storage, and the duration of infection.^{10,13} One of the efforts to overcome anemia in children due to worm infestation is the implementation of a worm infection control program.¹⁴ This study was conducted to compare hemoglobin (Hb) concentrations of children suffering from either *Ascaris lumbricoides*, *Trichuris trichiura*, or mixed infection and to evaluate the efficacy of a single dose of 400mg albendazole in increasing Hb concentration.

Methods

This study was a randomized clinical trial carried out from March to July 2002 in primary schoolchildren in Suka Village, Tiga Panah Subdistrict, Karo Regency, North Sumatera Province. Stool was collected in a plastic bottle and examined using the quantitative Kato-Katz method.¹⁵ Stool examination was done in the Pediatrics Laboratory, Medical School, University of Sumatera Utara, Adam Malik Hospital, Medan. Of the children who were positive for worm infection, 113 were selected as study subjects by simple random sampling.

Eligibility criteria

Primary schoolchildren of any level who agreed to participate in the study, had written parental permission, positive stool examination for worm eggs, good nutritional status, had not taken anthelmintic drugs for at least one month before the study, did not have any contraindication for anthelmintic agents, and were living in the vicinity of the study location, were included in this study. They were excluded if they were absent from school or withdrew from the school, or suffered from any serious infection.

Study protocol

Subjects were simultaneously given a single dose of oral 400 mg albendazole, witnessed by the investigators. Prior to treatment, the nutritional status

of each subject was determined based on the standard recommended by the Center for Disease Control and Prevention, National Center for Health Statistics (CDC, NCHS).¹⁶

Examination of Hb concentration using the cyanide method¹⁷ was carried out twice; prior to and three months after treatment, to monitor Hb concentration improvement and anemia prevalence. The examination was conducted at the Emergency Installation of Adam Malik Hospital, Medan. Hb concentration was corrected for high altitude according to Dirren *et al*, as the study area was located 1400 m above sea level. A child was considered anemic if his/her Hb concentration was less than 11.6 g/dl.¹⁸

Data analysis

Analysis of variance (ANOVA) was performed to determine any difference in Hb concentration between children suffering from the different types of worm infection. Paired t-test to evaluate the difference in Hb concentrations before and after treatment and chi-square test to evaluate the association between anemia and albendazole treatment, age, sex, and nutritional status, respectively, were done. A *P* value of <0.05 was considered significant. Data were analyzed using SPSS 10.0 for Windows.

Results

Out of 434 children who participated in the study, 336 children (84.6%) were positive for intestinal helminthiasis. Among 113 selected subjects, 4 children were excluded due to lack of written parental permission (2 children) and absence from school during the study (2 children). Out of the 109 children who completed the study, 20 (18.3%) suffered from *Ascaris lumbricoides*, 44 (40.4%) from *Trichuris trichiura*, and 45 (41.3%) from mixed-type worm infections.

There was no difference in children's age group, sex, and nutritional status among the different types of worm infection (**Table 1**). There was no difference in average Hb concentration between children suffering from the different types of worm infection (**Table 2**). There was a significant difference in the mean Hb concentration before and after treatment for each type of worm infection ($P < 0.05$) (**Table 3**).

TABLE 1. SUBJECT CHARACTERISTICS

Characteristics	Type of infection			Total	%
	<i>A. lumbricoides</i>	<i>T. trichiura</i>	Mixed infection		
	n	n	n	n	
Age (years)					
6-7	4	10	8	22	20.2
8-9	5	16	17	38	34.9
10-11	7	13	19	39	35.8
12- 3	4	5	1	10	9.2
Sex					
Male	12	21	22	55	50.5
Female	8	23	23	54	49.5
Nutritional status					
Normal	9	19	19	47	43.1
Mild malnutrition	5	18	22	45	41.3
Moderate malnutrition	6	7	4	17	15.6

TABLE 2. Hb CONCENTRATIONS IN THE DIFFERENT TYPES OF WORM INFECTION

Type of worm	Hb concentration (mg/dl)			
	n	Mean	SD	P
<i>A. lumbricoides</i>	20	12.60	2.36	0.620
<i>T. trichiura</i>	44	13.20	2.22	
<i>Mixed infection</i>	45	13.10	2.42	

TABLE 3. Hb CONCENTRATION BEFORE AND AFTER TREATMENT IN EACH TYPE OF WORM INFECTION

Type of worm	Hb concentration (mg/dl)			
	N	Mean	SD	P
Ascaris lumbricoides				
Before treatment	20	12.60	2.36	0.006*
After treatment	20	14.45	1.1367	
Trichiuris trichiura				
Before treatment	44	13.20	2.22	0.014*
After treatment	44	14.2159	2.2986	
Mixed infections				
Before treatment	45	13.10	2.42	0.000*
After treatment	45	14.5556	1.8066	

TABLE 4. CHANGE IN ANEMIA PREVALENCE BEFORE AND AFTER TREATMENT IN EACH TYPE OF WORM INFECTION

Type of worm	(+) Anemia		(-) Anemia		P
	n	%	n	%	
<i>A. lumbricoides</i>					
Before	8	40.0	12	60.0	0.002*
After	0	0	20	100.0	
<i>T. trichiura</i>					
Before	15	34.1	29	65.9	0.049*
After	7	15.9	37	84.1	
Mixed infection					
Before	13	28.9	32	71.1	0.006*
After	3	6.7	42	93.3	

The proportions of anemia before and after treatment were significantly different for each type of worm infection ($P < 0.05$) (Table 4, Figures 1, 2, and 3).

Discussion

From 109 subjects with worm infection, the prevalence of *Ascaris lumbricoides*, *Trichuris trichiura*, and mixed-type worm infection were 18.3%, 40.4%, and 41.3%,

respectively. The relatively high prevalence of mixed-type worm infection in this study is comparable to that in a previous study on primary school children in North Sumatera, in which the prevalence was found to be 79.7%.¹⁹ In South India, Nallam et al (1998) also found similar results.²⁰ Smith et al (2001) discovered the prevalence of *Ascaris lumbricoides* and *Trichuris trichiura* to be 45% and 38%, respectively. Approximately a quarter of these subjects (25.8%) had concomitant infestation of *Ascaris lumbricoides* and

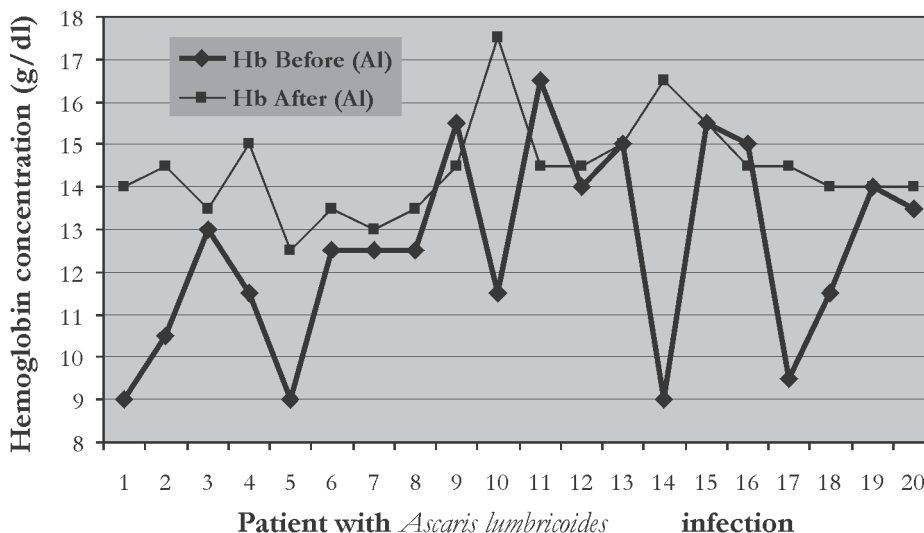


FIGURE 1. HEMOGLOBIN CONCENTRATION BEFORE AND AFTER TREATMENT OF *ASCARIS LUMBRICOIDES* INFECTION

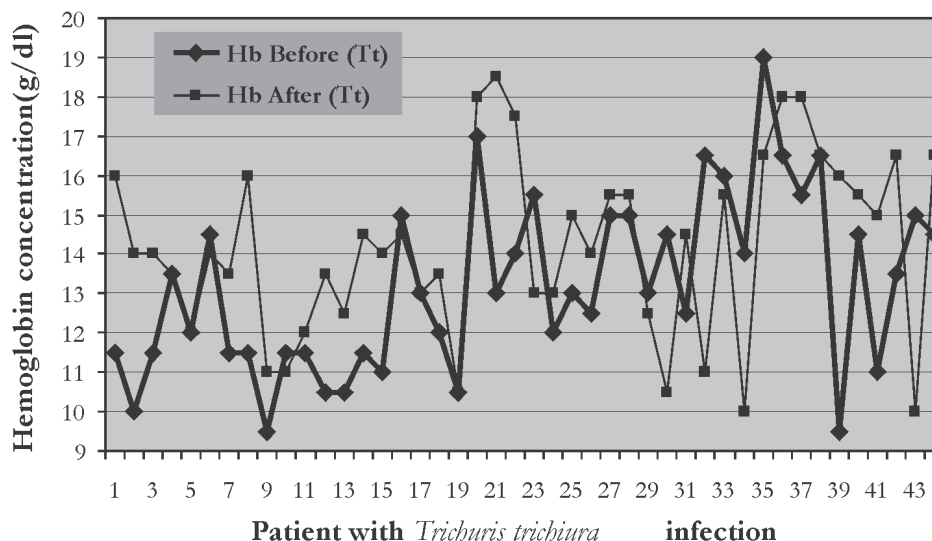


FIGURE 2. HEMOGLOBIN CONCENTRATION BEFORE AND AFTER TREATMENT OF *TRICHURIS TRICHIURA* INFECTION

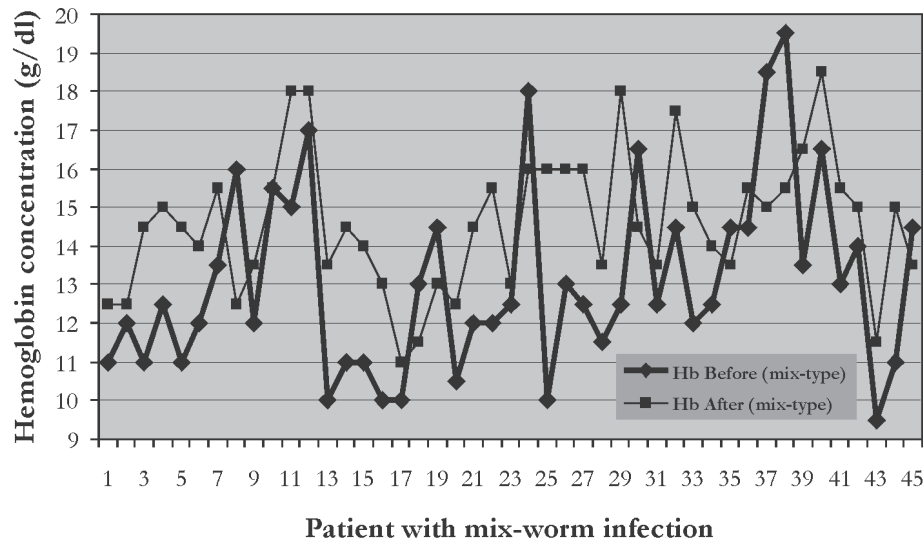


FIGURE 3. HEMOGLOBIN CONCENTRATION BEFORE AND AFTER TREATMENT OF MIXED-TYPE WORM INFECTION

Trichuris trichiura.²¹ These findings show that there was a positive interaction between *Ascaris lumbricoides* and *Trichuris trichiura* infestation. A high intensity of infestation with *Ascaris lumbricoides* has been significantly associated with that of *Trichuris trichiura*. It has been suggested that the high prevalence of concomitant infection is because both worm species share the same fecal-oral route of infection.^{21,22}

The high prevalence of intestinal helminthiasis in primary school children was probably due to a poor hygienic standard and high outdoor activity, which renders them susceptible to worm transmission.⁹

Data showed no significant difference in the children's age group, sex, and nutritional status between the three types of worm infections. The same finding has been described by Pasaribu *et al* in 1996.¹⁹ Meanwhile, Norhayati *et al* (1997),²² Ozumba *et al* (2002),⁹ and Smith *et al* (2001)²¹ found a significant difference in *Ascaris lumbricoides* and *Trichuris trichiura* prevalence among different age groups but no difference between sexes. In Madagascar, there was a higher prevalence of *Ascaris lumbricoides* in boys than in girls. This shows that sex may or may not have a role in the risk of worm infection depending on regional, environmental, and behavioral factors.²⁰

In this study, no difference was found in the children's Hb concentration between each type of worm infection in (Table 2). Greenberg *et al* discovered that *Trichuris trichiura* infection had a positive

correlation with a low Hb concentration but not with iron deficiency.²³ Nallam *et al* (1998) found that *Ascaris lumbricoides* infection had no role in causing anemia,²⁰ while Blumenthal *et al* (1976) in Louisiana reported that ascariasis influenced nutritional status and found that almost 50% of subjects suffered from anemia and 40% had inadequate transferrin saturation.²⁴ Robertson *et al* (1992) found that children with severe trichuriasis or mixed infection of *Trichuris trichiura* and hookworm had low Hb concentration.²⁵ Stoltzfus *et al* reported that *Ascaris lumbricoides* infection is related to anemia but not to intestinal blood loss.²⁶

Our study showed the benefits of administering a single oral dose of 400 mg albendazole in improving Hb concentration and decreasing the prevalence of anemia. This was evident in the statistically significant differences in Hb concentration and anemia prevalence before and after treatment ($P < 0.005$) (Tables 3 and 4, Figures 1, 2, and 3). The result was similar to that of Robertson's study.²⁵ Oguntibeju described that worm infection had a relation with changes in hematological indices.²⁷

In this study, due to limitations, no further hematological examination was performed to determine other possible causes of anemia. Therefore, we assumed that intestinal helminthiasis is the only cause of anemia in our subjects, although other factors could not be disregarded. We suggest that further studies be carried out with more detail and more comprehensive evaluation for other causes of anemia.

In conclusion, there is no difference in the hemoglobin concentration of children suffering from either *Ascaris lumbricoides*, *Trichuris trichiura*, or mixed-type worm infection. A single oral dose of 400 mg albendazole is beneficial in improving hemoglobin concentration and reducing the prevalence of anemia.

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