

## Original Article

## Nutritional status of soil-transmitted helminthiasis-infected and uninfected children

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### Abstract

**Background** Soil-transmitted helminth (STH) infections remain a public health problem in developing countries. Their prevalence is particularly high in rural areas with people of low socioeconomic level. A single or mixed STH infection rarely causes death, but can affect nutritional status, growth, cognitive development and human health, especially in children.

**Objective** To compare the nutritional status of STH-infected and uninfected children.

**Methods** This cross-sectional study was conducted in June 2010 in children from 3 primary schools in the Simpang Empat and Kabanjahe Subdistricts, Karo District, North Sumatera Province. Fecal examinations were done by the Kato-Katz method to diagnose STH infections. Participants of this study consisted of 140 infected children and 141 uninfected children. Nutritional status classification was based on the 2000 Centers for Disease Control growth charts. All categorical data were analyzed by Chi-square test.

**Results** Of 140 infected children, 8.6% were infected with *Ascaris lumbricoides*, 17.1% with *Trichuris trichiura* and 74.3% with mixed infections (*Ascaris lumbricoides* and *Trichuris trichiura*). We found significantly more STH infected children with mild to moderate malnutrition than the uninfected group. We also found significantly more mildly to moderately malnourished children with moderate infection intensity than mild infection intensity.

**Conclusion** We find significantly more STH infected children with mild to moderate malnutrition than the uninfected group. We also find significantly more mildly to moderately malnourished children with moderate infection intensity than mild infection intensity. Higher severity of infection is associated with lower nutritional status. [Paediatr Indones. 2015;55:136-41.].

**Keywords:** nutritional status, STH infection, intensity of STH infection

Approximately 2 billion people worldwide are infected with intestinal helminths. Presently it is estimated that 1.2 billion people are infected with *A. lumbricoides*, 765 million people are infected with *T. Trichiura*, and 740 million people are infected with hookworms.<sup>1</sup> In Indonesia, prevalence of STH-infected children in 2008 was approximately 24.1%, of which the species distributions of *A. lumbricoides*, *T. trichiura*, and hookworms were 14.5%, 13.9 and 3.6%, respectively.<sup>2</sup> The Department of Health Report in North Sumatera Province from 2003 to 2006 showed that the prevalences of *A. lumbricoides*, *T. Trichiura*, and hookworms were 39%, 24% and 5%, respectively.<sup>3</sup>

Soil-transmitted helminths as single or mixed infections rarely cause death, but do affect food intake, digestion, absorption, and metabolism.<sup>4,5</sup> Children have the highest prevalence of infection and are vulnerable to the effects of STH infections.

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These include nutritional deficiencies which aggravate malnutrition, leading to anemia and impaired physical and mental development, all of which significantly contribute to school absenteeism.<sup>6</sup>

Various studies have noted a relationship between nutritional status and infectious diseases, in which poor nutritional status worsened infectious diseases and vice versa, infectious diseases decreased nutritional status.<sup>6-8</sup> A Health Ministry survey also showed a relationship between nutritional status and STH infections. Prevention and treatment of STH infections are important because STH infections are most commonly found in toddlers and primary school age children in Indonesia.<sup>8</sup>

The aim of this study was to compare the nutritional status of STH-infected and uninfected children.

## Methods

A cross-sectional study was conducted in June 2010 in the Simpang Empat and Kabanjahe Subdistricts, Karo District, North Sumatera Province. Subjects were collected by consecutive sampling. Inclusion criteria were school-aged children in grades 1 to 6, who agreed to provide stool specimens for Kato-Katz examination, lived near the study location, had not taken anti-helminthics in the one month prior to enrollment, and whose parents provided informed consent. Exclusion criteria were children with other chronic diseases that could interfere with nutritional status, such as tuberculosis, persistent diarrhea, or malaria, or congenital diseases, such as heart disease.

Physical examinations were conducted on the children. Basic data were obtained from interviews and questionnaires. Fecal examinations were done by trained analysts using the Kato-Katz method to diagnose STH infection.<sup>5</sup> Children with STH infections underwent assessment for infection intensity. Body weight (BW) was measured using Camry scales with 0.1 kg precision. Children wore minimal clothing without shoes or sandals during the weight measurement. Body height (BH) was measured using a microtoise with 0.1 cm precision, with children standing up straight, feet parallel, and heels, buttocks and back of head touching the wall. Nutritional status was assessed using the 2000 CDC

growth charts.<sup>9</sup> Nutritional status classification was based on body weight/body height (BW/BH), and categorized into: obese (BW/BH >120%), overweight (BW/BH >110-120%), normal (BW/BH >90-110%), mildly malnourished (BW/BH >80-90%), moderately malnourished (BW/BH 70-80%), or severely malnourished (BW/BH <70%).<sup>10</sup>

Infection intensity was defined as the density of eggs per gram of feces (epg) and used to determine the severity of disease, as described by the World Health Organization (WHO).<sup>11</sup> *Ascaris lumbricoides* severity was classified as mild (1-4,999 epg), moderate (5,000-49,999 epg), or severe (> 50,000 epg). *Trichuris trichiura* severity was classified as mild (1-999 epg), moderate (1,000-9,999 epg) or severe (> 10,000). Hookworm severity was classified as mild (1-1,999 epg), moderate (2,000-3,999 epg) or severe (> 4,000 epg).<sup>11</sup>

This study was approved by the Ethics Committee of the Faculty of Medicine at the University of North Sumatera. Chi-square test was done to analyze the relationship between STH infection and nutritional status, as well as the relationship between the infection intensity and nutritional status. Results were considered to be statistically significant for P values <0.05.

## Results

Subjects were recruited from 3 primary schools in the Kabanjahe and Simpang Empat Subdistricts, Karo District, about 80 kilometers from Medan. Of the 475 children initially recruited, 41 children did not return the stool specimens, so 434 children were examined for STH infections. From feces examinations, we found 279 STH-infected children and 155 uninfected children. Subjects were taken consecutively, for a final sample of 140 STH-infected children and 141 uninfected children.

The prevalence of STH infection in Karo was 64.2%. Most children suffered from mixed infections of *T. trichiura* and *A. Lumbricoides*, at a prevalence of 74.3%. Single infection prevalences were 17.1% for *T. trichiura* and 8.6% for *A. lumbricoides*.

Subjects' characteristics are shown in **Table 1**. The infected and uninfected groups were of similar age, with means of about 9 years. The STH-infected group had slightly more females, while the uninfected

group had slightly more males. Mean body weights were 22.7 kg and 26.9 kg, respectively. Mean body heights were 126.7 cm and 129.6 cm, respectively.

Table 2 shows the nutritional status comparison between STH-infected and uninfected children. There were significantly more children with mild to moderate malnutrition in the STH infected group.

Further assessment was done to compare STH-infection intensity (single or mixed) and nutritional status in the infected group. Table 3 shows that in each of the single or mixed infection groups, there were significantly more mildly to moderately malnourished children with moderate infection intensity than mild infection intensity.

**Table 1.** Characteristics of subjects

Characteristics	STH infected (n = 140)	Uninfected (n = 141)
Mean age (SD), years,	9.2 (1.64)	9.3 (1.61)
Gender, n (%)		
Male	67 (47.4)	78 (55.3)
Female	73 (52.1)	63 (44.7)
Mean body weight (SD), kg	22.7 (4.40)	26.9 (6.22)
Mean body height (SD), cm	126.7 (15.75)	129.6 (13.32)
Mean BW/BH (SD), %	85.9 (5.38)	96.7 (7.59)
Infection types, n (%):		
Single: - <i>A. lumbricoides</i>	12 (8.6)	-
- <i>T. trichiura</i>	24 (17.1)	-
Mixed infection	104 (74.3)	-
Mean (SD) STH, epg		
Single: - <i>A. lumbricoides</i>	5,400.0 (6,026.15)	-
- <i>T. trichiura</i>	1,009.0 (673.07)	-
Mixed infection	5,084.9 (6,700.61)	-
Intensity of STH infection, n (%)		
Single: - <i>A. lumbricoides</i> : - Mild	6 (50.0)	-
- Moderate	6 (50.0)	-
- <i>T. trichiura</i> : - Mild	8 (33.3)	-
- Moderate	16 (66.7)	-
Mixed infection: - Mild	69 (66.3)	-
- Moderate	35 (33.7)	-

**Table 2.** Comparison of nutritional status in the STH-infected and uninfected groups

Nutritional status, n, %	STH infected (n = 140)	Uninfected (n = 141)	P value
Severely malnourished	2 (1.4)	0	0.0001
Mildly to moderately malnourished	98 (70.0)	19 (13.5)	
Normal	40 (28.6)	111 (78.7)	
Overweight	0	10 (7.1)	
Obese	0	1 (0.7)	

**Table 3.** Association between intensity of single and mixed STH infections and nutritional status

Intensity of STH infection	Nutritional status					P value
	Severely malnourished	Mildly to moderately malnourished	Normal	Overweight	Obese	
<i>A. lumbricoides</i> :						
Mild	0	2	4	0	0	0.014
Moderate	0	6	0	0	0	
<i>T. trichiura</i> :						
Mild	0	5	3	0	0	0.009
Moderate	0	16	0	0	0	
<i>A. lumbricoides</i> and <i>T. trichiura</i> :						
Mild	0	44	25	0	0	0.048
Moderate	2	25	8	0	0	

## Discussion

In this study, 279/434 children (64.2%) were positive for STH infection. This finding was higher than the 24.1% national average.<sup>2</sup> High prevalences of STH infection is related to socioeconomic level, inadequate water supply, sanitation, crowded living conditions, lack of access to health care, and low levels of education.<sup>12,13</sup> High prevalence of STH infection in primary school children in Karo District may be associated with low prevention of STH infection, but we did not assessed it furthermore.

Soil-transmitted helminth infection can be found as a single or mixed infection.<sup>14</sup> The prevalence of *A. lumbricoides* in North Jakarta was 59.96% and *T. trichiura* 79.64%. In Lombok, the prevalence of *A. lumbricoides* was 78.5% and *T. trichiura* 63.95%. In South Sumatera, the prevalence of *A. lumbricoides* was 40.3% and *T. trichiura* 41%. In West Sumatera, the prevalence of *A. lumbricoides* was 58.6% and *T. trichiura* 73.7%. In South Sulawesi, the prevalence of *A. lumbricoides* was 92% and *T. trichiura* 98%.<sup>15</sup> We found that most children had mixed STH infections (*A. lumbricoides* and *T. trichiura*), with a prevalence of 70.6%. *T. trichiura* infection alone was found in 17.1% of children and *A. lumbricoides* infection alone in 8.6% of children. This STH infection varies from one area to another, depending on several factors such as location (village or city, slum area, etc.), natural conditions or geography, age groups, examination techniques, local habits (latrine, washing hands before eating, lack of footwear), and residents' work.<sup>16,17</sup> Our study was conducted in the Karo District with moist soil conditions and high rainfall, which is advantageous for STH growth. Residents had poor hygiene habits, such as not washing their hands before eating and rarely using footwear outdoors. As this area is a farming community, most residents had regular contact with soil.

Infections with *T. trichiura* and *A. lumbricoides* are common in children aged 5 to 15 years.<sup>16,18</sup> Our subjects with STH infections were around 9 years of age. The prevalence of STH infection is related to age, with increased age related to lower STH infection. Older children have different play and activity patterns, as well as better levels of hygiene and body endurance than younger children. If a child has good food consumption, uses sandals and shoes, and

has a better sanitary environment, then along with increased age within a period of 16 months without antihelmintics in endemic areas, STH infection will often resolve itself.<sup>19</sup>

The prevalences of STH infection are similar between males and females due to similar customs and living environment. Given that in rural communities of endemic countries all children may be similarly exposed and experience comparable risks of infection, looking for an association between gender and STH infection may not be useful.<sup>6,19</sup> We found that slightly more females had STH infection than males.

*Ascaris lumbricoides* and *T. trichiura* can infect children from an early age, potentially impairing their growth and development. If the infection is prolonged into the school-aged years, the learning process may be disrupted.<sup>20</sup> A study that evaluated the relationship between *A. lumbricoides* infection and growth of children found a slight weight difference between STH-infected and uninfected children.<sup>21</sup>

Several studies have noted a relationship between nutritional status and STH infections. The relationships are complex and may depend on environmental, social and economic influences.<sup>21-23</sup> In addition, different types of STH infection can affect growth in various ways, such as interfering with absorption of nutrients and damaging the intestinal mucosa. STH infection can affect the nutritional status of the host by causing anorexia, increasing the nutrient needs of the STH itself, inhibiting absorption of mucosa by infection of *A. lumbricoides* and blood loss by infection due to *A. duodenale* and *N. americanus*.<sup>23</sup> A study in Brazil found a relationship between STH infection and nutritional status. *Ascaris lumbricoides* infection was associated with growth impairment in childhood and *N. americanus* and *A. duodenale* infection were associated with body mass disorders in adults. These infections could lead to cognitive function impairment, disability, and even death.<sup>7</sup>

The STH infection can cause stunting and growth impairment in children living in endemic areas. Although predictive factors for stunting vary, STH infection can affect nutritional status of school aged children by decreasing appetite and food intake.<sup>4,24,25</sup> A study of a cohort of children aged 2 to 7 years over a 9-year period in North Eastern Brazil found that early childhood helminthiasis was associated with a 4.63 cm shortfall at age 7.<sup>4</sup>

The nutritional status of children does not only reflect acute and chronic episodes of infection earlier in life, but it can also describe adequacy of food intake that supports good growth. Every child has a history of infection and differences in nutritional intake.<sup>13</sup> In our study, the assessment of nutritional status was done in STH-infected and uninfected children. We observed that STH infected children had lower nutritional status than uninfected children.

The interaction between nutritional status and STH infection affects human health, in a synergistic way, such that mild-to-moderate malnutrition aggravates STH infection and STH infections aggravate the problem of mild-to-moderate malnutrition.<sup>23,25</sup> Since mild-to-moderate malnutrition and the high prevalence of STH infection is a problem in Indonesia, health care workers should be aware of the reciprocal influence between nutritional status and STH infection in children.<sup>26</sup> From this study STH-infected children were mainly in the mildly to moderately malnourished category.

The Kato-Katz method is used to diagnose the presence or absence of STH infection by counting the number of eggs in stool specimens.<sup>5,18</sup> This is the method of choice to detect STH infection for research conducted in rural areas.<sup>27</sup> We used the Kato-Katz method to diagnose the presence or absence of STH infection in children.

Decreased nutritional status due to STH infection is common in children with severe intensity of infection, but even mild ones can impair growth in children with vulnerable nutritional condition.<sup>28</sup> Some studies found that severe intensity of *T. trichiura* infection was related to growth disorders in children and treatment of STH infection may improve their rate of growth.<sup>4,18,28</sup> One study found that stunting and malnutrition were associated with moderate-to-severe intensity of STH infection.<sup>23</sup>

Several epidemiological studies found that mixed STH infection in children often have more severe infection than single-species infections.<sup>16,27</sup> A study in school aged children in China found that moderate-to-heavy intensity of STH infection was an important risk factor for stunting.<sup>29</sup> The present study investigated that mildly to moderately intensity of infection affect children having mildly to moderately malnourished nutritional status.

In conclusion, we find significantly more STH

infected children with mild to moderate malnutrition than the uninfected group. In each of the single or mixed infection groups, we find significantly more children with mild to moderate malnutrition in moderate infection intensity. Higher severity of infection is associated with lower nutritional status.

## Conflict of interest

None declared.

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