

SOIL-TRANSMITTED HELMINTH INFECTION AND MACRONUTRIENT INTAKE AMONG STUNTED TODDLERS IN PANTI SUB-DISTRICT, JEMBER

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ABSTRACT

*Soil-transmitted helminth (STH) infections are one of the most common infectious diseases in the developing world, with prevalence rates as high as 65%. STH infections generally affect the digestive system, which can reduce appetite and nutrient absorption. This study aimed to determine the association between STH infection and macronutrient intake in stunted toddlers aged 12-36 months in Panti Sub-district, Jember Regency. This study used observational analysis method with cross-sectional approach. The total number of subjects was 83 stunted toddlers. Data on STH infection were collected through fecal examination and 2x24 hour food recall questionnaire to assess their macronutrient intake. This study showed that the prevalence of STH was 4.8% with species identified in the examinations such as *Ascaris lumbricoides* (2.4%) and hookworm (2.4%). The majority of macronutrient intake was considered sufficient for protein (77.1%), deficit for carbohydrate (94%) and fat (77.1%). Bivariate analysis using the contingency coefficient correlation test showed that there was no significant correlation between STH infection and macronutrient intake. Macronutrient intake may be influenced by other factors such as the role of parents in preparing nutritious food, economic status, and mild degree of infection. However, the underlying mechanism remains unclear and should be further investigated.*

Keywords: macronutrient, soil-transmitted helminth, stunted, toddlers

INTRODUCTION

Soil-transmitted helminth (STH) infections are one of the most common infectious diseases in the developing countries. STH infections belong to the group of diseases often neglected by the public. STH species that commonly cause infections in stunted toddlers include *Ascaris lumbricoides*, *Trichuris trichiura*, and hookworms (*Necator americanus* and *Ancylostoma duodenale*) (Zeynudin et al., 2022). The prevalence of STH infection in Indonesia is still high, ranging from about 45 percent to 65 percent, and can even reach as high as 80 percent in areas with poor sanitation (Nasution et al., 2019). Meanwhile, other developing countries such as Ethiopia, Nigeria, and Gabon show lower prevalence of 67.4%, 54.8%, and 42%, respectively (Edoa et al., 2024; Geleto et al., 2022; Karshima, 2018). Data from Jember District Health Office in 2016 indicated

that there were 109 cases of STH infection in Jember (Baidowi et al., 2019).

Toddlers are a high risk group for infection with some factors may contribute the incidence of infections, including their medical history and stunting (Sunarpo et al., 2023). Infected toddlers usually become malnourished and anemic due to the resulting nutritional deficiencies (Kabatende et al., 2020). Diagnosis of STH infection is established through microscopic fecal examination in the laboratory with a positive result when found one or more worm eggs (Khurana et al., 2021).

Stunting is characterized by the below the norm length or height of toddlers for their age based on the World Health Organization (WHO) growth curve (Elmighrabi et al., 2024). According to data from the Indonesian Nutrition Status Survey (SSGI) in 2022, the prevalence of stunting in East Java was found to be 19.2%, with Jember

district having the highest prevalence of 34.9% (Kemenkes, 2023). The prevalence of stunting in Panti sub-district is relatively high, reaching 56.2% (Ainy, 2020).

Previous studies shows that prevalence of stunted toddlers with STH infection (59,4%) is higher than those without STH infection. (Yoseph & Beyene, 2020). That was in line with study in Western Rwanda which showed significant associations between stunting and STH infection (Kabatende et al., 2020). However, specific research related to STH infection and macronutrient intake it still limited, therefore, this study aims to determine the correlation between STH infection and macronutrient intake in Jember due to stunting and STH infection still high.

METHODS

Observational analysis was used in this study with a cross-sectional approach. This study was conducted in Panti Sub-district, Jember Regency, East Java Province from May to December 2023. The study subjects were a total of 83 stunted toddlers aged 12-36 months, identified using purposive sampling method from the population of 451 stunted toddlers in Panti Sub-district. Sample size was defined using the Lameshow formula with a minimum of 62 samples. The source of population data for stunted toddlers was obtained from the Panti Subdistrict Health Center. Subjects were selected using the inclusion criteria of having a body length or height for age index (H/A) less than -2 standard deviations of the child growth curve. Toddlers who had taken deworming medication in the previous month were excluded. Researchers ensure that toddlers take deworming medication by asking for Integrated Service Post attendance in the last month and confirming it with parents and Integrated Service Post midwife cadres. Informed consent was obtained from parents. Consent forms were signed by parents after they were given sufficient information regarding this study.

Macronutrient intake data were collected from interviews with parents who completed the 2x24-hours food recall questionnaire. Interviews were conducted by asking what foods and beverages were consumed over the last 24 hours. The results

from the questionnaire were converted into grams with reference to the Food Photo Book by the Individual Food Consumption Survey Team of the Indonesian Ministry of Health. The data were entered into Nutrisurvey software to determine the satisfactory level of macronutrient intake. The results were categorized into deficit and sufficient according to the recommendations of the Nutritional Adequacy Score (Permenkes, 2019). Parents were then given a stool pot to collect the toddler stool. Parents will informing by phone when the stool has been put in the stool pot, then the officer will take it to send to laboratory directly. Microscopic stool examination using direct smear and flotation methods were carried out to detect *Ascaris lumbricoides*, *Trichuris trichiura*, and hookworm eggs. The examination was conducted at the Parasitology Laboratory of the Faculty of Medicine, University of Jember. The equipment and materials used for the examination include a centrifuge, centrifuge tube, pipette, cover glass, object glass, microscope, distilled water, saturated MgSO₄ solution, and 1% Lugol solution. Examination results were matched with WHO guidelines for diagnosis of STH infection and confirmed by experts in parasitology.

Data were analyzed using IBM SPSS Statistic 26 and presented in tables of frequencies and percentages, while bivariate analysis was examined using the contingency coefficient correlation test. Ethical approval with number 4959/UN25.1.10.2/KE/2023 was obtained from the Ethics Committee of the Faculty of Medicine, University of Jember.

RESULTS AND DISCUSSIONS

Total subjects in this study were 83 stunted toddlers aged 12-36 months in Panti sub-district, Jember Regency. Table 1 provides the information regarding subject characteristics in this study including the characteristics of toddlers, mother of toddlers, and the family economics status. The characteristics of toddlers include gender and age group.

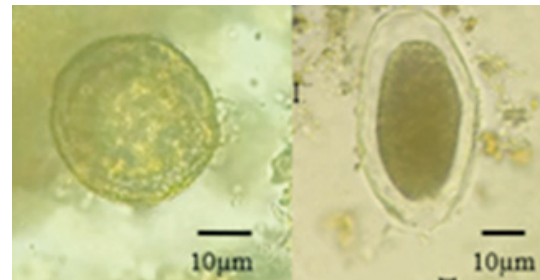
Previous research, shows that male toddlers have a higher risk of stunting compared to females (Elmighrabi et al., 2024). However, this study found that male toddlers were not significantly

different from female toddlers. The 12-24 month age group was also not significantly different from the 24-36 month age group. This group is considered crucial during the growth period of the toddler and vulnerable to stunting as found in previous studies (Elmighrabi et al., 2024). The majority of mothers of toddlers were between 20-39 years old and most of them had low to medium level of education. Mother method in educating toddlers is influenced by their educational level. Due to mother very limited knowledge and most of them followed the existing traditions in the society. Previous research shows that the risk of stunting is higher in mothers with low education (Elmighrabi et al., 2024).

Family economic status is also associated with stunting (Htet et al., 2023). This study found that most families of toddler had low incomes. This may affect the family ability to meet the nutritional needs of toddler, which increases the risk of stunting (Harvey et al., 2022). Families with lower incomes have higher rates of stunting at all ages, according to previous studies (Karlsson et al., 2023).

Table 1 also describes the results of fecal microscopic examination. Results of fecal examination using microscopy in the Laboratory of Parasitology, Medical Faculty, University of Jember found 4 positive samples infected with STH (4.8%). The STH eggs identified from the examination results showed *Ascaris lumbricoides* (2.4%) and hookworm (2.4%). Results of fecal examination can be seen on Figure 1. No *Trichuris trichiura* eggs were found in this study.

Stunted toddlers under five years of age are generally at high risk of infection due to their weak immune system (Agrawal et al., 2024). The prevalence of STH infection in this study showed lower prevalence than previous studies in Sikapas and Singkuang, North Sumatra, which found a prevalence of 76.8% and 87.2%, respectively (Nasution et al., 2019). Only a few eggs were found in the fecal examination results, indicating a mild degree of infection. The prevalence and mild level of infection may be due to routine worm infection prevention programs implemented in Panti subdistrict. Toddlers are dewormed every February and August. To reduce the incidence of worm infections, treatment is provided to



(a) *Ascaris lumbricoides* egg (b) Hookworm egg

Figure 1. Microscopic Fecal Examination

reduce infection rates and improve health (Taylor-Robinson et al., 2019). In addition, to support this program, many of the mothers of toddlers in this study practiced good hygiene behaviors, which can reduce the risk of infection (Lebu et al., 2023).

Ascaris lumbricoides and hookworm eggs were found in this study. However, *Trichuris trichiura* was not found in this study. According to previous studies, *Ascaris lumbricoides* is the most infecting species among other species with a prevalence of 26%, while hookworm is less at 7.9% (Ganguly et al., 2022). Diarrhea is the most common presenting symptom of STH infection (Gitore et al., 2020). Diarrhea in toddlers in this study averaged more than 3 times per day. Infected toddlers had diarrhea symptoms within the previous month. However, a few were brought to health facilities for treatment of diarrhea. Accumulation of adult *Ascaris lumbricoides* and hookworm in the intestines of toddlers can cause inflammation of the intestinal wall, which can disrupt the process of food absorption and lead to a liquid stool consistency (Wei et al., 2017).

Ascaris lumbricoides transmits via the oral fecal route by ingestion of eggs with food or drink. Therefore, hand and food hygiene, including cutlery, must be considered. The infective larvae of hookworm penetrate the skin. That's why wearing shoes when playing on the ground is important for toddlers (Hailu et al., 2019; Holland et al., 2022). Infected toddlers in this study liked to play on the ground, some rarely cut their nails, and did not use soap to wash their hands. These factors may increase the risk of transmission, as described in previous studies (Pasaribu et al., 2019).

Results of macronutrient intake data are presented in Table 2. These results derive from the 2 × 24-hour food recall interviews with

Table 1. Distribution of Subject Characteristics and STH Infection

Subject Characteristics	n	%
Toddler Gender		
Male	42	50.6
Female	41	49.4
Toddler Age (month)		
12-24	42	50.6
25-36	41	49.4
Mother Age (years)		
10-19	2	2.4
20-39	78	94.0
40-59	3	3.6
Mother's Educational Level		
Low	19	23.0
Moderate	39	71.0
High	5	6.0
Household Income		
Low	65	78.3
Moderate	18	21.7
STH Infection		
Positive	4	4.8
Negative	79	95.2
STH Species*		
Ascaris lumbricoides	2	2.4
Trichuris trichiura	0	0.0
Hookworm	2	2.4

Note: *= 4 out of 83 subjects were infected with STH

mothers or caregivers of toddlers and completed questionnaires. Levels of macronutrient intake fulfillment are categorized into deficit and sufficient. The results showed that the majority of 64 toddlers (77.1%) were in the sufficient category for protein intake. While the majority of carbohydrate (94%) and fat (77.1%) intake was deficit.

The protein intake results showed that stunted toddlers aged 12-36 months tended to be quite good. Based on the results of the 2x24-hour food recall, toddlers had adequate protein intake from commonly consumed side dish sources such as eggs, fish, tofu, and tempeh. Protein sources were readily available in the Panti sub-district community. In addition, the prices of these side dishes were relatively low, which made them the preferred choices for daily family meals. Other protein sources such as meat and fresh cow milk were rarely found because the price was more expensive. Among these protein sources, chicken eggs were the most preferred because they were

Table 2. Distribution of Macronutrient Intake Fulfillment Level

Macronutrient Intake	n	%
Protein		
Deficit	19	22.9
Sufficient	64	77.1
Carbohydrate		
Deficit	78	94.0
Sufficient	5	6.0
Fat		
Deficit	64	77.1
Sufficient	19	22.9

easy to cook and almost every toddler in this study loved fried egg.

Data from food recalls showed inadequate intake of carbohydrates and fats. Many of the toddlers consumed few sources of carbohydrates and fats in a day. Toddlers ate only a few spoonfuls of rice. Most mothers replaced it with snacks that did not contain enough nutrients.

Table 3 shows the distribution of infection status with macronutrient intake for each toddler. Table 3 also explains the results of statistical analysis of all variables. Statistical analysis showed all significance value >0.05 for correlation between STH infection and macronutrient intake. These results indicate that there is no significant correlation among all variables.

There was no significant association between STH infection and macronutrient intake of stunted toddlers in this study. This is different from previous research findings that mentioned STH infection as one of the factors causing poor nutritional intake in children under five years of age (Rahmi et al., 2021). STH infections in toddlers usually cause loss of appetite, leading to nutritional deficiencies (Oyeyemi & Okunlola, 2023). Reasons for this non-significant association may be due to several factors. The findings in this study may have been influenced by the mild degree and duration of infection. The toddlers infected with STH in this study did not show severe gastrointestinal symptoms. They only showed a history of diarrhea symptoms in the past month. Fecal analysis also found few STH eggs in the positive samples. This condition has less impact on toddlers nutrition than when they experience a more severe degree of infection and for a longer period of time.

Table 3. STH Infection and Macronutrient Intake

Variable	Macronutrient Intake					
	Protein		Carbohydrate		Fat	
	Deficit	Sufficient	Deficit	Sufficient	Deficit	Sufficient
STH Infection						
Positive	0	4	4	0	2	2
Negative	19	60	74	5	62	17
Significance	0.264		0.604		0.186	
Contingency Coefficient	0.122		0.057		0.144	

Mother contribution is one of the factors to ensure that toddlers receive adequate nutrition. Mother understanding influences the choice of foods consumed by toddlers (Duong et al., 2023). Most of the mothers of the subject in this study had low to moderate education. This may affect the nutritional status of toddlers. Mothers play an important role in providing good care for toddlers. Mothers were expected to be able to provide guidance to toddlers on good eating habits. For example, toddlers should be given orderly eating schedules, accustomed to eating nutritious foods, and advised to maintain cleanliness before and after eating. Implementation of good parenting by mothers can form good habits in toddlers when eating, with a hope that the nutritional needs of toddlers can be met (Mahmood et al., 2021).

The economic status indirectly influences toddler dietary intake. Low economic status affects limited access to food, which affects the ability to meet the family nutritional needs (Elmighrabi et al., 2024). Majority of the respondents in this study were found to have low income. This affected their daily diet. It can be seen from the results of food recall interviews that most of the respondent families tended to lack varied nutritional content. Therefore, some of the nutritional needs of toddlers were not adequately provided. An interesting finding in this study was that infected toddlers were included in the sufficient category for protein intake. It may be due to the fact that the toddlers really liked protein sources such as eggs, tofu and fish. In addition, the price of protein foods was relatively cheap and was easily accessible by those families with toddlers.

This study used the 2x24-hour food recall interview method, which has limitations that it is highly dependent on the mother memory (Huang et al., 2022). Some mothers of toddlers in this study forgot the overall menu provided and only

remembered parts of the food menu provided to their toddlers, which affected the completeness of the questionnaire. Food conversions to grams were also sometimes inaccurate because only the standardized food photo book measurements were used without direct weighing on the food scales. More accurate methods may be selected for further study. Our study has informed the community to pay more attention to the prevention of STH infection and nutritional fulfillment in children under five years of age. This includes efforts to maintain good hygiene and dietary habits.

CONCLUSION

Our results show that STH infection does not have a significant correlation with the intake of macronutrients in stunted toddlers between the ages of 12 and 36 months. This is probably because all infected toddlers had a mild degree of infection and were asymptomatic. Hence, it did not affect their digestive system. Deficits in macronutrient intake may also be caused by other factors such as mother contribution to parenting and diet. Economic status also plays a role in this regard. However, the underlying mechanism remains unclear and warrants further investigation.

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