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Malnutrition in Children with Helminthiasis: A Review Article

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ABSTRACT

Various factors strongly influence the development and growth of children. One of the factors that influence this is the nutritional status of children. The child's nutritional status is also influenced by how the child eats and whether there is an infection. One of the conditions that affect illness is helminthiasis. Helminthiasis caused by intestinal parasites, mostly soil-transmitted helminthes, a particular species of worm that requires soil as media for its spreading. These parasitic infections are more common in school-age children due to lack of hygiene awareness, such as not using appropriate footwear, keeping the long and dirty nails, and not washing hands before eating - water, sanitation, and hygiene influence risk factors in developing countries and worm prevalence rates.

The incidence of soil transmitted helminthes is evenly distributed worldwide, mainly among school-age children. These worms can affect the absorption of food, interfere with the number of calories, and cause blood loss. Children who suffer from worms will look thin, tired, weak, easy to get sick, and have decreased in learning concentration, thereby reducing academic performance. This worm infection is chronic, so complaints are initially unknown and felt, most of complaints are realized too late and have far-reaching effects. In general, this worm affects children in almost all parts of the world, affecting nutritional status, anemia, and IQ. Research in Indonesia shows a relationship between the incidence of helminthiasis and nutritional status disorders, such as malnutrition. Helminthiasis affect all digestive pathways, intake, absorption, and metabolism of food.

Keywords: malnutrition, helminthiasis, children

INTRODUCTION

Quality resources determine the future of a nation. Children play an essential role in determining that direction. Children will grow and develop optimally if supported by good nutrition (Risa et al., 2017). According to the American Society of Parenteral and Enteral Nutrition (ASPEN), pediatric malnutrition is defined as an imbalance between nutrient requirements and intake, resulting in cumulative deficits of energy, protein, or micronutrients that may negatively affect growth, development, and other relevant outcomes (Mehta et al., 2013). The nutritional status of children is directly affected by intake and the presence of infection. The infection that affects the nutritional quality of children is helminthiasis (Febrindari and Nuryanto, 2016).

Helminthiasis is a disease caused by intestinal parasites (Annida et al., 2018). STH (Soil-Transmitted Helminths) often occur in children and require soil media to spreading (Kamila, Margawati, and Nuryanto, 2018). STH infections are among the most prevalent neglected tropical diseases (NTD) worldwide (Silver *et al.*, 2018). STH infections may result from poor hygiene in many school-aged children, for example, not wearing footwear and not washing hands before meals. In developing countries, water, sanitation, and hygiene

become risk factors for infection in school-aged children (Rohmah *et al.*, 2022).

Soil-transmitted helminths (STH) infections may disrupt the children's health, nutritional status, and cognitive development. Especially, poly-parasitism and high intensity of helminths could lead to morbidity and malnutrition, which could end in mortality (WHO, 2017). Helminths may exacerbate malnutrition of the human hosts due to their physical barrier and competition for food. Anemia is more related to intestinal blood loss and insufficient micronutrient absorption (Gier *et al.*, 2016). This review will discuss nutritional disorders caused by soil-transmitted helminth.

DISCUSSION

Soil-transmitted helminth infections and malnutrition are major health problems of school-age children in developing countries. Malnutrition and soil-transmitted helminth infections often co-exist with synergetic consequences (Mekonnen *et al.*, 2020). Globally in 2020, 149 million children under five were estimated to be stunted (too short for age), 45 million were wasted (too thin for height), and around 45% of deaths among children under five are linked to undernutrition. These mainly occur in low- and middle-income countries (WHO, 2021).

Soil-transmitted helminth (STH) infections are a significant public health problem in tropical and subtropical regions with low-income and middle-income countries, especially in marginalized populations with poor access to clean water and sanitation, and living in overcrowded conditions with low levels of education and lack of access to health services. The highest prevalence was reported in sub-Saharan Africa, China, South America, and Asia. Estimates suggest that more than 1.45 billion humans worldwide are infected with STH parasites causing up to 4.98 million years lost due to disability and 5.18 disability-adjusted life years (Pullan *et al.*, 2014). Over 260 million preschool-age children, 654 million school-age children,108 million adolescent girls, and 138.8 million pregnant and lactating women live where these parasites are intensively transmitted and need treatment and preventive interventions (WHO, 2023).

The main species that infect people are the roundworm (*Ascaris lumbricoides*), the whipworm (*Trichuris trichiura*), and hookworms (*Necator americanus* and *Ancylostoma duodenal*). They are transmitted by eggs that are present in human feces, which in turn contaminate soil in areas where sanitation is poor. Adult worms live in the intestine and produce thousands of eggs daily in it. In addition, hookworm eggs hatch in the soil, releasing larvae that mature into a form that can actively penetrate the skin. People become infected with hookworm primarily by walking barefoot on contaminated soil (WHO, 2023).

Depending on parasitic loads, hookworms are associated with varying degrees of iron deficiency anemia; *A. lumbricoides* can cause intestinal obstruction, protein-energy malnutrition, decreased fat absorption, and deficiency of vitamins A & C, *T. trichiura* is associated with dysentery and rectal prolapse. Hookworm transmission is more frequently percutaneous; *A. lumbricoides* and *T. trichiura* are orally transmitted. This may be related to different dynamics and risk factors, hookworms being more associated with the inadequate destination of feces in the peridomestic environment and *A. lumbricoides* and *T. trichiura* more dependent on the insufficient supply of clean water and consumption of clean food (Almeida *et al.*, 2020) (Bharti, Bharti and Khurana, 2018).

Although most helminthic infections are mild and are often asymptomatic, but moderate to heavy worm infestations are generally associated with growth faltering, nutritional compromise, anemia and suboptimal academic performance among children from endemic regions (Bharti, Bharti and Khurana, 2018) (Rahma *et al.*,

2020). Worms can affect the state of nutrients by interfering with the amount of calories, protein and blood loss can occur. Worms will have an impact on intake, digestion, absorption, and metabolism of food (Annida *et al.*, 2018).

Symptoms of worms in children are seen in thin bodies and impaired growth; children feel tired and weak, have low immunity, get sick quickly, and affect concentration in learning, decreasing learning achievement. Nutritional status can be affected by worms, and the level of investment also influences this. However, some investment conditions, such as those for intestinal worms, are affected by age. The higher the period, the more investment begins to decrease. This is due to changes in playing patterns, awareness of maintaining cleanliness, and increased immunity at a higher age. Worm infections can cause problems in the intestinal mucosa, which can interfere with food absorption and lead to malnutrition. This occurs in chronic adult *A. lumbricoides* worm infections (Kamila, Margawati, and Nuryanto, 2018).

Soil-transmitted helminth (STH) infections are still prevalent in Indonesia, with roughly one-third of the infected population being preschool-age children (PSC), generally at higher risk of morbidities such as malnutrition and anemia. A total of 393 PSCs randomly selected from 22 villages were examined. The prevalence of underweight, stunting, wasting, and anemia was 33.1%, 40.2%, 17.1%, and 60.3%, respectively. STH infection, predominated by *A. lumbricoides*, was found in 160 (58.8%) PSC. Single STH infection, but not multiple infections, was independently associated with a lower risk of anemia. A similar association with anemia was also found in mild STH infection (Djuardi *et al.*, 2021).

Moncayo, Lovato, and Cooper's research on 920 children aged 6-16 years in Ecuador showed that 257 (27.9%) children were infected with at least one of STH species. *T. trichiura*, *A. lumbricoides*, and hookworm prevalence were 19.3%, 18.5%, and 5.0%, respectively. Malnutrition was present in 14.2% of children, and stunting was the most common (12.3%). They have estimated the prevalence of STH infections in the three ecological zones in Ecuador and observed the highest prevalence and intensity of disease in the Amazon region, likely a consequence of poor living conditions and an environment that is highly favorable for transmission. Stunting was also higher in the Amazon region, and malnutrition was associated with the intensity of *A. lumbricoides* infections (Moncayo, Lovato, and Cooper, 2018).

Guan and Han studied the association between intestinal worm infection and malnutrition among rural children aged 9–11 in Guizhou Province, China. The results of that study were found that among 2179 children, part of the children was infected by intestinal worms (41.85%). Stunting (28%), low memory IQ (87.52%), and intense process IQ (62.59%) were highly prevalent in the sample. Socio-demographic factors were associated with thinness, being underweight, stunting, low memory IQ, low process IQ, anemia, and intestinal worm infection. Intestinal worm infection was associated with low IQ, anemia, and stunting (Guan and Han, 2019).

Research by Hasyim, Mayulu, and Ponidjan in North Bolaang Mongondow, North Sulawesi, Indonesia, found that children with helminthiasis have a 59 times risk of developing anemia compared to children who do not have helminthiasis. The type of worm detected was hookworm (*N. americanus*). The spread of these worms often occurs in children in rural mining areas, especially plantations, because their activities touch the ground more (Hasyim, Mayulu, and Ponidjan, 2013).

The pathological process underlying the host response for helminthiasis may lead to inflammatory conditions. In helminthiasis, altered intestinal iron uptake and iron metabolism, and intestinal bleeding can lead to iron deficiency. The destruction of the intestinal mucosa impedes the absorption of nutrients, including

micronutrients such as iron, negatively affecting the host's nutritional status and immune system. Globally, the leading cause of iron deficiency anemia is infection by parasites such as hookworms, whipworms, and roundworms, which results in intestinal bleeding in the stool. Hookworm infection leads to anemia by inducing chronic intestinal blood loss: disorder by *A. duodenale* and *N. americanus* can cause blood loss of 0.15–0.2 mL per day. These hookworms release anticlotting factors such as coagulase to prevent blood clots and ensure continuous blood flow. Disruption of iron absorption can also be due to damage to the intestinal integrity caused by the inflammatory process. Helminthic infection can increase inflammation: in a host, the existence of helminths is detected by the epithelial or immune cells in response to worm products; these cells then release cytokines (e.g., IL-25) from the enterocytes, promote Th2 cell proliferation, and upregulate effector mechanisms (e.g., an evocation of eosinophils by IL-5), all to destroy the parasite. However, the helminths manipulate the host immune system by releasing molecules to facilitate the formation of a leaky epithelial barrier. This damage to intestinal integrity can reduce intestinal iron uptake and induce anemia. In children with such parasitic infections, malnutrition may occur due to a lack of essential nutrients, resulting in nutritional anemia. (Bukhari *et al.*, 2020) The overall effect may alter the children's cognitive development, including their memory, reaction time, learning, and innate intelligence (Pabalan *et al.*, 2018).

CONCLUSION

Helminthiasis significantly affect the growth and development of children. Helminthiasis also have an impact on nutritional status, so that it can lead to malnutrition. Some of the factors that cause the occurrence of helminthiasis are awareness of hygiene. Helminthiasis are more common in school-age children related to personal hygiene. Attention is needed from the government and specifically from families to reduce the incidence of helminthiasis so that it does not have a chronic impact on children's health because children are the future of the nation.

Declaration by Authors

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