JTL 14 (2) 2025
Page: 267-274

Contents list available at Jurnal Teknologi Laboratorium

JURNAL TEKNOLOGI LABORATORIUM

Journal Homepage: www.teknolabjournal.com
ISSN 2580-0191(Online) I ISSN 2338 – 5634(Print)

Original Research

OPEN ACCESS

Association between Soil-Transmitted Helminth infections and total protein levels among 6–7-year-old children in Palembang, Indonesia: a case–control study in landfill-adjacent areas

Fajriah Purnama[1,2], **Ahmad Syauqy**[1], **Achmad Zulfa Juniarto**[1]

[1] Department of Nutritional Sciences, Universitas Diponegoro, Semarang, Indonesia
[2] Politeknik Kesehatan Kemenkes Palembang, Palembang, Indonesia

Abstract: Soil-Transmitted Helminth (STH) infections remain a significant public health concern in Indonesia, particularly affecting the pediatric demographic. These infections may adversely affect nutritional status, total protein levels, and serum albumin, consequently impeding children's growth and development. This study aimed to examine the relationship between soil-transmitted helminth (STH) infection and nutritional status, total protein levels, and serum albumin in children aged 6 to 7 years in Palembang, Indonesia. A case-control study was conducted involving 160 children aged 6 to 7 years, divided into two groups based on proximity to a landfill: those living near the landfill and those living at a wider distance. Stool analyses were conducted to detect STH infection, anthropometric measurements were employed to assess nutritional status, and blood samples were collected to evaluate total protein and serum albumin levels. We employed chi-square tests and the non-parametric Mann–Whitney U test to analyze the data. The overall prevalence of STH infections was 11.2%, with all affected children residing in proximity to the landfill. A significant correlation existed between STH infection and reduced total protein levels ($p < 0.001$; OR = 172.5). However, no substantial relationships were seen between STH infection and serum albumin levels ($p = 0.060$) or nutritional status as assessed by body mass index-for-age, weight-for-age, and height-for-age measures. In conclusion, STH infection was substantially associated with an increased risk of low total protein levels in children aged 6 to 7 years in Palembang. In contrast, no substantial association was found between STH infection and serum albumin levels or anthropometric indicators of nutritional status. These findings indicate that immediate public health interventions are necessary, including enhanced sanitation, health education, and routine deworming initiatives, particularly in communities adjacent to landfills.

Keywords: Soil Transmitted Helminths; Children; Total protein; Nutritional status; Landfill exposure

INTRODUCTION

Soil Transmitted Helminths (STH) infection remains a significant public health problem, particularly in communities with poor sanitation. The World Health Organization (WHO) estimates that more of 1.5 billion people in the world are infected with STH, with elementary school-age children are most vulnerable populations[1,2,3,4]. In 2021, it was estimated 642.72 million cases of STH infection globally[5]. In 2024, the prevalence of STH infections among the schoolchildren in Ethiopia was 18.2% [6]. Justine *et al* (2024) declared the prevalence of STH infection among the primary school children in Tanzania was 56.2% [7]. WHO has identified six targets for STH prevention and control up to 2030 [8].

Corresponding author.
E-mail address: syauqy@fk.undip.ac.id (Ahmad Syauqy)
DOI: 10.29238/teknolabjournal.v14i2.616
Received 08 August 2025; Received in revised form 15 August 2025; Accepted 25 September 2025

In Indonesia, STH infection has been strongly associated with a high risk of stunting of up to 44%[9]. A number of recent local studies have highlighted the correlation between STH infection with nutritional status and environmental conditions. Nutritional status is the condition of the body that is affected by food consumption and the intake of nutrients necessary for energy, tissue maintenance, growth, and regulation of body processes[10,11].

A study in Samosir, North Sumatera found that despite the implementation of the Mass Deworming Program (MDA), STH infection prevalence (4.8–5.9%) still impacted childhood anemia, highlighting the need for improved sanitation and clean water[12]. Prevalence of STH infection among elementary school students in Kulonprogo was 22.7%[13]. Study in Banjar showed 18.2% STH infection among elementary school students[14]. Some previous studies showed that worm infection can cause nutrients malabsorption, protein loss through digestive track, and decreased nutritional status[15,16]. While previous studies have examined the association between STH infection and anthropometric nutritional indicators, few have focused on biochemical parameters such as serum total protein and albumin, particularly in early school-aged children living in high-exposure environments.

This study addresses this gap by examining the blood collected from the elementary school children to measure the serum total protein and albumin. The primary objective of this study was to examine the association between STH infection and nutritional status, total protein levels, and serum albumin levels in elementary school children aged 6–7 years in Palembang.

MATERIAL AND METHOD

This study was conducted in January – March 2025, in two elementary schools, one is located near (approximately 1 kilometres) and the other is far from a landfill (approximately 6 kilometres). The study population consisted of two groups: children infected with STH and those uninfected. Sample size was calculated by Lemeshow formula, selected through purposive sampling with a total of 160 respondents (80 cases and 80 controls). The selected respondents should fulfill the inclusion criteria that were students of the elementary school and obtaining parental consent by completing the informed consent form. Participant who did not collect fecal samples were excluded from the study.

This study was declared to be ethically appropriate with ethical approval number 1034/KEPK/Adm2/XI/2024 published by Health Research Ethics Committee of Poltekkes Kemenkes Palembang. The blood sample was collected using standard phlebotomy procedures. Informed consent and the fecal container were distributed to the parents simultaneously in the previous day. In the same day with samples collection, blood and fecal samples were transported to the laboratory, the blood samples were processed to separate the serum while the feces were processed using Kato-Katz method to identify STH infection[17]. The serum samples were examined to determine total protein and albumin using spectrophotometry method. Reference range for Total Protein and Albumin as noted in the manual procedure of Biosystem reagent (6.6-8.7 g/dl for Protein and 3.8-5.1 g/dl for Albumin). Anthropometric measurements (weight and height) were conducted in the same day when blood and fecal samples were collected.

All data were analyzed using SPSS software version 24. As the data were numerical, we have to verify the distribution using Kolmogorov-Smirnov test. A p-value of < 0.001 confirmed that the data were not normally distributed; therefore, the analysis was continued using a non-parametric test, specifically the Mann–Whitney U test[18].

RESULTS AND DISCUSSION

This study illustrates the distribution of respondent characteristics among children aged 6 to 7 years in relation to their proximity to a landfill (table 1). The

overall prevalence of soil-transmitted helminth (STH) infection was 11.2% (18/160), with all infected children residing near the landfill. No STH infection was observed in children residing at a greater distance from the landfill.

Low total protein levels were observed in 11.9% of individuals, all of whom were children living in proximity to the refuse. Conversely, all individuals in the non-landfill cohort exhibited normal levels of total protein. Reduced blood albumin levels were prevalent in both groups. They impacted 75.0% of the youngsters residing near the landfill and 62.5% of those living at a further distance. Based on BMI-for-age, the majority of children in both groups were classified as underweight. This constituted 85.6% of the total sample. The weight-for-age assessment revealed that more than one-third of the youngsters were classified as overweight or obese. All children in both groups displayed normal height-for-age, indicating the lack of stunting in the research population.

Table 1. Frequency Distribution of Respondent Characteristics

Variables	Near landfill (n = 80)	Far from landfill (n = 80)	Total (n = 160)
	n (%)	n (%)	n (%)
STH Infection			
Yes	18 (22.5)	0 (0.0)	18 (11.2)
No	62 (77.5)	80 (100.0)	142 (88.8)
Total Protein Level			
Low	19 (23.8)	0 (0.0)	19 (11.9)
Normal	61 (76.2)	80 (100.0)	141 (88.1)
Serum Albumin Level			
Low	60 (75.0)	50 (62.5)	110 (68.7)
Normal	20 (25.0)	30 (37.5)	50 (31.3)
Body Mass Index-for-Age (BMI/A)			
Underweight	69 (86.3)	68 (85.0)	137 (85.6)
Normal	11 (13.7)	12 (15.0)	23 (14.4)
Weight-for-Age (W/A)			
Normal–Above Normal	54 (67.5)	52 (65.0)	106 (66.3)
Overweight/Obese	26 (32.5)	28 (35.0)	54 (33.7)
Height-for-Age (H/A)			
Normal	80 (100.0)	80 (100.0)	160 (100.0)

The findings indicate that STH infections are distinctly concentrated in the environment, affecting primarily youngsters residing near the trash. This pattern clearly indicates that proximity to a landfill may elevate exposure to polluted soil and inadequate sanitation, hence increasing the probability of STH transmission.

The distinctive occurrence of low total protein levels in children residing near the dump, coupled with the substantial correlation revealed in subsequent study, corroborates the notion that STH infection results in impaired protein metabolism or increased protein loss. This discovery is biologically plausible, as helminth infections are recognized to impair nutrient absorption and increase protein catabolism. Conversely, serum albumin levels did not show a significant difference among groups, suggesting that albumin may be less sensitive to early or mild dietary and viral disturbances than total protein. The absence of significant differences in anthropometric markers indicates that metabolic alterations may transpire before measurable changes in growth parameters, particularly in early childhood.

These findings underscore the significance of biochemical indicators as early markers of nutritional deficiencies in infants afflicted with STH infections, particularly in areas susceptible to environmental influences, such as communities adjacent to landfills.

Table 2 contrasts the biochemical and anthropometric markers of children aged 6 to 7 years residing near the landfill with those living at a greater distance.

Significant discrepancies were seen in total protein levels and serum albumin levels between the two groups ($p < 0.001$ for both variables). No statistically significant differences were seen among groups for anthropometric characteristics, including BMI-for-age ($p = 0.451$), weight-for-age ($p = 0.740$), and height-for-age ($p = 1.000$). The height-for-age variable demonstrated minimal variability across participants, indicating a uniform normal stature within the study group.

Table 2. Comparison of Biochemical and Anthropometric Parameters Between Children Living Near and Far from the Landfill

Variable	Mean	95% CI	SD	Min–Max	p-value
Total Protein (g/dL)	72.19	70.52 – 73.85	10.66	28.0 – 96.0	<0.001
Serum Albumin (g/L)	34.97	33.94 – 36.00	6.59	18.0 – 71.0	<0.001
BMI-for-Age (kg/m²)	15.24	14.68 – 15.80	3.57	7.7 – 32.0	0.451
Weight-for-Age (W/A)	2.94	2.85 – 3.04	0.59	1.8 – 5.3	0.740
Height-for-Age (H/A)	0.20	0.20 – 0.20	0.00	0.2 – 0.2	1.000

Note: Statistical analysis was performed using the non-parametric Mann–Whitney U test. BMI/A = Body Mass Index-for-Age; W/A = Weight-for-Age; H/A = Height-for-Age.

The significant differences in total protein and serum albumin levels suggest that children living near landfills experience more marked biochemical alterations than those live at greater distances. These findings correspond with the increased prevalence of STH infection and reduced protein levels observed in the group adjacent to the landfill.

Total protein appears to be a highly sensitive assay that reflects the cumulative effects of infection, inflammation, and dietary intake. Despite considerable variations in serum albumin levels among groups, the lack of a direct association with STH infection in multivariate analysis suggests that albumin may be influenced by other factors beyond parasite infection, such as hydration status and subclinical inflammation.

The absence of significant variations in anthropometric indicators indicates that metabolic disturbances may occur prior to measurable changes in physical growth. This supports the idea that subclinical nutritional deficits may occur before observable growth retardation, especially in early life. Overall, our findings underscore the need of employing biochemical assays in conjunction with anthropometric data when assessing the impact of STH infection on the health of individuals residing in high-risk locations.

Although light infection often asymptomatic, heavy STH infections can cause abdominal pain and intestinal obstruction, as well as damage to the mucosal lining, leading to nutrient malabsorption[19]. These findings support the theory that STH infections can cause impaired nutrient absorption and protein loss through the digestive tract, which impacts the nutritional status and biochemical balance of the child's body [16,20].

Previous study showed correlation between stunting *and Ascaris lumbricoides* infection[21,22]. Djuardi *et al* (2021) found STH infection in 58,8% of preschool-age children in Nangapanda subdistrict, Indonesia. The study declared STH infection was associated with lower risk of stunting[23]. In line with this, Mekonnen *et al* (2020) reported a significant association between STH infection particularly *Trichuris trichiura* and stunting. Their study found that 55% of elementary school children in Jimma Town, Southwestern Ethiopia, were infected with STH[24]. Association between STH infection and nutritional status also described by Moncayo *et al* (2018) in 27.9% of school-age children in rural areas of Ecuador[25].

Salma *et al* (2021) discovered 16.5% of elementary school children in Sorong District, West Papua, Indonesia were infected with STH. The study concluded that there was no statistically significant difference nutritional status between children infected with STH and those who were uninfected [26]. In 2018, Molla and Mamo found STH infection in 54% of school children in Yirgacheffee,

South Ethiopia. The study reported that undernutrition was not statistically associated with STH infection[27]. Study in Kenya found 40% of school-age children were infected by STH. However, Suchdev *et al* who performed that study, declared that STH infection was not associated with poor nutritional status[28].

Overall, the results of this study confirm the importance of integrating deworming programs with hygiene education and regular monitoring of children's nutritional and biochemical status in high-risk areas. A multifactorial intervention approach is essential to breaking the cycle of infection and malnutrition. The WHO advises breastfeeding new-borns until they are two years old since the immune systems of children under five have not yet developed to the same degree as those of adults and are still supported by the mother's antibodies in the blood and breast milk[29,30].

The findings of this study further support the evidence that STH infections have a multifactorial impact on children's nutritional status and biochemical balance. Together, these findings indicate that landfill-associated exposure and STH infection are linked to early biochemical alterations in protein status, while measurable impairments in physical growth have not yet manifested in this age group. Recommended control strategies should include the integration of periodic deworming programs, improvements in sanitation and access to clean water, community-based interactive health education, and the strengthening of nutritional interventions aimed at improving children's protein and albumin status.

This case-control study exploring the association between STH infection and nutritional status has several limitations inherent to its design. One of the case-control study limitation is the potential of confounding variables[31]. This study did not measure factors that could influence both the risk of STH infection and children's nutritional status such as socioeconomic status, dietary diversity, and parental education. It is suggested to future research to include these factors as variables of the study.

CONCLUSION

This study found a significant association between soil-transmitted helminth (STH) infection and total protein levels in school-aged children. However, no association was found between STH infection and albumin levels, body mass index (BMI), weight-for-age (W/A), or height-for-age (H/A) indicators. It is necessary to implement a policy requiring students to directly ingest the deworming medication provided by the community health center, in order to ensure compliance with the recommended routine administration every six months. It is recommended that further studies be conducted to investigate the level of compliance with deworming medication intake.

AUTHORS' CONTRIBUTIONS

FP contributed to conceptualization, formal analysis, investigation, and writing the original draft. **AS** contributed to methodology development, validation, and supervision. **AZJ** contributed to methodology development, validation, and manuscript review and editing.

ACKNOWLEDGEMENT

The author expresses his deepest gratitude to the school for the permission and facilities provided for this research. We also thanks all subjects who participated and provided complete data throughout the research process. Furthermore, we extends our gratitude to all parties who assisted, directly or indirectly, in completing this research.

FUNDING INFORMATION

This study was funded by Ministry of Health of Republic of Indonesia.

DATA AVAILABILITY STATEMENT

The utilized data to contribute to this investigation are available from the corresponding author on reasonable request.

DISCLOSURE STATEMENT

The views and opinions expressed in this article are those of the authors and do not necessarily reflect the official policy or position of any affiliated agency of the authors. The data is the result of the author's research and has never been published in other journals.

REFERENCES

1. Organization WH. Soil-transmitted helminth infections. Published 2023. Accessed June 5, 2025. https://www.who.int/news-room/fact-sheets/detail/soil-transmitted-helminth-infections
2. Bakari HB, Aliu R, Manga MM, Wasinda SB, Usman AS. Association of intestinal helminthic infection and nutritional status of primary school children in Gombe State, Nigeria. *African J Clin Exp Microbiol*. 2023;24(1):80-87. doi:10.4314/ajcem.v24i1.10
3. Sinhorin GH, Carneiro ACG, Farias BES, et al. Intestinal parasite infections associated with sociodemographic and seasonal factors in the Western Amazon. *Parasitol Res*. 2023;122(2):419-423. doi:10.1007/s00436-022-07736-9
4. Hakizimana E, Kim JY, Oh S, Yoon M, Yong TS. Intestinal parasitic infections among children aged 12–59 months in Nyamasheke District, Rwanda. *Parasites Hosts Dis*. 2023;61(3):304-309. doi:10.3347/PHD.23045
5. Chen J, Gong Y, Chen Q, Li S, Zhou Y. Global burden of soil-transmitted helminth infections, 1990–2021. *Infect Dis Poverty*. 2024;13(1). doi:10.1186/s40249-024-01238-9
6. Andargie Y, Alelign A, Tekeste Z. Prevalence and associated risk factors of soil-transmitted helminth infections among schoolchildren in Mekan Eyesus town, northwestern Ethiopia. *Parasite Epidemiol Control*. 2024;27. doi:10.1016/j.parepi.2024.e00379
7. Justine NC, Bhuko J, Rubagumya SL, et al. Prevalence, Infection Intensity, and Risk Factors for Soil-transmitted Helminth Infections among School Children in Northwestern Tanzania. *Pathogens*. 2024;13(8). doi:10.3390/pathogens13080627
8. Montresor A, Mupfasoni D, Mikhailov A, et al. The global progress of soil-transmitted helminthiases control in 2020 and world health organization targets for 2030. *PLoS Negl Trop Dis*. 2020;14(8):1-17. doi:10.1371/journal.pntd.0008505
9. Sunarpo JH, Ishartadiati K, Al Aska AA, Sahadewa S, Sanjaya A. The impact of soil-transmitted helminths infection on growth impairment: systematic review and meta analysis. *Healthc Low-resource Settings*. 2023;11. doi:10.4081/hls.2023.11742
10. Prasetyo YB, Permatasari P, Susanti HD. The effect of mothers' nutritional education and knowledge on children's nutritional status: a systematic review. *Int J Child Care Educ Policy*. 2023;17(1). doi:10.1186/s40723-023-00114-7
11. Khan DSA, Das JK, Zareen S, et al. Nutritional Status and Dietary Intake of School-Age Children and Early Adolescents: Systematic Review in a Developing Country and Lessons for the Global Perspective. *Front Nutr*. 2022;8(February). doi:10.3389/fnut.2021.739447
12. Ipa M, Isnani T, Girsang VI, et al. Soil-transmitted helminth infections and anemia in children attending government run schools on Samosir Island,

Indonesia. *Parasite Epidemiol Control*. 2024;25(January):e00344. doi:10.1016/j.parepi.2024.e00344
13. Fatimah F, Sumarni S, Juffrie M. *Derajat Keparahan Infeksi Soil Transmitted Helminths Terhadap Status Gizi Dan Anemia Pada Anak Sekolah Dasar Severity of Soil Transmitted Helminths Infection with Nutritional Status and Anemia in Elementary School Student*.
14. Yuda Pratama M, Anton Cahyono J, Studi Sarjana Terapan Teknologi Laboratorium Medis P, Analis Kesehatan J, Kemenkes Banjarmasin P, Selatan K. Hubungan Infeksi Kecacingan Soil Transmitted Helminth (Sth) Dengan Jumlah Eosinofil Pada Anak Sekolah Dasar Di Sdn Teluk Selong Kabupaten Banjar. *J Labora Med*. 2023;7:62-70.
15. Steinmann P, Utzinger J, Du ZW, et al. Efficacy of single-dose and triple-dose albendazole and mebendazole against soil-transmitted helminths and taenia spp.: A randomized controlled trial. *PLoS One*. 2011;6(9). doi:10.1371/journal.pone.0025003
16. Stephenson LS, Latham MC, Ottesen EA. Malnutrition and parasitic helminth infections. *Parasitology*. 2000;121(SUPPL.). doi:10.1017/s0031182000006491
17. Ash LR, Orihel TC, Savioli L, Abu Sin M, Montresor A, Renganathan E. TRAINING MANUAL ON DIAGNOSIS OF INTESTINAL PARASITES - Based on the WHO Bench Aids for the diagnosis of intestinal parasites: Tutor's Guide. *World Health*. Published online 2004:43.
18. Parveen H, Gull M. Quadrant-I (e-Text). 2021;(August).
19. Weatherhead JE, Hotez PJ. Worm infections in children. *Pediatr Rev*. 2015;36(8):341-352. doi:10.1542/pir.36-8-341
20. Crompton DWT, Nesheim MC. Nutritional impact of intestinal helminthiasis during the human life cycle. *Annu Rev Nutr*. 2002;22:35-59. doi:10.1146/annurev.nutr.22.120501.134539
21. Gutiérrez-Jiménez J, Luna-Cázares LM, Cruz LM de la, et al. Children from a rural region in The Chiapas Highlands, Mexico, show an increased risk of stunting and intestinal parasitoses when compared with urban children. *Bol Med Hosp Infant Mex*. 2019;76(1):18-26. doi:10.24875/BMHIM.18000069
22. Yoseph A, Beyene H. The high prevalence of intestinal parasitic infections is associated with stunting among children aged 6-59 months in Boricha Woreda, Southern Ethiopia: A cross-sectional study. *BMC Public Health*. 2020;20(1):1-13. doi:10.1186/s12889-020-09377-y
23. Djuardi Y, Lazarus G, Stefanie D, Fahmida U, Ariawan I, Supali T. Soil-transmitted helminth infection, anemia, and malnutrition among preschool-age children in nangapanda subdistrict, indonesia. *PLoS Negl Trop Dis*. 2021;15(6):1-16. doi:10.1371/journal.pntd.0009506
24. Mekonnen Z, Hassen D, Debalke S, et al. Soil-transmitted helminth infections and nutritional status of school children in government elementary schools in Jimma Town, Southwestern Ethiopia. *SAGE Open Med*. 2020;8. doi:10.1177/2050312120954696
25. Moncayo AL, Lovato R, Cooper PJ. Soil-transmitted helminth infections and nutritional status in Ecuador: Findings from a national survey and implications for control strategies. *BMJ Open*. 2018;8(4):1-9. doi:10.1136/bmjopen-2017-021319
26. Salma Z, Fitriah, Renaldy RBY, et al. Soil-Transmitted Helminthes Infection and Nutritional Status of Elementary School Children in Sorong District, West Papua, Indonesia. *Indones J Trop Infect Dis*. 2021;9(2):84-92. doi:10.20473/ijtid.v9i2.24202
27. Molla E, Mamo H. Soil-transmitted helminth infections, anemia and undernutrition among schoolchildren in Yirgacheffee, South Ethiopia. *BMC Res Notes*. 2018;11(1):1-7. doi:10.1186/s13104-018-3679-9
28. Suchdev PS, Davis SM, Bartoces M, et al. Soil-transmitted helminth

infection and nutritional status among urban slum children in Kenya. *Am J Trop Med Hyg*. 2014;90(2):299-305. doi:10.4269/ajtmh.13-0560
29. Saboyá MI, Catalá L, Nicholls RS, Ault SK. Update on the Mapping of Prevalence and Intensity of Infection for Soil-Transmitted Helminth Infections in Latin America and the Caribbean: A Call for Action. *PLoS Negl Trop Dis*. 2013;7(9):e2419. https://doi.org/10.1371/journal.pntd.0002419
30. Bradbury RS, Martin L, Malloch L, et al. Surveillance for Soil-Transmitted Helminths in High-Risk County, Mississippi, USA. *Emerg Infect Dis*. 2023;29(12):2533-2537. doi:10.3201/eid2912.230709
31. Grimes DA, Schulz KF. Bias and causal associations in observational research. *Lancet*. 2002;359(9302):248-252. doi:10.1016/S0140-6736(02)07451-2