



Relationship between Soil-Transmitted Helminth and Anemia in Elementary School Students Negeri 96 and 97 Palembang

Indri Ramayanti¹, Atika Safitri Armo², Miranti Dwi Hartanti³, Ahmad Ghiffari⁴

^{1,4}Department of Parasitology and Microbiology, Faculty of Medicine, Universitas Muhammadiyah Palembang, Indonesia

²Medical Study Program at Universitas Muhammadiyah Palembang, Indonesia

³Department of Pharmacology, Faculty of Medicine, Universitas Muhammadiyah Palembang, Indonesia

Email: dokter.ghi@gmail.com

Abstract:

Soil-transmitted helminth (STH) prevalence is high worldwide. School-aged children are at risk of infection due to poor self-hygiene and contaminated soil and water. Anemia is caused by infection in children, and it affects cognitive development, physical development, and school performance. To ascertain the relationship and distribution of STH and anemia in elementary school students, as the cross-sectional objectives. Students from SDN 96 and 97 Palembang participated in the study. Using stratified random sampling, 84 students from grades 4, 5, and 6 were chosen at random. Anemia is diagnosed through a test using the Quick Check hemoglobin method. They discovered that 40.5 percent of students had intestinal worms, 15.5 percent were anemic, and 11.8 percent were both anemic and worm-infected. A p-value of 0.438 was obtained from the chi-square bivariate analysis. There is no link between STH and anemia.

Keywords:

low haemoglobin; intestinal worms; child development; South Sumatra

I. Introduction

Anemia is caused by a poor diet, a lack of micronutrients, inflammation, genetics, and parasitic infections (Righetti et al., 2012). Serum 25(OH)D levels correlated with hemoglobin levels in children with iron-deficient anemia (Niknamian, 2019). Intestinal parasitic diseases are caused by intestinal worms, namely soil-transmitted helminth (STH). STH is a parasitic disease spread to humans by nematode worms infected soil. They are *Trichuris trichiura* (TT), *Necator americanus* (NA), *Ancylostoma duodenale* (AD) and *Ascaris lumbricoides* (AA). AA is the most common worm in vulnerable pregnant women due to poor behavioral aspects (Aswita, Siregar, & Nurmaini, 2020). School-aged children are particularly vulnerable to STH infection due to their rapid growth and frequent exposure to contaminated soil and water (Tefera, Belay, Mekonnen, Zeynudin, & Belachew, 2017). More than 2 billion people are infected with STH, with children from Southeast Asia accounting for 42% of those infected. 64% are Indian, 15% are Indonesian, and 13% are Bangladeshi (WHO, 2011). Preschoolers and school-aged children require deworming in Indonesia.

The Ministry of Health defines anemia in schoolchildren aged 6 to 12 as Hb 12.0 g/dL (Departement Republik Indonesia, 2012). Anemia affects both developed and developing countries around the world. Anemia affects 1.62 billion people worldwide, accounting for 24.8 percent of the global population. Asia has the highest prevalence of anemia among school-aged children (315 billion) (WHO, 2015). 26.4 percent of Indonesian children aged 5-14 were anemic in 2013 (Kemenkes RI., 2018). Anemia was discovered in 25% of children aged 6 to

12 in ten Palembang City elementary schools (SD) (Desti Handayani, Rismarini, Kesuma, Purnamasari, & Husin, 2016). Impact anemia harms children's cognitive, physical, and academic development. This study aims to find a link between intestinal worm infection and anemia in Palembang City students in SDN 96 and 97. Seberang Ulu II District has the lowest sanitation level number 4 in Palembang City, and preliminary observations show that many children still play barefooted.

II. Review of Literatures

2.1. Soil-Transmitted Helminths

One or more STHs affect about 1.7 billion people globally (Parija, Chidambaram, & Mandal, 2017). According to a 2010 research by Pullan et al., the prevalence rate of AA was 819 million, while the prevalence rate of TT was 464 million and the prevalence rate of hookworm was 439 million, with more than half of all cases occurring in South Asia and Sub-Saharan Africa (Pullan, Smith, Jasrasaria, & Brooker, 2014).

STH transmission levels are influenced by urbanization, settlement patterns, and economic growth. In 2010, 77 percent of the world's population resided in regions where chronic transmission was a concern. Due to these constraints, an STH risk distribution must change rapidly, emphasizing the links between urbanization, sanitation, and infection. The global burden of STH infection may be estimated to target individuals with preventive chemotherapy, improved water and sanitation infrastructure, and health education (Pullan & Brooker, 2012). Significant social and economic changes have occurred globally in recent decades. In a global parasite update, STH infections remain the most prevalent. Infection rates are unlikely to decrease until the global economy improves substantially (de Silva, N.R., Brooker, S., Hotez, P.J., Montresoro, A., Engels, D., and Savioli, 2003).

Efforts to deworm individuals have been unsuccessful. Contrary to expectations, STH infection has persisted in Central Java. Integrated sanitation and hygiene practices prevent STH. WASH and health education are not prioritized, and chemotherapy is seldom administered as recommended. Poverty, a lack of knowledge about STH causes and prevention, poor hygiene and sanitation, and ideal environmental circumstances for STH transmission may persist (Kurscheid et al., 2020). In western Kenya, a pit latrine with a plastic slab and drop hole cover, a plastic child toilet, and a metal scoop were examined to determine whether STH eggs in the soil outside rural homes were reduced. The features of homes, toilets and adjacent areas linked with STH eggs in soil were also studied. Cleaner homes did not decrease the presence or concentration of STH eggs in household soil samples. The ability of financing partners and political and financial logistics and infrastructure may have an enormous impact on STH transmission rates (Steinbaum et al., 2019).

2.2 Anemia

Anemia is defined as a reduction in the number of red blood cells, hemoglobin, and packed red blood cells per 100 milliliters of blood (World Health Organization, 2011). The Ministry of Health Indonesia (MoH) defines anemia in children aged 6 to 12 as Hb 12.0 g/dL (Departement Republik Indonesia, 2012). Anemia was found in 52.5% of the South and Southeast Asian (SSEA) population, ranging from 22.7% in Timor-Leste to 63.5% in the Maldives.

According to multiple logistic regression, anemia is more likely to occur in women in reproductive-aged (WRA) 15–24 years, women with primary or no education, women from the poorest wealth quintile, women without access to toilets or improved water sources, women who are underweight, and women who have had more than one child in the last five years. Fighting anemia requires evidence-based, multidisciplinary policies and initiatives to improve mothers' health, nutrition, education, and socioeconomic position. It is critical to provide nutrition-sensitive and tailored services for people from low-income families (Sunuwar et al., 2020).

Anemia is a widespread and severe global health issue that has received insufficient attention, particularly in low-and middle-income countries (LMICs), where progress has been sluggish and uneven. Even though iron deficiency (ID) remains the most frequent cause of anemia in most nations, recent research shows that the etiology of anemia is complex and environment-dependent. In order to accurately assess anemia in clinical settings and populations, it will be necessary to incorporate biochemical measurements of micronutrient status (particularly iron and vitamin A concentrations) and indicators of infection into the assessment process in addition to hematological indicators. (Chaparro & Suchdev, 2019).

III. Research Methods

An observational method is used in this cross-sectional study conducted in October 2020. In Palembang, the investigation was conducted at SDN 96 and 97. From fourth to sixth grades at Palembang City Elementary School. We chose 84 students who met the inclusion and exclusion criteria using stratified random sampling.

The researcher explained the sampling method to elementary school students who received the pot the day before and collected it the next day in class. In the Faculty of Medicine, the laboratory used the Kato-Katz method to test the stools. Finding *Ascaris lumbricoides*, *Trichuris trichiura*, *Ancylostoma duodenale*, or *Necator americanus* eggs makes it detected. Hemoglobin measurement and reading tool At a Glance Hb Anemia is defined as hemoglobin less than 12 g/dL.

An analysis of the data using the Chi-Square test was carried out. The p-value is related to anemia in elementary school kids (0.05). There is no statistically significant link between intestinal worm infection and anemia in elementary school children (p-value >0.05).

IV. Discussion

4.1 Socio-Demographic Data of Respondents

Thirty-four of the 84 respondents (40.5%) had STH. In 2015, five people (6.8%) were infected at SDN 169 Gandus Village in Palembang City, and 27 students (6.8%) were infected in 2018 at Madrasah Ibtidaiyah (29.3%) (Dwi Handayani, Ramdja, & Nurdianthi, 2015). Intestinal worms benefit from soil and water contamination, as well as poor sanitation practices. Dangerous habits and natural conditions lead to the growth of intestinal worms. Without a doubt, a good education helps parents understand the importance of clean and healthy living (Sanya, Nkurunungi, Andia Biraro, Mpairwe, & Elliott, 2017). The family patriarch's education, financial state, and attitude impact open defecation (Syarifah Syarifah, Yustina, & Lumongga Lubis, 2020). Belief in human excrement interment, thus environmental and personal hygiene problems have grown less critical in West Sumba, especially Taramanu Village. Youngsters defecate in public places (bushes, forests, or behind their homes), and not wearing shoes guarantees the STH's life cycle is completed (Suharmiati & Rochmansyah,

2018). In Palembang's Gandus district, the co-occurrence of *Ascaris lumbricoides* (88.90%), *Trichuris trichiura* (7.4%), and *Ancylostoma duodenale* (1%) were discovered (Dwi Handayani et al., 2015).

The study discovered that 13 of the 84 students (15.5%) tested positive for anemia. Anemia affected 25% of children aged 6 to 12 in ten Palembang schools. Anemia affects 34 of the 225 students at Kokap I Health Center Kulonprogo (Fatimah, Sumarni, & Juffrie, 2012). The lower anemia response rate was supported by normal-weight students (64 versus two skinny and ten thin) (less than the previous study). There was no history of anemia-related bleeding or bleeding. (Kemenkes RI., 2018).

Table 1. Characteristics of Respondents, Based on Age, Gender, Nutritional Status, Co-Morbidities, Parents' job and education (n=84)

Characteristics	N	Percentage (%)
Age (Years)		
8-9	30	35.7
10-11	51	60.7
12-13	3	3.6
Total	84	100
Gender		
Man	45	53.5
Woman	39	46.4
Total	84	100
Nutritional status		
Very thin	2	2.4
Thin	10	11.9
Normal	64	76.2
Fat	7	8.3
Obesity	1	1.2
Total	84	100
co-morbidities, thalassemia, diarrhea, hemophilia, acute bleeding		
Yes	0	0
Not	84	100
Total	84	100
Parental Education		
SD	12	14.3
Junior High School	21	25
Senior High School	42	50
Bachelor	9	10.7
Total	84	100
Parents' job		
Laborer	36	42.9
Service	18	21.4
Private	12	14.3
Military	6	7.1
Etc	12	14.3

Total	84	100
Parents' Income		
< 1,000,000	37	44.04
1,000,000 - 2,000,000	26	30.95
>2,000,000	20	23.8
Total	84	100

Four of the 34 students (11.8%) with STH had anemia (82.2%). This study also discovered that 62 students had STH, 32 (51.6%) had intestinal worms and anemia, and 30 (48.4%) did not. Consuming iron-inhibiting foods such as tea can cause a low heme intake, aggravated anemia (Rahayu & Indarto, 2020). It is also lower than the results of the SD 060925 Medan City study. 48.27% had STH infection and anemia, while 51.72% did not (Sandy, Sumarni, & Soeyoko, 2015).

Table 2. Distribution of Anemia (n=84)

Anemia	Frequency	Percentage (%)
Yes	13	15.5
Not	71	84.5
Total	84	100

Table 3. Distribution of STH (n=84)

Soil Transmitted Helminth Infection	Frequency	Percentage (%)
Positive	34	40.5
Negative	50	59.5
Total	84	100

Table 4. Species Distribution of STH Eggs

Species of STH	Frequency	Percentage (%)
<i>Ascaris lumbricoides</i>	34	100
<i>Trichuris trichiura</i>	0	0
Hookworm	0	0
Total	34	100

Table 5. Distribution of Anemia in Elementary School Students 96 and 97 Infected with STH

Anemia	Frequency	Percentage (%)
Yes	4	11.8
Not	30	88.2
Total	34	100

4.2. Relationship of STH and Anemia in School Children

Four students were suffered from STH infection and anemia. In a bivariate Chi-square test, anemia and STH are not related ($p\text{-value} > 0.05$). There is no link between STH infection and nutritional status or anemia at Kokap I Health Center Kulonprogo (Fatimah et al., 2012). STH infection, however, is associated with low hemoglobin levels in Medan (Arrasyid, Sinambela, Tala, Darlan, & Warli, 2017). The severity and duration of the infection and diet and iron stores play a role in this anemia. Symptoms of chronic or severe hookworm infections *Ancylostoma duodenale* caused injury to the mucosa of the small intestine with

cutting plates/teeth (Ghodeif AO & Jain H, 2021; Pearson, 2012). In chronic infections, *Trichuris trichiura* causes diarrhea, dysentery syndrome, anemia, and weight loss. *Trichuris trichiura* causes anemia for every thousand eggs in 1 g of feces (Gyorkos, Gilbert, Larocque, Casapía, & Montresor, 2012). *Ascaris lumbricoides* infection caused poor absorption, thus malabsorption by interfering with iron absorption through the duodenum and jejunum walls. The *Ascaris lumbricoides* parasite consumes 2.8 grams of carbohydrates and 0.7 grams of protein per day (CDC, 2020). Poverty and malnutrition were also factors in the development of anemia (Arrasyid et al., 2017; Rahman, Mushfiquee, Masud, & Howlader, 2019). Risk of intestinal worm infection, personal hygiene takes precedence over nutritional statuses, such as not wearing shoes (Oliveira et al., 2015).

Table 6. Relationship of STH and Anemia

Soil- Transmitted Helminth	Anemia						<i>p-value</i>
	yes		Not		Amount		
	N	%	N	%	N	%	
Positive	4	4.8	30	35.7	34	40.5	0.438
Negative	9	10.7	41	48.8	50	59.5	
Total	13	15.5	71	84.5	84	100	

V. Conclusions

Anemia was 15.5 percent among 84 respondents in SD Negeri 96 and 97 Seberang Ulu II District, Palembang City, while the STH infection was 40.5 percent. Thirty-four respondents were infected with *Ascaris lumbricoides* worms. This study found no link between intestinal worm infection and anemia.

References

- Arrasyid, N. K., Sinambela, M. N., Tala, Z. Z., Darlan, D. M., & Warli, S. M. (2017). Correlation between Soil-Transmitted Helminths Infection and Serum Iron Level among Primary School Children in Medan. *Open Access Macedonian Journal of Medical Sciences*, 5(2), 117–120. <https://doi.org/10.3889/oamjms.2017.016>
- Aswita, R., Siregar, F. A., & Nurmaini, N. (2020). The relationship of behavior factors with Helminthiasis incident on Helminthiasis infection disease in pregnant mothers in Langkat regency. *Britain International of Exact Sciences (BIOEx) Journal*, 2(1), 327–342. <https://doi.org/10.33258/bioex.v2i1.156>
- CDC. (2020). Ascariasis.
- Chaparro, C. M., & Suchdev, P. S. (2019). Anemia epidemiology, pathophysiology, and etiology in low- and middle-income countries. *Annals of the New York Academy of Sciences*, 1450(1), 15–31. <https://doi.org/10.1111/nyas.14092>
- de Silva, N.R., Brooker, S., Hotez, P.J., Montresor, A., Engeles, D., and Savioli, L. (2003). Soil transmitted helminth infection: updating the global picture. *Trends in Parasitology*, 19(12), 547–551.
- Departement Republik Indonesia. (2012). Indonesia Health Profile. *Profil Kesehatan Indonesia*.
- Fatimah, F., Sumarni, S., & Juffrie, M. (2012). Derajat keparahan infeksi Soil Transmitted Helminths terhadap status gizi dan anemia pada anak sekolah dasar. *Jurnal Gizi Klinik Indonesia*, 9(2), 80. <https://doi.org/10.22146/ijcn.15384>
- Ghodeif AO, & Jain H. (2021). Hookworm. *Treasure Island (FL): StatPearls Publishing*.

- Gyorkos, T. W., Gilbert, N. L., Larocque, R., Casapía, M., & Montresor, A. (2012). Re-Visiting *Trichuris trichiura* Intensity Thresholds Based on Anemia during Pregnancy. *PLOS Neglected Tropical Diseases*, 6(9), e1783.
- Handayani, Desti, Rismarini, R., Kesuma, Y., Purnamasari, R., & Husin, S. (2016). Hubungan Defisiensi Besi dengan Perilaku Anak Usia Sekolah di Kota Palembang. *Sari Pediatri*, 16(5), 307. <https://doi.org/10.14238/sp16.5.2015.307-14>
- Handayani, Dwi, Ramdja, M., & Nurdianthi, I. (2015). Hubungan infeksi soil transmitted helminths (STH) dengan prestasi belajar pada siswa SDN 169 di kelurahan Gandus kecamatan Gandus kota Palembang. *Majalah Kedokteran Sriwijaya*, 47(2), 91–96. <https://doi.org/10.36706/mks.v47i2.2750>
- Kemenkes RI. (2018). Riset Kesehatan Dasar. Jakarta.
- Kurscheid, J., Laksono, B., Park, M. J., Clements, A. C. A., Sadler, R., McCarthy, J. S., ... Gray, D. J. (2020). Epidemiology of soil-transmitted helminth infections in semarang, central java, indonesia. *PLoS Neglected Tropical Diseases*, 14(12), 1–17. <https://doi.org/10.1371/journal.pntd.0008907>
- Niknamian, S. (2019). Determining the predictive power of vitamin D levels in iron deficiency anemia. *Britain International of Exact Sciences (BIOEx) Journal*, 1(1), 29–35. <https://doi.org/10.33258/bioex.v1i1.25>
- Oliveira, D., Ferreira, F. S., Atouguia, J., Fortes, F., Guerra, A., & Centeno-Lima, S. (2015). Infection by Intestinal Parasites, Stunting and Anemia in School-Aged Children from Southern Angola. *PLOS ONE*, 10(9), e0137327.
- Parija, S. C., Chidambaram, M., & Mandal, J. (2017). Epidemiology and clinical features of soil-transmitted helminths. *Tropical Parasitology*. https://doi.org/10.4103/tp.TP_27_17
- Pearson, S. M. (2012). Molecular mechanisme of hookworm disease: Stealth, virulence, and vaccines. *American Academy of Allergy & Immunology*, 130(1), 13–21.
- Pullan, R. L., & Brooker, S. J. (2012). The global limits and population at risk of soil-transmitted helminth infections in 2010. *Parasites and Vectors*, 5(1), 1–14. <https://doi.org/10.1186/1756-3305-5-81>
- Pullan, R. L., Smith, J. L., Jasrasaria, R., & Brooker, S. J. (2014). Global numbers of infection and disease burden of soil transmitted helminth infections in 2010. *Parasites and Vectors*, 7(1), 1–19. <https://doi.org/10.1186/1756-3305-7-37>
- Rahayu, D., & Indarto, D. (2020). A case-control study related to vitamin and mineral intake in female adolescents with iron deficiency anemia. *Health Science Journal of Indonesia*, 11(1), 52–56. <https://doi.org/10.22435/hsji.v11i1.3066>
- Rahman, M. S., Mushfiquee, M., Masud, M. S., & Howlader, T. (2019). Association between malnutrition and anemia in under-five children and women of reproductive age: Evidence from Bangladesh Demographic and Health Survey 2011. *PloS One*, 14(7), e0219170–e0219170. <https://doi.org/10.1371/journal.pone.0219170>
- Righetti, A. A., Koua, A.-Y. G., Adiossan, L. G., Glinz, D., Hurrell, R. F., N'goran, E. K., ... Utzinger, J. (2012). Etiology of anemia among infants, school-aged children, and young non-pregnant women in different settings of South-Central Cote d'Ivoire. *The American Journal of Tropical Medicine and Hygiene*, 87(3), 425–434. <https://doi.org/10.4269/ajtmh.2012.11-0788>
- Sandy, S., Sumarni, S., & Soeyoko, S. (2015). Analisis Model Faktor Risiko Yang Mempengaruhi Infeksi Kecacingan Yang Ditularkan Melalui Tanah Pada Siswa Sekolah Dasar Di Distrik Arso Kabupaten Keerom, Papua. *Media Penelitian Dan Pengembangan Kesehatan*, 25(1), 1–14. <https://doi.org/10.22435/mpk.v25i1.4091.1-14>

- Sanya, R. E., Nkurunungi, G., Andia Biraro, I., Mpairwe, H., & Elliott, A. M. (2017). A life without worms. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 111(1), 3–11. <https://doi.org/10.1093/trstmh/trx010>
- Steinbaum, L., Mboya, J., Mahoney, R., Njenga, S. M., Null, C., & Pickering, A. J. (2019). Effect of a sanitation intervention on soil-transmitted helminth prevalence and concentration in household soil: A cluster-randomized controlled trial and risk factor analysis. *PLoS Neglected Tropical Diseases*, 13(2), 1–17. <https://doi.org/10.1371/journal.pntd.0007180>
- Suharmiati, S., & Rochmansyah, R. (2018). Revealing the event of helminthic infection in primary school children (Ethnographic study in Taramanu village of West Sumba regency). *Buletin Penelitian Sistem Keschatan*, 21(3), 211–217. <https://doi.org/10.22435/hsr.v21i3.420>
- Sunuwar, D. R., Singh, D. R., Chaudhary, N. K., Pradhan, P. M. S., Rai, P., & Tiwari, K. (2020). Prevalence and factors associated with anemia among women of reproductive age in seven South and Southeast Asian countries: Evidence from nationally representative surveys. *PLoS ONE*, 15(8 August), 1–17. <https://doi.org/10.1371/journal.pone.0236449>
- Syarifah Syarifah, Yustina, I., & Lumongga Lubis, N. (2020). Effect of predisposing factors (education, economic level, knowledge and attitude) on defecation behavior in Bener Meriah regency. *Britain International of Exact Sciences (BIOEx) Journal*, 2(1), 142–149. <https://doi.org/10.33258/bioex.v2i1.122>
- Tefera, E., Belay, T., Mekonnen, S. K., Zeynudin, A., & Belachew, T. (2017). Prevalence and intensity of soil transmitted helminths among school children of Mendera Elementary School, Jimma, Southwest Ethiopia. *The Pan African Medical Journal*, 27, 88. <https://doi.org/10.11604/pamj.2017.27.88.8817>
- WHO. (2011). *Helminth Control in School-Age Children: A Guide for Managers of Control Programs*.
- WHO. (2015). *The global prevalence of anaemia in 2011*.
- World Health Organization. (2011). *Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity*. <https://doi.org/2011>