Risk Factors for the Incidence of Anemia in Elementary-School Children Living in Malaria-Endemic Regions

Maraden Sirait
Postgraduate School
Faculty of Public Health
Sriwijaya University
maradensirait131175@gmail.com

Rostika Flora
Master's Degree Program
Public Health Sciences
Faculty of Public Health
Sriwijaya University
rostikaflora@gmail.com

Chairil Anwar
Department of Parasitology
Faculty of Medicine,
Sriwijaya University
chairil53@fk.unsri.ac.id

Mohammad Zulkarnain
Public Health Sciences
Faculty of Medicine
Sriwijaya University
septi_2003@yahoo.com

Nur Alam Fajar
Faculty of Public Health
Sriwijaya University
mr.nuralamfajar@gmail.com

Achmad Fickry Faisya
Environmental Health Study Program
Faculty of Public Health
Sriwijaya University
fickry@fkm.unsri.ac.id

Samwilson Slamet
Diploma Three year Program in Nursing Science
Faculty of Mathematics and Natural Sciences
Bengkulu University
samwilson.slamet@gmail.com

Abstract *- Anemia is an indicator of both poor nutrition and poor health. The most common anemia caused by malnutrition is iron deficiency anemia. Helminthiasis, clinical history of malaria, nutritional status, and breakfast-eating habits are the main factors that contribute to the increased incidence of anemia in school-age children. The objective of this study was to analyze the relationship between the risk factors and the incidence of anemia in elementary-school children living in malaria-endemic regions.This study was analytical-observational applying a cross-sectional design. The research was conducted on 133 elementary- school children aged 9 – 12 years old coming from five subdistricts in Seluma regency. These respondents were collected using random sampling technique. The stool of respondents was also taken for laboratory examination to detect and identify the presence of helminthiasis, and the whole blood was drawn to measure hemoglobin levels. The nutritional status was divided into two categories i.e short and normal ones by calculating the z-score index (TB/U). All the obtained were then analyzed using bivariate and multivariate analyses. The results of laboratory examination on hemoglobin levels showed that 22.6% of children were anemic, and those on stools indicated that 37.6% of the respondents were positive of worm infections. The bivariate analysis showed that helminthiasis (p = 0.014 and PR = 2.72), nutritional status (p = 0.006 and PR = 3.40), and breakfast-eating habits (p = 0.001 and PR = 4.34) were significantly correlated with the incidence of anemia. However, the clinical history of malaria (p = 0.391 and PR = 1.50) had no significant correlation with anemia. The study found that the most dominant factor for*

anemia was breakfast-eating habits. The breakfast-eating habit was the most influencing risk factor for the incidence of anemia in elementary-school children in malaria-endemic regions.

Keywords: Anemia, risk factors, elementary-school children, malaria-endemic regions

INTRODUCTION

Anemia that occurs in childhood has a strong influence on their physical development, mental activities, social welfare, and infant development [1]. Anemia is defined as a condition in which the number and size of red blood cells or hemoglobin concentrations are below the predetermined normal value, thus disrupting the blood's capacity to carry oxygen throughout the body. Anemia is used as an indicator of poor nutrition and poor health [2]. Anemia can occur in all age groups but it often occurs in children especially those coming from low-income families. The children have a higher risk of developing iron-deficiency anemia as a result of the increased iron demand during a period of rapid growth [3]. Anemia becomes a significant global problem affecting 305 million (25.4%) school-age children with an estimated prevalence of 40% in developing countries suffering from anemia [4].

The type of anemia commonly occurs in school-age children is iron deficiency anemia. This type of anemia is influenced by various factors such as nutritional status, parents' education, number of family members, and parasitic infections [3]. Worm parasitic infections in Indonesia are still a big problem for the cause of anemia, because it is estimated that worms can suck as much as 2-100 cc of blood every day [5]. The most common helminthiasis is generally *Ascaris lumbricoides*, hookworm, and *Trichuris trichiura* [6]. This condition can affect the quality of life, especially school children who are still in the golden age to develop body structure [7]. A new study by Pullan *et al*. found that 126.7 million people transmitted through earthworms in Southeast Asia were infected with roundworms (*Ascaris*), while 115.3 million were infected with hookworm (*Trichuris*), and 77.0 million had hookworm infections, [8] The prevalence of helminthiasis in Indonesia is still high, especially in the poor population with poor sanitation. The prevalence of helminthiasis varies between 2.5% - 62% [9]. Other infections such as malaria can cause anemia, such as *Plasmodium falciparum* with rapid destruction of red blood cells erythrocytes leading to the sudden drop of hemoglobin level [10].

Seluma regency is one of the regencies in Bengkulu Province that has not yet been eliminated from malaria. Until now, Seluma regency is still considered as one of the malaria-endemic regions. In addition to being a part of the malaria-endemic regions, Seluma regency is also included in districts with underdeveloped categories [11]. The presence of malaria infection and low nutrient intake increase the incidence of anemia in school-age children. The World Health Organization (WHO) estimates 216 million cases and 445,000 deaths due to malaria in 2016. This significant proportion of deaths either directly or indirectly is caused by anemia [12].

This study aims to analyze the risk factors for the incidence of anemia in elementary-school children living in malaria-endemic regions.

METHODS

This research was an analytical-observational study with a cross-sectional study design. The study was conducted in March-June 2019 and was carried out in elementary-school children in five subdistricts of Seluma regency. The subdistricts were Lubuk Sandi, Seluma Barat, Seluma Timur, Seluma Utara, and Talo. The number of samples obtained in this study was 133 elementary-school children selected by using random sampling technique considering the inclusion criteria set by researchers. The inclusion criteria were male or female, not having menstruation during the study, 4-5 graders, 9-12 years old, active students, and submitting an informed consent signed by their parents.

The primary data of this study were obtained from direct observation using a questionnaire. The data collected from the observation were respondent's characteristics, clinical history of malaria, parents' education, parents' income, and the number of family dependents. Hemoglobin level was measured using hemoglobin analyzer (Easy Touch). The results of hemoglobin level were divided into two categories: anemia (hemoglobin < 11.5 g/dL) and non-anemia (hemoglobin > 11.5 mg/dL). The determination of nutritional status was calculated from height for age (H/A) and categorized as short if the z-score < -2 SD and normal if the z-score > -2 SD. The stool examination for helminthiasis was carried out in a laboratory using qualitative methods.

The research data collected from this study were analyzed using SPSS version 19.0 in three steps of analysis i.e univariate, bivariate, and multivariate. In bivariate analysis, the data were analyzed using the Chi-square test (x2) at a

significance level of 95% (α = 0.05). Meanwhile, in multivariate analysis, the data were analyzed using multiple logistic regressions.

ETHICAL CLEARANCE

This present study has been approved by the Ethics Research Committee of the Faculty of Public Health, Sriwijaya University Number: 76/UN9.1.10/KKE/2019.

RESULTS

a. Univariate Analysis

Based on the data distribution of respondent's characteristics, it was found that the age group of 9-10 years old took the highest proportion (63.1%), 49.6% of the respondents were boys, 33.1% of their fathers and 32.8% of their mothers graduated from elementary school, 66.9% of the respondents living with other < 5 people financed by parents, and 63.2% of the respondents were coming from low-income family.

Table 1. Respondent's Characteristic

Characteristic	**n (%)**
Age (years old)	
9-10	84 (63.1)
> 10-12	49 (36.9)
Sex	
Boy	66 (49.6)
Girl	67 (50.4)
Father's Education	
Not graduated from Elementary School	7 (5.3)
Graduated from Elementary School	44 (33.1)
Graduated from Junior High School	36 (27.1)
Graduated from Senior High School	37 (27.8)
Graduated from College	9 (6.8)
Mother's Education	
Not graduated from Elementary School	7 (5.3)
Graduated from Elementary School	43 (32.8)
Graduated from Junior High School	39 (29.3)
Graduated from Senior High School	35 (26.3)
Graduated from College	9 (6.8)
Father's Occupation	
Farmer/Labor	90 (67.7)
Civil Servant/Armed Force/Police	14 (10.5)
Self Employed	29 (21.8)
Mother's Education	
Housewife	79 (59.4)
Farmer	37 (27.8)

Civil Servant/Armed Force/Police	8 (6.0)
Self Employed	9 (6.8)
Family Member Financed by Parents	
< 5 people	89 (66.9)
≥ 5 people	44 (33.1)
Family Income	
< Rp. 1,833,458	84 (63.2)
≥ Rp. 1,833,458	49 (36.8)

1. Distribution of the incidence of anemia, helminthiasis, clinical history of malaria, nutritional status, and breakfast-eating habit

Table 2 showed that the incidence of anemia in elementary-school children in Seluma regency was 22.6%, 37.6% of the children were positive helminthiasis, 21.1% of them had clinical history of malaria, 50.4% of them had short nutritional status, and 42.9 % of them did not have or sometimes had their breakfast.

Table 2. Distribution of the incidence of anemia, helminthiasis, clinical history of malaria, nutritional status, and breakfast-eating habit

Variable		n	%
Incidence of Anemia	Anemia	30	22.6
	Non-anemia	103	77.4
Helminthiasis	Positive	50	37.6
	Negative	83	62.4
Clinical history of malaria	Yes	28	21.1
	No	105	78.9
Nutritional status	Short	67	50.4
	Normal	66	49.6
Breakfast-eating habit	No/Sometimes	57	42.9
	Yes	76	57.1

b

. Bivariate Analysis

The results of bivariate analysis on the relationship between the status of helminthiasis and the incidence of anemia showed $p = 0.014$ and PR = 2.77. This indicated that there was a significant

relationship between helminthiasis and the incidence of anemia. Besides, the children who were positive helminthiasis were 2.77 times at risk of having anemia compared to those who were not infected with helminthiasis. The presence of clinical history of malaria in children did not show a significant relationship with the incidence of anemia, p = 0.391 and PR = 1.509. The children who had a clinical history of malaria were 1.50 times at risk of developing anemia higher than those who never had the clinical history. Meanwhile, there was a significant relationship between the nutritional status and the incidence of anemia, p = 0.006 and PR = 3.40. The children who had short nutritional status were 3.40 times at risk of having anemia compared to those with normal nutritional status. The results of the Chi-square analysis on breakfast-eating habits revealed p = 0.001 and PR = 3.34. It can be stated that there was a significant relationship between breakfast-eating habits and the incidence of anemia. The children who never or sometimes had breakfast were 3.34 times at risk of having anemia compared to those who are accustomed to having breakfast.

Table 3. Relationship between helminthiasis, clinical history of malaria, nutritional status, breakfast-eating habit, and the incidence of anemia

Variable	Category	Anemia				*P*	OR 95% CI
		(+)		(-)			
		n	%	n	%		
Helminthiasis	Positive	17	34.0	33	66.0	0.014	2.772 (1.20 - 6.37)
	Negative	13	15.7	70	84.3		
Clinical history of malaria	Yes No	8	28.6	20	71.4	0.391	1.509 (0.58-3.88)
	Short	22	21.0	83	79.0		
Nutritional status	Normal	22	32.4	46	67.6	0.006	3.408 (1.38-8.36)
	No/Sometimes	8	12.3	57	87.7		
Breakfast-eating habit	Yes	21	36.8	36	63.2	0.001	4.343 (1.80-10.46)
		9	11.8	67	88.2		

c. Multivariate Analysis

In multivariate analysis, it was used multiple logistic regression tests. In this study, the data with $p < 0.25$ in the bivariate analysis proceeded into multivariate analysis. There were three variables namely helminthiasis,

nutritional status, and breakfast-eating habit that were analyzed in multivariate analysis. The results of multivariate analysis showed that the children with positive helminthiasis were 2.42 times at risk of developing anemia compared to those who were not infected with helminthiasis. The children with short nutritional status were 2.29 times at risk of developing anemia compared to those with normal nutritional one. Besides, the children who did not have or sometimes had their breakfast were 4.32 times at risk of developing anemia compared to those who always had their breakfast. Therefore, it can be concluded that the breakfast-eating habit was a dominant factor and the most influencing one to the incidence of anemia in elementary-school children in malaria-endemic regions.

Table 4. A multivariate analysis of determinants of the incidence of anemia

Variable	B	SE	Wald	df	Sig.	Exp(B)	95% CI For EXP(B)	
							Lower	Upper
Helminthiasis	0.885	0.454	3.795	1	0.051	2.422	0.995	5.899
Nutritional status	0.832	0.459	0.328	1	0.070	2.298	0.934	5.652
Breakfast-eating habit	1.465	0.465	9.941	1	0.002	4.326	1.741	10.753
Constant	-3.537	1.163	9.248	1	0.002	0.029		

DISCUSSION

The incidence of anemia in school-age children is not only caused by nutritional status related to food intake, but it can also be affected by several infections such as helminthiasis and malaria. The results of this present study showed that 22.6% of the elementary-school children in Seluma regency were developing anemia, and 37.6% of them were positively infected with helminthiasis. There was a significant relationship ($p < 0.05$) between helminthiasis and the incidence of anemia. The children who were positive for helminthiasis were 3.32 times at risk of having anemia compared to those who were not infected with helminthiasis. The results of this study were in line with those of Saifudin's investigation in Makassar. His study stated that the intestinal worm infections were significantly related to the incidence of anemia.

The entry of worms into the intestinal mucosa can cause irritation and problems in the intestines. The attachment of worms in the intestine can cause bleeding, and prolonged bleeding can cause anemia [13]. The high number of helminthiasis in the respondents of this study was closely related to the environmental conditions, namely the poor hygiene and sanitation and poor environmental conditions [14]. The behavior of children for not wearing their footwear in their outdoor activities and not washing their hands after playing and before eating are facilitating soil-transmitted helminths easily enter their body. Apart from these, this study also showed that 21.1% of the children did not have a clinical history of malaria with $p = 0.31$. So, it can be said that there was no significant relationship ($p > 0.05$) between the clinical history of malaria and the incidence of anemia.

In this study, it was found that 50.4% of the respondents had short, $p = 0.006$ and PR = 3.40. The short nutritional status was significantly associated ($p < 0.05$) with the incidence of anemia. The children with short nutritional status would be 3.40 times at risk of developing anemia compared to those with normal nutritional status. Another similar study by Bohari in Palu also found that short nutritional status was significantly related ($p < 0.05$) with the incidence of anemia. Nutritional status in children is a manifestation of the health status of the body from daily diets. If daily food intake of children does not meet the nutritional adequacy rate for a long time, the growth of children is disrupted. [15].

Nutritional status is also influenced by the education level of parents and family income. The distribution of respondents' characteristic data in this present study showed that the majority of the fathers (67.7%) worked as farmers and 59.4% of the mothers were housewives. In terms of education levels, most parents only graduated from elementary school, 33.1% for fathers and 32.8% for mothers. 63.2% of the parents were economically paid less and 33.1% of them worked to make a living of more than five family members. This condition will certainly have an impact on the low availability of and the purchasing power for food in the house. The results of this present study were in line with those by Ansar in Mamuju that showed a significant relationship between socioeconomic family levels and the incidence of anemia [16].

The results of this present study also revealed that there was a significant relationship ($p < 0.05$) between the breakfast-eating habit and the incidence

of anemia. The school children who did not eat breakfast were 4.34 times at risk of developing anemia compared with those who liked to have breakfast. The results of this present study were also in line with a similar study by Sirajuddin on 179 elementary-school children in Makassar [13] and with that by Utami on 344 elementary-school children in Manado; there was a significant relationship between breakfast and the incidence of anemia [15]. According to Bartffeld *et al*, breakfast is a basic requirement for children and needs to be promoted at all schools to improve the nutritional status of children. Therefore, breakfast is highly recommended in schools [17].

Breakfast for school children is very necessary because it can make their body fit and improve their learning focus. Breakfast also serves as a source of energy for children to do their activities in school. A study conducted in Teheran, Iran showed that a complete breakfast (six times or less) in one week was closely associated with the academic performance of elementary-school children [18].

CONCLUSION

Helminthiasis, nutritional status, and breakfast-eating habit are risk factors for the incidence of anemia. However, the breakfast-eating habit itself is the most influencing factor in the incidence of anemia in elementary-school children living in malaria-endemic regions.

ACKNOWLEDGMENT

This research was funded by a grant of *Hibah Kompetitif Universitas Sriwijaya 2019*. The researchers are very grateful to all people for their contribution and assistance to this study.

REFERENCES

[1] World Health Organization, "Global Health Risk ; Mortality and Burden Of Disease Attributable to Selected Major Risk," *GenevaWord Heal. Organ.*, 2009.

[2] Weise A, "WHA Global Nutrition Targets 2025: Anemia Policy Brief," *W.H.O Publ.*, pp. 1–7, 2014.

[3] Firehiwot M, Yemane B, and Alemayehu W, "Anemia among primary school children in Eastern Ethiopia," *PLoS One*, vol. 10, no. 4, pp. 1–11, 2015.

[4] Benoist B, Mclean E, Cogswell M, Egli I,Wojdyla D., "Worldwide prevalence of anaemia 1993-2005: Who Global Database on Anaemia," *GenevaWord Heal. Organ.*, pp. 7–13, 2008.

[5] Proverawati A, Misaroh., "Manarche (Menstruasi pertama penuh makna)," *Muha Med.*, 2009.

[6] Adebara O V, Ernest S.K and Ojuawo I.A "Association between intestinal helminthiasis and serum ferritin levels among school children," *Sci. Res. Open J. Pediatr.*, vol. 1, pp. 12–6, 2011.

[7] Chajhlana S P S, Mahabharat R.N and Varaprasa M S "Nutritional deficiencies among school-age children in urban areas of Hyderabad Telangana India," *Int. J. Comm. Med. Pub. Heal.*, vol. 4(2), 2017.

[8] Pullan RL *et al*, "Global numbers of infection and disease burden of soil transmitted helminth infection in 2010," *Parasites & vector*, vol. 7 :37, pp. 2–19, 2014.

[9] DItjen P2PTVZ, "Panduan Pemelih raan Eliminasi Malaria," *Pandu. Pemeliharaan Elimin. Malar.*, pp. 1–28, 2017.

[10] Golles HM, *Hand Book Of Malaria Infection In The Tropics*. .

[11] Peraturan Presiden (Perpres) RI No131., *Tentang Penetapan Daerah Tertinggal Tahun 2015 - 2019*. 2015.

[12] Nicholas. J.white, "Anaemia and malaria," *NCBI journal2018*, vol. 17, p. 371, 2018.

[13] Sirajuddin S and Masni, "The incidence of anemia pada Siswa Sekolah Dasar Anemia Incidence among Elementary School Students," *J. Kesehat. Masy. Nas.*, vol. 9, no. 3, 2015.

[14] Favour O., "A significant association between intestinal helminth infection and anaemia burden in children in rural communities of edo state, Nigeria," *N. Am. J. Med. Sci.*, vol. 3(1), pp. 30–4, 2011.

[15] Erina Utami Tandirerung, Nelly Mayulu,Shirley E.S., "Hubungan Kebiasaan Makan Pagi Dengan Anemia pada Murid SD Negeri 3 Manado," *J. e-Biomedik*, vol. 01 no.03, pp. 53–58, 2013.

[16] Ansar, Nurpupudji.A.Taslim and Nurhaedar Jafar, "Fakto-Faktor Yang Berkaitan Dengan Kejadian Anemia di Daerah Endemik Malaria Kabupaten Mamuju, Propinsi Sulawesi Barat, Indonesia," *JST Kesehatan.*, vol. 2, no. 1, pp. 18–26, 2012.

[17] Bartfeld J S, Kim Myoung, Ryu Hee J, and Ahn Min H, "The School Breakfast Program Participation and Impacts," 2009.

[18] Soheilipour F, Salehiniya H, and Farajpour M, "Breakfast habits , nutritional status and their relationship with academic performance in elementary school students of Tehran , Iran," *Public Heal. Med. Fharmacy Reports*, vol. 92, no. 1, pp. 52–58, 2019.