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Factors Related to Anaemia in Toddlers Aged 6 - 59 Months in Indonesia (Riskesdas Data Analysis 2018)

Nutriani Rahma Baitilla[a*], Ummi Kalsum[b], Raden Halim[b]
[a]Program Study of Public Health, Faculty of Medicine and Health, Universitas Jambi, Indonesia
[b]Department of Epidemiology, Faculty Public Health, Universitas Jambi, Indonesia.

[*]**Corresponding author:** nutrianir@gmail.com

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Abstract
Introduction: The prevalence of anemia in toddlers is increasing in Indonesia. Various factors can influence the anemia status of toddlers, such as toddler characteristics, maternal factors, and sociodemographics. **Purpose**: of this study was to determine the factors associated with the occurence of anemia in toddlers aged 6–59 months in Indonesia. **Methods**: This is a secondary study with a cross-sectional design. Data were sourced from the 2018 Basic Health Research (Riskesdas), with a sample size of 1,614 toddlers aged 6–59 months. The variables studied were toddler characteristics, maternal factors, and sociodemographics. Complex Sample Analysis (CS) Chi-Square and Cox Regression were used. **Results**: The study found that the proportion of toddlers with anemia in Indonesia is 38.4%. Risk factors for toddler anemia were the toddler's age, maternal education, and maternal anemia status. There was no association between gender, birth weight, nutritional status, health status, maternal occupation, personal hygiene, gestational age, family size, and socioeconomic status to occurrence of anemia. The dominant factor was toddler age (PR 1.96; 95% CI 1.52-2.52) after controlling for birth weight, toddler nutritional status, maternal occupation, maternal education, maternal anemia, personal hygiene, residence, family size, and socioeconomic status. **Conclusion:** Younger toddlers increase the risk of anemia in Indonesia. It is recommended that mothers with toddlers pay attention to their consumption patterns and parenting to ensure a balanced, nutritious diet to meet iron needs, especially for toddlers aged 6-23 months, who are generally still breastfed.

Introduction
Human Resources (HR) is an essential aspect in the development of a country. The quality of these resources in the future will be largely determined by the capacity of today's children who will become the next generation of the nation. Efforts are needed to maintain the optimal growth and development of children from birth to meet quality human resources. Children's growth and development can be influenced by a variety of factors, both genetic and environmental. One of the main environmental factors is iron nutrition. Iron is an important mineral that the body needs for the purpose of producing one of the components of red blood

cells, namely hemoglobin. If the level of hemoglobin in the blood is low, it will cause anemia [1,2].

Anemia is a major health problem worldwide, especially in developing countries [3]. Iron deficiency anemia is the most common cause of anemia [4]. Iron deficiency anemia rarely causes death, but its impact on human health is quite significant [5]. This can result in reduced oxygen delivery to the body's tissues, which can lead to paleness and weakness [6]. One of the groups that is susceptible to anemia is toddlers. Iron deficiency in toddlers will interfere with cognitive development from infancy to adulthood, especially during the first two years of life. In addition, it will affect the immune system, interfere with growth, social interaction, impaired concentration, and heart function, allowing the death rate to increase. There are so many effects of anemia on children's intellectual intelligence and health that it can have an impact on the quality of human resources [7]. Common signs and symptoms of anemia in children are dizziness, fatigue and body tension, general weakness of the body, loss of appetite, low body weight, pale skin, fainting to the point of death [8,9].

According to World Health Organization (WHO) data, the global prevalence of anemia in toddlers aged 6–59 months in 2019 reached 39.8%. It is estimated that this number will continue to increase until it exceeds 40% [10]. Meanwhile, several countries in Southeast Asia have a fairly high prevalence of toddler anemia in 2019, including Myanmar in first place with a prevalence of anemia in toddlers of 49.6%, Cambodia ranks second with a prevalence of anemia in toddlers of 49%, Timor Leste is in third place with a prevalence of anemia in toddlers of 46.3%, and Laos is in fourth place with 41.4%. Then, Indonesia is in fifth position with a prevalence of 38.4% [10].

The results of Basic Health Research in Indonesia show that the prevalence of anemia in toddlers has experienced an increasing trend of cases, in 2007 by 27.7% [11], in 2013 it increased to 28.1% [12], and in 2018 it increased dramatically to 38.5% in 2018 [13]. The increased incidence of anemia in toddlers can be caused by the nutritional needs of toddlers more during the growth period [14]. Not only that, the incidence of anemia under five in Indonesia in rural areas is known to be higher, at 25.0% than in urban areas by 22.7% [13].

The most common causes of anemia include nutritional deficiencies, iron deficiencies, folate, vitamins B12 and A and infectious diseases, such as malaria [15]. In addition, anemia problems for toddlers can be caused by rapid growth, improper diet, infections, the appearance of bleeding in the gastrointestinal tract, malabsorption, mothers suffering from anemia, less than a month of birth, and low birth weight. Children tend to consume less iron-rich foods, such as red meat and vegetables. This can occur in children who like to be picky about food, so that the child cannot meet the intake of iron in the body as it should [16].

Many factors affect the anemia status of toddlers, including the characteristics of toddlers, namely gender, age, birth weight, nutritional status, health status, and status of getting vitamin A [17–22]. Maternal factors are occupation, education, anemia status, personal hygiene, and gestational age [21,23–26]. Sociodemographic factors are place of residence, family size, and socio-economic [27,28]. The purpose of this study is to obtain a prediction model of the incidence of anemia in toddlers aged 6–59 months in Indonesia based on Riskesdas 2018 data.

Methods

Study Design

This study uses secondary research data on Basic Health Research 2018 in Indonesia with a cross-sectional research design.

Population and Sample

The population is all toddlers aged 6–59 months throughout Indonesia totaling 59,028 toddlers. The number of samples was calculated using a hypothesis test formula for different proportions from Lemeshow and Lwanga [29]. The minimum number of samples needed is 3,008 toddlers, however, in this study all samples that are in accordance with the inclusion and exclusion criteria obtained from the Laboratory and Data Management of the Ministry of Health amounted to 1,614 toddlers. The inclusion criteria in this study were toddlers aged 6–59 months who were last born during the period from January 1, 2013 to the time of the Riskesdas 2018 data collection interview. The exclusion criteria are twins, toddlers who do not have weight records or toddlers with a BB/U flag based on WHO Anthro, and toddlers with mothers who do not have Hb levels checked.

Data Collect

The collection of Riskesdas 2018 data was carried out by interviews, measurements, and examinations. The interview method uses individual and household questionnaires. Blood hemoglobin levels are checked based on photometric wavelengths, carried out quickly using the Hemocue device. Weight measurement was carried out using a digital weight scale (accuracy level 0.1 kg)13. Then, in looking at the nutritional status of toddlers, it was calculated using weight indicators according to age with the help of WHO Anthro software to get a Z-score.

Data Analysis

Data analysis used the Chi-Square test for bivariate analysis and the Cox Regression test for multivariate analysis at a 95% confidence level using the spss application.

Results

This study found that the average Hb level for toddlers was 11.15 g/dl. Characteristics of toddlers are on average 31 months old. the average birth weight of toddlers was 3,110.66 grams, measures of nutritional status of toddlers according to BB/U -0.92 standard deviation, maternal Hb levels of 13.04 g/dl, gestational age 37.86 weeks, and the average number of household members was four people with a minimum of two people and a maximum of 14 people. A sample of table is presented in Table 1.

Table 1. Distribusi Data

Variable	Min-Max	Mean	95% CI	SD	Median
Up to Hb Balita (g/dl)	5,0 – 16,6	11,15	11,07 – 11,23	1,59	11,3
Toddler Age (bulan)	6 – 59	31,80	31,05 – 32,54	15,31	31,80
The Birth Weight of a Toddler (g)	1.300 – 5.300	3.110,66	3.081,91 – 3.139,41	462,82	3.100
Nutritional Status News BB/U (SD)	-5,04 – (4,91)	-0,92	-0,98 – (-0,86)	1,26	-1,04
Maternal Hb Rate (g/dl)	5,0 – 21,2	13,04	12,96 - 13,12	1,65	13,2
Gestational Age (minggu)	21 – 43	37,86	37,75–37,97	2,27	38
Large Family (orang)	2 – 14	4,64	4,57 – 4,71	1,44	4

Source: Processed Secondary Data, 2022

From the results of the bivariate analysis, it was found that there was a relationship between the age of toddlers, the mother's education, the status of maternal anemia, and the place of residence and the incidence of anemia in toddlers. From the characteristics of toddlers, namely the age of toddlers 6-23 months, it can increase the risk of anemia by 1.82 times compared to those aged 24-59 months (PR 1.82; 95% CI 1.56-2.13) and this is proven to be significant p-value (0.00). However, this study has not been able to prove the relationship between gender, birth weight of toddlers, nutritional status, health status of toddlers, and status of receiving vitamin A with the incidence of anemia in toddlers 6-59 months in Indonesia.

Related to maternal factors, toddlers with low-educated mothers were 1.46 times more likely to suffer from anemia compared to toddlers whose mothers were highly educated (PR 1.47; 95% CI 1.17-1.85), this proved to be significant p-value <0.05 (0.00). Then, toddlers with mothers with anemia status experienced more anemia than toddlers whose mothers were not anemic, from bivariate results showed that mothers with anemia were 1.26 times more at risk of toddler anemia compared to mothers who did not have anemia PR 1.26; 95% CI 1.04-1.52. This proved to be significant with a p-value of <0.05 (0.02). However, this study has not been able to prove the relationship between maternal work, personal hygiene, and gestational age with the incidence of anemia in toddlers 6-59 months in Indonesia.

Furthermore, sociodemographic factors where there is a difference in the proportion of toddlers who live in rural areas have more anemia than in urban areas, the results of bivariate analysis found that toddlers living in villages are 1.25 times more at risk of anemia than toddlers living in cities (PR 1.25; 95% CI 1.07-1.46) and this is proven to be significant with a p-value of <0.05 (0.00). However, this study has not been able to prove the relationship between family size and socioeconomics and the incidence of anemia in toddlers 6-59 months in Indonesia. A sample of table is presented in Table 2.

Table 2. Analisis Bivariate

Variabel	Anemia				Total		PR (95% CI)	p-value [a]
	Yes		No					
	n	%	n	%	n	%		
Gender of Toddlers								
Male	338	38,6	537	61,4	875	100	1,01 (0,86-1,19)	0,884
Female	282	38,2	457	61,8	739	100	Ref	
Toddler Age								
6-23 Months	292	55,1	238	44,9	530	100	1,82 (1,56-2,13)	0,000*
24-59 Months	328	30,3	756	69,7	1084	100	Ref	
The Birth Weight of a Toddler (n = 998)								
Low Birth Weight (<2500 g)	17	30,7	37	69,3	54	100	0,77 (0,49-1,20)	0,218
Normal Birth Weight (≥2500 g)	378	40,0	566	60,0	944	100	Ref	
Nutritional Status News (BB/U)								
Malnutrition	121	44,3	153	55,7	274	100	1,24 (0,97-1,60)	0,089
More Nutrition	12	32,1	24	67,9	36	100	0,83 (0,45-1,53)	0,546
Good Nutrition	487	37,4	817	62,6	1304	100	Ref	
Health Status of Toddlers								
Sick	158	41,0	228	59,0	386	100	1,09 (0,91-1,31)	0,352
Healthy	462	37,6	766	62,4	1228	100	Ref	
Status of Getting Vitamin A								
Never	60	35,3	110	64,7	170	100	0,91 (0,70-1,17)	0,458
Yes, Ever	560	38,8	884	61,2	1444	100	Ref	
Mother's Work								
Work	169	34,6	318	65,4	487	100	0,86 (0,73-1,03)	0,092

Not working	451	40,0	676	60,0	1127	100	Ref	
Mother's Education								
Low	253	48,4	270	51,6	523	100	1,47 (1,17-1,85)	0,001*
Medium	152	30,9	339	69,1	491	100	0,83 (0,64-1,08)	0,171
Hight	216	35,9	384	64,1	600	100	Ref	
Maternal Anemia Status								
Anemia (<12 g/dl)	156	45,8	184	54,2	340	100	1,26 (1,04-1,52)	0,022*
Not Anemia (≥12 g/dl)	464	36,4	810	63,6	1274	100	Ref	
Personal Hygiene Mother's								
Poorly	143	43,2	188	56,8	331	100	1,16 (0,97-1,38)	0,105
Good	477	37,2	806	62,8	1283	100	Ref	
Gestational Age								
Prematur (<37 week)	168	40,8	244	59,2	412	100	1,08 (0,91-1,29)	0,369
Not permatur (≥37 week)	452	37,6	750	62,4	1202	100	Ref	
Residence								
Rural	218	44,7	269	55,3	487	100	1,25 (1,07-1,46)	0,004*
Urban	403	35,7	724	64,3	1127	100	Ref	
Number of Families								
≥5 Family members	274	41,0	393	59,0	667	100	1,12 (0,95-1,33)	0,187
<5 Family members	347	36,6	600	63,4	947	100	Ref	
Socio-Economic								
Low	298	40,3	441	59,7	739	100	1,15 (0,91-1,47)	0,243
Medium	124	38,4	198	61,6	322	100	1,08 (0,79-1,48)	0,615
Hight	199	36,0	354	64,0	553	100	Ref	

[a]Analyzed using Mann-Whitney test
*Statistically significant at p=0.05

From the results of the multivariate analysis, the variables related to anemia in toddlers were the age of toddlers 6-23 months (PR 1.96; 95% CI 1.52-2.52), low maternal education (PR 1.63; 95% CI 1.20-2.20), and maternal anemia status (PR 1.51; 95% CI 1.14-2.00). The dominant variable is the age of toddlers with the most influential PR value of 1.96 times, meaning that toddlers aged 6-23 months can increase 1.96 times greater risk of anemia compared to toddlers who are 24-59 months old after controlling for the variables of birth weight of toddlers, nutritional status of toddlers, mother's work, mother's education, maternal anemia status, Personal Hygiene, Residence, Family Size, and Socio-Economy. A sample of table is presented in Table 3.

Table 3. Analisis Multivariate

Variabel	B	p-value [a]	PR (95% CI)
Toddler Age	0,671	0,000*	1,96 (1,52-2,52)
The Birth Weight of a Toddler	-0,224	0,395	0,80 (0,48-1,34)
Primary Maternal Education	0,487	0,002*	1,63 (1,20-2,20)
Medium Mother Education	-0,029	0,857	0,97 (0,71-1,33)
Maternal Anemia Status	0,415	0,004*	1,51 (1,14-2,00)

[a] Analyzed using Cox Regression.
*Statistically significant at p=0.05

Discussion

Based on the results of the multivariate analysis, it was found that the factors related to the incidence of anemia in toddlers aged 6-59 months in Indonesia were the age of toddlers, maternal education, and maternal anemia status. There is a relationship between the age of toddlers and the anemia status of toddlers. Toddlers aged 6-23 months can increase the risk of anemia by 1.96 times compared to those aged 24-59 months (PR 1.96; 95% CI 1.52-2.52). These results are in line with research by Zuffo (2016) which said that there is an association

between anemia and age younger than 24 months (OR 1.88; 95% CI 1.15–3.09 p = 0.01). This relationship is related to increased growth rate and the resulting increase in iron requirements in the first years of life [30].

Multivariate results showed that there was a relationship between maternal education and the anaemia status of toddlers where toddlers with low-educated mothers were 1.63 times more likely to suffer from anemia compared to toddlers whose mothers were highly educated (PR 1.63; 95% CI 1.20-2.20). In addition, the results of the analysis show that the higher the mother's education, the more it can reduce the risk of anemia in toddlers. Mothers with low levels of education have the highest risk of suffering from anemia compared to other levels of education and the risk decreases if mothers complete their education to higher education. In a study in Malaysia where children with parents with a low educational background were more likely to develop iron deficiency anemia than children with parents with a higher education background (OR 2.52; 95% CI 1.38–4.60, p = 0.002). They better understand and provide healthy and hygienic food for their children [28].

Toddlers with mothers with anemia status experienced more anemia than toddlers whose mothers were not anemic, from the results showed that mothers with anemia were 1.51 times more at risk of developing anemia in toddlers compared to mothers who were not anemia (PR 1.51; 95% CI 1.14-2.00). Furthermore, Al-Qaoud et al. (2015) also showed this association among mothers of Kuwaiti preschool children (OR 1.59; 95% CI 1.02–2.47 p = 0.041) [31]. The underlying reason is that mothers and toddlers most often share the same home environment, socioeconomic, dietary conditions, and mother/child anemia may reflect the general nutritional status of the household. In addition, maternal iron deficiency is associated with low birth weight; Even children born with a moderate weight experience a decrease in iron reserves when their mothers suffer from anemia [14].

Furthermore, factors that are not related to the incidence of anemia in toddlers aged 6-59 months in Indonesia are gender, birth weight of toddlers, nutritional status of toddlers, health status of toddlers, status of getting vitamin A, maternal work, personal hygiene, gestational age, place of residence, family size, and socio-economy. From the results of the analysis, it was found that there was no relationship between sex and the incidence of anemia under five in Indonesia. This is similar to the findings by Ewusie et al. (2014) in Brazil where the gender of toddlers was not associated with the incidence of anemia with a p-value of 0.167 [32]. However, another finding by Keokenchanh et al (2021) found that boys were 1.16 times more likely to develop anemia than girls (aOR 1.16; 95% CI 1.01–1.4 p = 0.1) and the results were significant [17]. Likewise, a study by Zuffo (2016) stated that boys under five are 1.86 times more likely to develop anemia than girls (PR 1.86; 95% CI 1.17–2.94, p = 0.000) [30]. The absence of a relationship between sex and anemia in toddlers is possible in this study the proportion of anemia in both boys and girls under five is almost balanced. Although the overall anemic status did not show significant variation in terms of sex included in the study, a possible explanation is that boys are more likely to develop anemia than girls. According to the research of Goswmai and Das (2015) this may be due to the fact that higher growth rates among boys during the growth stage result in a higher prevalence of anemia, as their bodies demand higher amounts of iron, which food cannot provide [33].

In this study, the absence of a relationship between birth weight and the anemia status of toddlers is possible because the nutritional needs of toddlers have been met even though they experience low birth weight, as found by Suwito et al (2014) that there is no relationship between nutritional status and child development due to adequate nutritional interventions

and extensive examinations in toddlers who experience signs of malnutrition so that the nutritional problems experienced has not had an effect on its development [34]. This is not in line with previous research, namely by Nofiani (2015) where toddlers with BBLR had a higher risk of anemia compared to non-BBLR toddlers (OR 4.36; 95% CI 2.74-6.94) [35]. In 2011 in Cuba by Pita (2014), this study also said a significant association between BBLR and anemia was (OR 1.74; 95% CI 1.04–2.92) [36]. Likewise, the study of Konstantyner et al. (2012) also found a relationship between BBLR and anemia (95% CI 3.23-3.33) [37]. However, other studies have found no association between BBLR and the incidence of anemia in both urban areas (OR 1.2; 95% CI 0.84-1.65) and rural areas (OR 1.0; 95% CI 0.66-1.38) [38]. Researcher Uchimura et al. (2003) explained that in population-based studies, BBLR and anemia are always correlated. This can be because babies born with normal birth weight have more iron stores than babies whose birth weight is less than normal. Not only that, the weight of babies born with less weight has a faster growth rate than babies born with normal weight, so that the iron deposits they have end up being used for metabolic processes faster than babies born with normal weight. Therefore, the need for iron in this baby is greater than that of normal babies. If BBLR babies get enough iron-rich food, then at 9 months of age Hb levels will be able to match normal babies [39].

The findings found that the incidence of anemia was most common in toddlers with poor nutritional status even though there was no significant relationship. Likewise, toddlers with more nutritional status also had no association with anemia. These findings are similar to a study by Ayoya (2013), in which toddlers with poor nutritional status were not associated with the incidence of anemia (OR 0.9; 95% CI 0.4–2.2 p = 0.917). Similarly, in a study in Brazil by Leal, both urban and rural, poor nutritional status was not associated with an increased risk of anemia in toddlers (PR 1.3; 95% CI 0.75-2.23 p = 0.36 and PR 1.2; 95% CI 0.76-2.03 p = 0.40) [38]. In contrast to research by Gebremedhin (2014), toddlers with undernutrition status increased the risk of anemia in toddlers by 2.7 times (OR 2.7; 95% CI 1.8-4.1). Children who are thin and have a MUAC (LILA) of less than 12 cm are more likely to develop anemia than their peers. Anemia and malnutrition often have the same cause, it is expected that double nutritional problems will occur in the same individual. These factors are exacerbated by poverty and food insecurity. Low intake of iron-rich foods and reduced nutrient absorption caused by changes in the gastrointestinal epithelium in malnourished individuals contribute to the development of anemia [20].

The results of the analysis show that the health status of toddlers does not correlate with the incidence of anemia in toddlers. In another study by Silva et al. (2018), it was stated that children who were hospitalized at least once in a lifetime had a higher risk of developing anemia compared to those who had never been hospitalized (OR 1.55; 95% CI 1.03 – 2.33 p = 0.036). In addition, children who had a current infection also had a higher risk of anemia compared to those who were healthy, although this was not significant (OR 1.57; 95% CI 0.97 – 2.54 p = 0.065). The main cause of hospitalization in children under 4 years old in Brazil is respiratory disease followed by parasitic infectious disease. According to the literature, infectious diseases are a common cause of anemia in childhood, and children with anemia are more susceptible to infectious diseases. This occurs because the disease can reduce food intake and nutrient absorption, and deplete iron and other micronutrient stores in the body [40]. Another study mentioned fever conditions in the past two weeks identified as a related factor for mild anemia. Fever is a common symptom of acute and chronic inflammatory diseases, mostly infections, which are associated with lower Hb levels [37].

The results of the analysis showed that the status of getting vitamin A was not related to the incidence of anemia in toddlers. The results of this study are supported by the study of Ribaudo (2021) which showed no significant association between vitamin A supplementation and anemia in children under five years of age (PR 0.95; 95% CI 0.87-1.04 p = 0.284). Nonetheless, there was a 5% reduction in anemia in children who were given the supplement. Similarly, another study in Peru found an insignificant association between iron deficiency anemia in children receiving vitamin A. These results differed from investigations in Ethiopian children aged 6 to 59 months in which vitamin A consumed was associated with a 9% reduction in the risk of anemia (RR 0.91; 95% CI 0.86-0.96) [20]. Likewise, another study in Northern Morocco concluded that vitamin A treatment increased average hemoglobin by 0.7 g/dL and reduced the prevalence of anemia from 54% to 38%. However, vitamin A is only given to children with low vitamin A status, contrary to Ethiopian research and research where vitamin A levels are unknown [41]. In this study, there was no association between vitamin A administration and the incidence of anemia in toddlers was estimated because the data used were conditions in which toddlers received vitamin A or not. This means that vitamin A is not necessarily consumed by toddlers so the results obtained are not related. This is stated in the 2018 Riskesdas questionnaire questions which only ask mothers of toddlers or related families whether they get vitamin A or not.

Mother's employment status is not related to the status of anemia of toddlers in Indonesia. This is supported by previous research, namely the 2013 Riskesdas study by Nofiani (2015) that no significant relationship was found between maternal work and anemia in toddlers (OR 0.87; 95% CI 0.65-1.17) [35]. Another case was found by Ngui (2012) who found that there was a relationship between non-working mothers and toddler anemia (OR 2.18; 95% CI 2.06–2.31 p= 0.013) [28]. Then, this study found that the proportion of toddler anemia incidence occurred most in toddlers who had non-working mothers (40%). This is explained because mothers who do not work will lack income, while working mothers are expected to increase family income so as to affect the family's purchasing power to meet the nutritional needs of toddlers. Therefore, families with higher incomes are more likely to be better at meeting food needs, whereas families with limited socioeconomic conditions may face barriers in accessing nutrition and health services, which can result in a higher risk of anemia [42]. On the other hand, Ahmad's research in Aceh (2018) found that working mothers 8.29 times increased the risk of anemia for toddlers (OR 8.29; 95% CI 1.71-53.40 p = 0.009) which is known that toddlers whose mothers have a job will affect childcare, namely the lack of time to directly care for their children. Working mothers will usually leave their children with a maid or parents (grandmothers) at home. Thus, in the case of childcare, it will be taken over by the maid or caregiver while the mother is working, including the practice of feeding [43].

Based on the results of the study, maternal personal hygiene was not related to the anemia status of toddlers (PR 1.16; 95% CI 0.88-1.54). It is estimated that the personal hygiene variable is not a direct risk factor that can be experienced by toddlers. Hygienic preventive practices, such as washing hands especially after using the toilet and before eating or after touching potentially germ-rich sides are essential to prevent bacterial and parasitic infections that can cause anemia in pregnancy. A study in Jamaica found that mothers who did not wash their hands regularly after using the toilet were almost 10 times more likely to develop anaemia compared to mothers who reported always washing their hands (OR 9.7; 95% CI 1.72–54.78, p = 0.045) [25]. This is allegedly due to the high proportion of the population who do not have drinking water sources and better sanitation facilities, poor hygiene practices and the transmission of geohelminths and other parasitic infections that cause malnutrition and anemia are likely to occur. Then, the mother's anemia will also affect the toddler [44].

In this study, the incidence of anemia in toddlers was higher in the history of premature birth (<37 weeks) compared to those who were not premature. However, the results of the analysis found that there was no relationship between gestational age and the incidence of anemia under five in Indonesia. These results are in contrast to the study of Qinrui Li (2019) in Beijing which found that premature infants had an increased risk of anemia at 6 months of age, finding that 26% of premature infants were iron deficient during the first year of life with premature infants at risk of developing anemia (OR 1.30; 95% CI 1.01–1.67 p = 0.04). Premature babies are at high risk of malnutrition because they have low deposits of iron, zinc, and vitamin A. Premature babies can experience blood loss at birth, inadequate erythropoiesis, blood sampling, rapid growth, bleeding and hemolysis. Therefore, most premature babies have smaller blood volumes and develop more severe anemia than full-term babies. The effects of iron deficiency include poor physical growth, indigestion, impaired neurodevelopment and altered immunity. Therefore, preterm infants should receive iron supplementation from sources, such as fortified breast milk, iron-fortified formula, or medicinal iron elements (e.g., 2–4 mg/kg/day) [45].

The incidence of anemia in toddlers occurs in rural areas, which is as much as 44.7%. However, based on multivariate results, residence was not associated with the incidence of anemia in toddlers (PR 1.20; 95% CI 0.93-1.54). The results are similar to the research of Nofiani (2015), the results of the analysis based on residence there is no difference in risk between urban and rural areas with the incidence of anemia under five and there is no association in Indonesia in 2013 (OR 1.3, 95% CI 0.98-1.72) [35]. However, research by Khan et al (2016) found that there was an association between residence and toddler anemia where rural areas were more at risk of increasing the incidence of toddler anemia (OR 1.21; 95% CI 1.01-1.46 p = 0.039) [14]. A higher prevalence of anemia was also found in rural areas of Bangladesh at 53.1%. It can be attributed to malnutrition due to limited availability of nutritious food, lower socioeconomic status, and lack of access to hygienic sanitation facilities, thus being associated with increased rates of disease which in turn is associated with an increased risk of anemia [14]. In addition, limited access to health services may be a contributing factor to the incidence of anemia. The median travel time to health facilities in rural areas is higher than in urban areas [42].

Family size was also found to be unrelated to the incidence of anemia under five in Indonesia (PR 1.13; 95% CI 0.89-1.44). Similarly, a study by Khan et al. (2016) showed that there was no significant association between families and anemia in toddlers (OR 1.05; 95% CI 0.87-1.28 p = 0.582) [14]. In this study, the incidence of anemia under five most occurred in families with more than 5 members, which was 41%. Children of large family sizes have a higher chance of anemia rates than children of smaller family sizes. This is supported by previous research in Egypt and China [46,47]. This is because children from large families may not get enough nutrition compared to children from small families. The large number of family members makes daily needs, including nutritious food, more and more. Especially in families with limited income, which makes access to sources of good nutrition increasingly reduced. So, inadequate intake of nutrients such as lack of iron, folate, and vitamin B12 can increase the risk of anemia in children [48].

The multivariate results showed that low socioeconomic levels were not associated with the incidence of anemia under five (PR 1.04; 95% CI 0.77-1.42). Likewise, moderate socioeconomic level was not related to the incidence of anemia under five (PR 0.90; 95% CI 0.61-1.32). Then, from these results, there is a dose response relationship where the higher the socioeconomic level, the lower the risk of toddlers experiencing anemia. This is not in line with

research by Habte et al. (2013) which found that families with low levels of obesity correlated with the incidence of anemia in toddlers (OR 1.25; 95% CI 1.06-1.48 p = 0.007) [49]. Then, a study by Thomas et al. (2020) found that socioeconomics was also associated with anemia in toddlers (OR 1.17; 95% CI 1.11-1.23 <0.001) [50]. In this study, toddlers from low-income families had a higher prevalence of anemia compared to moderate and high households. The possible explanation is that poverty is strongly linked to food insecurity and therefore children from low-income households may not have access to foods rich in iron, vitamin B12, and folic acid, which in turn increases the risk of developing anemia. Another possible explanation is that low-income families are less likely to buy nutrient-rich foods, guarantee food availability, and pay for health care during illness for their children. Therefore, it reasonably reflects an improvement in household nutrition status for families under five with moderate to high socioeconomic levels [48].

Then, the dominant factor causing anemia of toddlers in Indonesia is the age of toddlers 6-23 months and this has been proven to be significant, where toddlers aged 6-23 months can increase the risk of anemia by 1.96 times greater compared to toddlers who are 24-59 months old after controlling for the variables of toddler birth weight, nutritional status of toddlers, maternal occupation, maternal education, maternal anemia status, personal hygiene, place of residence, family size, and socio-economy. Judging from the age of toddlers, it is known that the proportion of toddlers aged 6-23 months is 32.9% with an outcome proportion of 55.1%. The results of this study are in line with the research conducted by Melku et al. (2018) in the African region, precisely in Ethiopia, the results of testing with multivariate analysis were obtained on the age variable of toddlers is the most dominant factor where toddlers aged less than 24 months are 8.53 times more at risk of anemia compared to toddlers over 24 months (POR 8.53; 95% CI 3.8-19.18 p <0.001) [51]. Based on the literature, the reason for the high likelihood of anemia in younger children may be due to different factors. The first reason is nutritional imbalance, children need a relatively large nutritional requirement due to the high growth rate during the first two years of life combined with the rapid expansion of blood volume. If the practice and initiation of timely complementary feeding is very poor, younger children may suffer from at least one micronutrient deficiency (vitamin B12, folate, or iron) that causes anemia. The second reason may be the low concentration of iron and other micronutrients in breast milk that cannot meet the daily needs of the child's growth. Third, it is also due to the high susceptibility of young children to infectious diseases, which affects the absorption and utilization of bioavailable micronutrients [52].

In preventing anemia in toddlers, the Indonesian Pediatrician Association also recommends prioritized iron supplementation for children aged 0-5 years, especially for babies aged 0-24 months with slightly different doses. In full-term infants and children under 2 years of age, iron supplementation is given if the prevalence of anemia is high (above 40%) or does not receive fortified foods. This supplementation is given from the age of 6-23 months with a dose of 2 mg/kgBB/day. Infants who receive exclusively for 6 months, then do not receive iron adequately from food, are advised to give iron supplementation at a dose of 1 mg/kg/day. It is important to know that one of the risk factors for anemia in infants and toddlers is prenatal and perinatal conditions in the form of maternal iron reserves. Therefore, the management of nutritional anemia in toddlers cannot be separated from the solution of anemia in pregnant and lactating women. The physiological need for iron during pregnancy is difficult to meet only from the consumption of foods that are not enriched with iron. Therefore, pregnant women should always receive iron supplements [52]. Currently, one of the government programs that has been running is the provision of blood-boosting tablets to pregnant women during

pregnancy [53]. Not only does it aim to prevent and overcome the incidence of anemia in pregnant women, but it is also expected to prevent anemia in toddlers.

Conclusion

The prevalence of anemia in toddlers aged 6-59 months in Indonesia in 2018 was 38.4%. There is a relationship between the age of toddlers, maternal education and maternal anemia status with the incidence of anemia of toddlers aged 6-59 months in Indonesia. The dominant factor for the incidence of anemia in toddlers aged 6-59 months is the age of toddlers after controlling for the variables of birth weight of toddlers, nutritional status of toddlers, mother's job, mother's education, maternal anemia status, personal hygiene, place of residence, family size, and socio-economy.

Ethics approval

The ethical approval of this research was issued by the Faculty of Public Health, University of Jambi.

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