

# Prevalence and Determinants of Anemia among Adolescent Girls: A School-Based Survey in Central Java, Indonesia

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## Abstract

**Introduction:** Anemia is the most common and inflexible nutritional problem affecting about 2 billion of the world's population with a significant impact on human health and social and economic development. Information about anemia prevalence and associated factors among adolescent girls in Indonesia is still limited.

**Objective:** This study aimed to examine determinant factors related to anemia among adolescent girls.

**Method:** This is an analytic study with a cross-sectional design, located in three regencies in Central Java Indonesia. This is a school-based survey in several senior high schools in three regencies that have a higher number of stunting cases, as a related indicator of Anemia. A total of 388 adolescent girls have participated in this study. Anemic status was assessed using HB quick-check. Independent variables such as breakfast habit, father's height, allowance per day, etc. were collected by a structured questionnaire. Data analysis is carried out by univariate, bivariate, and multivariate. Ethical clearance has been approved by Medicine Faculty Ethics Committee, Jenderal Soedirman University.

**Result:** The study found that 26,3% of girls were categorized as having anemia. Results showed that there was a correlation between anemic and breakfast habit ( $p = 0.07$ ), and allowance per day ( $p = 0.08$ ), and father's height ( $p = 0.01$ ) among adolescent girls.

**Conclusion:** This research highlighted the importance for the adolescent girl of having daily breakfast. Good eating habits can help to reduce the incidence of anemia and its negative adverse health effects.

**Keywords:** anemia, adolescent, girl, Indonesia

## 1. Introduction

Globally, anemia is the most common and inflexible nutritional problem affecting about 2 billion of the world's population with a significant impact on human health and social and economic development. Anemia is characterized as a condition in which the number and oxygen-carrying ability of red blood cells (RBCs) is inadequate to meet the physiological needs of the body (Castro De Andrade Cairo et al., 2014; Soundarya & Suganthi, 2016). Iron deficiency anemia is the most common cause of anemia, accounting for half of all cases (Christian & Smith, 2018). Iron deficiency anemia can occur at all stages of life and is more common among pregnant women, young children, and adolescents. Adolescent particularly girl is the one of the vulnerable group at risk of anemia. This because of the increase of nutrient requirements during this period due to rapid changes in their physical dimension and body composition. Since this time is often ignored, adolescent girls are subjected to various forms of macro-and micronutrient malnutrition and therefore the period is the last opportunity to break the vicious cycle of intergenerational connection (Ramzi et al., 2011). Also, the adolescent girl also more vulnerable to experience social discrimination and pressure such as detailing with body image (Christian & Smith, 2018).

The drawbacks associated with iron deficiency anemia include lower academic potential; lower well-being and performance at home or in the community; and increased maternal and child morbidity and mortality for pregnant adolescents (WHO, 2011). The previous study also showed that stunting in children is also associated with the condition of mothers who have anemia (Rahman, Mushfiquee, Masud, & Howlader, 2019). Indonesia is the fourth-highest average stunting prevalence in Southeast Asia in 2005-2017 (36%) after Laos (44%), Bangladesh (42%), and Cambodia (40%). Based on the 2018 Basic Health Research Survey, stunting events in children across the country reached 30.8% (IMoH, 2019). The prevention of anemia in adolescent girls is one of the attempts made

to reduce the incidence of stunting. However, anemia often becomes a neglected issue that did not receive much attention.

Indeed, identifying factors associated with anemia in adolescent girls is undoubtedly important for diminish the health problem related to anemia. A previous study showed that dietary diversity score, household security status, and living status were associated with anemia incidence of adolescent girls (Gonete, Tariku, Wami, & Derso, 2018). Heme iron food consumption also showed a significant association with anemia, where adolescent girls who consumed heme iron foods less than once a month were 11 times more likely to develop anemia compared to those who eat more than twice a week (Engidaw, Wassie, & Teferra, 2018). Information about the prevalence of anemia and associated factors among adolescent girls in Indonesia is still limited. In the current study, we eager to determine the prevalence of anemia among adolescent girls based on a school-based survey. Besides, we also analyze the associated factors with anemia. The results of this study would provide crucial information for implementing a successful intervention to enhance their nutritional status to avoid the incidence of various risks during puberty, pregnancy, childbirth, and beyond.

## **2. Method**

### *2.1 Study Location and Design*

This is an analytical study with a cross-sectional design. This research is located in three regencies in Central Java namely Banyumas, Purbalingga, and Kebumen districts from June-September 2019. This research was conducted at selected senior high schools in the three districts. The districts were chosen based on their high number of stunting cases. Since there was no data on anemia in adolescents, stunting which was a related indicator of anemia was used. Stunting cases in Indonesia highly occurred in the child from young mothers, thus the government started to concern about the maternal health of adolescents.

### *2.2 Sampling Method*

The population of this study was senior high school girls students aged 16-18 in Central Java. This study involved 388 adolescent girls from 12 senior high schools. Class 12 was chosen since most of the age group criteria were there. It also related to administrative reason, which just allowed researchers to approached class 12, since class 11 and 13 were in the tight academic schedules. The population involved in this study was all the high schools in 3 selected districts, which include public schools, private schools, vocational schools, and Islamic schools. Systematic random sampling was applied to select the sample.

### *2.3 Data Collection*

The dependent variable of this study was anemic status which was assessed using Haemoglobin measurement taken by Hb-quick check using Easy-touch GCHP test-kit. Independent variables such as allowance per day, parental education, parental income, number of family members, availability of latrines at home, breakfast habit, menstruation period, parents height, nutritional status (BMI indicator), history of infectious disease, intake sources of iron and zinc were carried out by structured questionnaire. The height of the father and mother was assessed based on the self-report of the respondent. Breakfast habit was measured as a behavior aspect. It was asked using a range frequent scale. The question is how frequent do you have breakfast. The answer options are every day, often, seldom, never. There was no assessment of the nutritional content of breakfast.

### *2.4 Data Analysis*

Data analysis is carried out by univariate, bivariate, and multivariate. Logistic regression was applied to investigate the determinant factors related to anemia. Results of this study represented in tables.

### *2.5 Ethics Consideration*

Ethical clearance for this research has been approved by Medicine Faculty Ethics Committee, Jenderal Soedirman University No. 346/KEPK/X/2019.

## **3. Result**

A total of 388 young women students were cited in this study. They were interviewed about several variables examined in this study. 73,7% of respondents did not have anemia, while 26,3% were categorized as having anemia. Details of respondent's characteristics can be seen in Table 1.

Table 1. Anemic Status and Demographic characteristics of respondents

Characteristics	Number	Percentage
<b>Anemia</b>		
Yes	102	26,3
No	286	73,7
<b>Father's education</b>		
Didn't finish elementary school	11	2,8
Elementary school	186	47,9
Junior Highs School	60	15,5
Senior High School	91	23,5
Higher education (university)	40	10,3
<b>Mother's education</b>		
Didn't finish elementary school	9	2,3
Elementary school	200	51,5
Junior High School	79	20,4
Senior High School	74	19,1
Higher education (University)	26	6,7
<b>Parents income</b>		
High	130	34,2
Low	250	65,8
<b>Father's occupation</b>		
Unemployment	9	2,4
Student	1	0,3
Civil servant	19	5,0
Private Employee	34	8,9
Entrepreneur	88	23,0
Others	231	60,5
<b>Mother's occupation</b>		
Unemployment	218	56,6
Student	1	0,3
Civil servant	11	2,9
Private Employee	15	3,9
Entrepreneur	29	7,5
others	111	28,8
<b>Number of a family member</b>		
≤ 4 people	208	54,6
> 4 people	173	45,4
<b>Age differences with siblings</b>		
≥ 3 years or the only child	291	76,4
< 3 years	90	23,6
<b>Water source</b>		
Local water company	81	20,9

Well	261	67,4
Others	45	11,6
<b>The existences of a latrine</b>		
Yes	363	93,8
No	24	6,2
<b>Breakfast habits</b>		
Never	27	7,0
Rarely	36	9,3
Often	26	6,7
Always	298	77,0
<b>Nutritional status</b>		
Underweight	91	23,5
Normal	255	65,7
Overweight	21	5,4
Obese	21	5,4
<b>History of infectious disease</b>		
Yes		
No		
<b>Consumption of animal protein</b>		
Less than recommendation	386	99,5
Appropriate to recommendation	2	0,5
<b>Consumption of plant protein</b>		
Less than recommendation	387	99,7
Appropriate to recommendation	1	0,3

There were several interesting facts based on Table 1. Only 0.3% of respondents consumed vegetable protein which according to recommendations, while majority of respondents (99.7%) were still less than recommendation. While based on the results of the bivariate analysis, it was found that the variable that had an effect on the incidence of anemia was breakfast habit ( $p = 0.07$ ). Meanwhile, father's education ( $p = 0,523$ ), mother's education ( $p = 0,845$ ), parents' income ( $p = 0,752$ ), father's occupation ( $p = 0,806$ ), mother's occupation ( $p = 0,833$ ), number of family members living in the same household ( $p = 0.309$ ), age difference with siblings ( $p = 0.143$ ), water source ( $p = 0.213$ ), latrines ( $p = 0.176$ ), nutritional status ( $p = 0.828$ ), history of infectious disease (0.989), protein consumption animal ( $p = 1$ ) and consumption of vegetable protein ( $p = 1$ ) are not related to the incidence of anemia (Supplementary data 2)

The mean difference test results showed that variables related to anemia were per day allowance ( $p = 0.040$ ) and father's height ( $p = 0.016$ ). Meanwhile, the number of menstrual days ( $p = 0.561$ ) and maternal height ( $p = 0.584$ ) were not related to the incidence of anemia. Based on the results of the bivariate analysis, it was found that the variables included as multivariate test candidates ( $p \leq 0.25$ ) were differences in age with siblings, breakfast habits, amount of allowance per day, and father's height (Supplementary data 3). The multivariate analysis can be seen in Table 2.

Table 2. Multivariate analysis

Variables	<i>p</i>	OR	95% C.I
Water source			
Well	0,139	0,65	0,37 – 1,15
Others	0,146	0,50	0,20 – 1,27
The existence of a latrine			
	0,184	0,42	012 – 1,51
Breakfast habits (every day)			
Never	0,088	2,10	0,90 – 4,92
Rarely	0,111	0,44	0,16 – 1,20
Often	0,755	1,15	0,47 – 2,82
Allowance per day			
	0,083	1,00	1,00 – 1,00
Father's height			
	0,012	1,05	1,01 – 1,09

The results of logistic regression showed that the variable most influential on the incidence of anemia was the father's height where adolescents who had higher fathers had a 1.05 times risk of developing anemia compared to shorter fathers. It needs to be studied more, whether if father's height is higher than average are more likely to have calorie intake history in his diet or not. Water source, the existence of latrine, breakfast habit, and allowance per day did not influence together on anemic status. The allowance per day used in the analysis was a continuous variable, with the minimum allowance per day of female high school students was 2,000 rupiah and the maximum was 100,000 rupiah.

#### 4. Discussion

In this study, we found that the variable that affected the incidence of anemia was breakfast habit, per day allowance and father's height. These results supporting the previous research which stated that a balanced diet and daily breakfast is one effort to improve nutritional quality in addressing the lack of protein and fuel nutritional anemia. Breakfast habit before 9 a.m can provide 15-30 percent of daily nutrition needs as part of a balanced diet for healthy living (Abalkhail & Shawky, 2002). Skipping breakfast can cause morning nutrient deficiency in the body and increase the risk of malnutrition. This also can lead to excessive consumption of food in other meals, especially dinner, thus causing obesity (Jawed, Tariq, Tariq, & Kamal, 2017). Adolescents who eat breakfast regularly also has better academic performance and competences (MacLellan, Taylor, & Wood, 2008). Besides, adolescent girls have a relatively higher intake of micronutrients, whereas those who do not eat breakfast may have vitamin A, vitamin B6, calcium, copper, iron, magnesium, and zinc deficiencies (Hwalla et al., 2017).

Skipping breakfast could lead the deficiencies of nutrients and the development of anemia. The mechanism of developing anemia iron deficiency is divided into three stages, i.e. the first step is a decrease in iron reserves in the liver expressed in serum or ferritin plasma levels, the second phase of further decline in iron deposits before saturation loss is reduced. The third phase entails a lack of iron deposits to minimize circulation iron levels and the development of microcytic hypochromic anemia resulting in reduced hemoglobin concentrations in red blood cells (Joosten, 2018).

Other variable found associated with anemia is the allowance per day. This is likely because the amount of allowance will impact young women's ability to purchase other food to meet their nutritional needs. These facts following the previous finding stated that that socioeconomic status (SES) and anemia are certainly linked. The percentage of anemia among adolescent girls was higher in the lower socio-economic strata (Kim et al., 2014). Also, the results of multivariate analysis showed that the variable most influential on the incidence of anemia was the father's height where adolescents who had higher fathers had a 1.1 times risk of developing anemia compared to shorter fathers. This finding is a new fact found in this report, as it is rarely mentioned so far. A previous study showed the association between maternal height and child mortality, anthropometric failure, and anemia (Subramanian, Ackerson, Smith, & John, 2009). Maternal height can be a useful marker for characterizing intergenerational health linkages because adult height represents the health inventory of a mother accrued over her life course, particularly in her early childhood social and environmental exposures. These results require further and in-depth study to find out why a father's height can be related to anemia in his daughter.

In this study, there were several variables such as nutritional status, history of infectious disease, and protein consumption not related to anemia. This is not following previous research that mentioned the correlation of several of these variables with the incidence of anemia (Teji, Dessie, Assebe, & Abdo, 2016). Nutritional status in adolescent girls is often affected by eating behavior and body image and could be caused anemia. Malnutrition in adolescents results in limitations on food consumption by not paying attention to nutrition and health laws, so the quantity and quality of nutritional intake are not consistent with the prescribed Diet Adequacy Level. These limits on food consumption harm the nutritional status of adolescents (Regasa & Haidar, 2019). This research highlights the importance for adolescent girls of daily breakfast so that they can fulfill their nutritional needs and avoid anemia. Good eating habits can help to reduce the incidence of anemia and its negative adverse health effects.

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### Competing Interests Statement

The authors declare that there are no competing or potential conflicts of interest.

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**Appendix A**

Table A1. Univariate analysis results

Variabel	n	Mean	SD	Min -Maks
Allowance per day (IDR)	387	10954,78	8809,1	2000-100.000
Menstruation periode (day)	388	6,71	1,28	3-15
Father's height (cm)	381	164,9	6,81	143-182
Mother's height (cm)	381	153,85	6,34	133-190

Table A2. Bivariate analysis results

Variabel	Anemia				p-value
	Yes		No		
	n	%	n	%	
Father's education					
Didn't finish elementary school	2	18,2	9	81,8	0,523
Elementary school	43	23,1	143	76,9	
Junior High School	19	31,7	41	68,3	
Senior High School	28	30,8	63	69,2	
Higher education (university)	10	25,0	30	75,0	
Mother's occupation					
Unemployment	2	22,2	7	77,8	0,845
Student	49	24,5	151	75,5	
Civil servant	24	30,4	55	69,6	
Private Employee	21	28,4	53	71,6	
Entrepreneur	6	23,1	20	76,9	
others					
Parents income					
< District Minimum Wage (DMW)	64	25,6	186	74,4	0,752
≥ DMW (1.900.000 rupiah)	36	27,7	94	72,3	
Father's occupation					
Unemployment	4	44,4	5	55,6	0,806
Student	0	0,0	1	100,0	
Civil servant	5	26,3	14	73,7	
Private Employee	8	23,5	26	76,5	
Entrepreneur	24	27,3	64	72,7	
Others					
Others					
Mother's occupation					
Unemployment	58	26,6	160	73,4	0,833
Student	0	0,0	1	100,0	
Civil servant	3	27,3	8	72,7	
Private Employee	4	26,7	11	73,3	
Entrepreneur	5	17,2	24	81,8	
others	31	27,9	72,1	72,1	
others					

Number of a family member					
≤ 4 people	41	23,7	148	76,3	0,309
> 4 people	60	28,8	132	71,2	
Age differences with siblings					
≥ 3 years or the only child	18	20,0	72	80,0	0,143
< 3 years	83	28,5	208	71,5	
Water source					
Local water company	26	32,1	55	67,9	0,213
Well	68	26,1	193	73,9	
Others	8	17,8	37	82,2	
The existences of a latrine					
Yes	3	12,5	21	87,5	0,176
No	99	27,3	264	72,7	
Breakfast habits					
Never	11	40,7	16	59,3	0,11
Rarely	5	13,9	31	86,1	
Often	8	30,8	18	69,2	
Always	78	26,2	220	73,8	
Nutritional status					
Underweight	26	28,6	65	71,4	0,828
Normal	66	25,9	189	74,1	
Overweight	6	28,6	15	71,4	
Obese	4	19,0	17	81,0	
History of infectious disease					
Yes	25	26,9	68	73,1	0,989
No	77	26,1	218	73,9	
Consumption on animal protein					
Less than recommendation	102	26,4	284	73,6	1
Appropriate to recommendation	0	0,0	2	100,0	
Consumtion of plant protein					
Less than recommendation	102	26,4	285	73,6	1
Appropriate to recommendation	0	0,0	1	100,0	

Tabel A3. Bivariate analysis result

<b>Variables</b>	<b>Anemia</b>	<b>n</b>	<b>Mean</b>	<b>SD</b>	<b><i>p-value</i></b>
Allowance per day	No	285	11335,09	9636,53	0,040
	Yes	102	9892,16	4116,87	
Menstruation period	No	286	6,73	1,35	0,561
	Yes	102	6,65	1,08	
Father's height	No	279	164,39	6,73	0,016
	Yes	102	166,29	6,89	
Mother's height	No	280	153,95	6,20	0,584
	Yes	101	153,55	6,73	

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