

Correlation of Body Mass Index and Menstrual Length to Hemoglobin Levels in Adolescent Women

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ABSTRACT

Anemia is a condition in which the body experiences a lack of hemoglobin levels in the blood. In Indonesia, those who experience anemia the most are teenagers with a prevalence of 30-55%, meanwhile the proportion of anemia in women is higher than in men with a prevalence of 23.9%. Anemia in teenagers increases pregnant women's risk of chronic energy deficiency, stunting, low birth weight and other health problems. Body mass index (BMI) as an indicator of nutritional status and duration of menstruation is one of the factors causing anemia in adolescent girls, so this research aims to determine the relationship between BMI and duration of menstruation on hemoglobin levels in adolescent girls. Method: The research used a quasi-experimental design using the Nonequivalent Control Group Design model by selecting 60 young women who met the inclusion criteria as a sample. Results: Pearson correlation analysis shows that BMI is not correlated with hemoglobin levels with a p-value of 0.717, while the length of menstruation is correlated with hemoglobin levels in adolescent girls with the strength of the relationship being sufficient with an r-0.331 p-value of 0.010, which means that the longer the adolescent girls menstruate, the longer they menstruate. the lower the hemoglobin level.

Keywords: body mass index; menstrual length; anemia; hemoglobin levels

INTRODUCTION

Hemoglobin is a protein found in red blood cells (erythrocytes) which gives blood its red color and is also the main oxygen carrier in the body (Riswanto, 2013). In the human body, one of the important roles of hemoglobin in the blood is as a contributor to 95% - 97% of cytosolic protein in erythrocytes, and functions as a means of transportation that carries oxygen to peripheral tissues. Because its function is very important in life, hemoglobin abnormalities can cause pathological conditions so that hemoglobin concentration has become an important monitoring indicator of health status (De Benoist et al., 2008b; Su et al., 2023). Hemoglobin is a blood biochemical measurement that is usually carried out in determining conditions of iron deficiency or anemia (Iqbal & Desty, 2019). A condition where the number of red blood cells or hemoglobin concentration in the blood is lower than normal is known as anemia. The limit of anemia in women of childbearing age 15-49 years is Hemoglobin (Hb) levels below 12.0g/dl (Sadiman et al., n.d.). Anemia will cause a decrease in the capacity of the blood to carry oxygen to the body's tissues, which is characterized by symptoms such as fatigue, weakness, dizziness, and shortness of breath (WHO, 2015, 2017). Anemia has also been shown to affect cognitive development, shortened attention span, and irritability, fatigue, difficulty concentrating, lethargy, increased mortality, and susceptibility to infection. Even anemia that occurs in children aged 6-59 months can hinder the increase in vocabulary, reading and other tests (Agho KE et al., 2008). Anemia can be caused by several factors such as nutritional deficiencies through inadequate diet or inadequate nutrient absorption, causing nutritional problems. About a quarter of teenagers in developing countries are anemic. Estimated prevalence of adolescent anemia in the Southeast Asia region ranges from 27% to 55% (Chalise et al., 2018). Based on this, young women are considered an important window and door to break the cycle of intergenerational malnutrition due to anemia. Unfortunately, around 1.2 billion people in the world are young, 90% of whom live in low- and middle-income countries (Gardner & Kassebaum, n.d.). Micronutrient deficiencies which result in disorders such as anemia often attack teenagers in developing countries. Malnutrition is still a health problem in Indonesia. The prevalence of nutritional anemia in Indonesia is 21.7% with a proportion of 20.6% in urban areas and 22.8%

in rural areas and 18.4% for men and 23.9% for women. Based on the age group, anemia sufferers aged 5-14 years were 26.4% and 18.4% in the age group 15-24 years (RISKESDAS, 2013). Nutrition is everything that is consumed and contains nutritional elements that are used to maintain life, optimize the growth and development of the body's organs. If we group the benefits of nutrients for women throughout their life cycle, namely as energy providers, growth supporters, body tissue maintenance and body process regulators, so that during adolescence, good and optimal nutritional intake is really needed (Siregar, 2018).

Anemia is a serious health problem throughout the world, especially affecting children, adolescent girls, menstruating women, and even pregnant and postpartum women. WHO estimates that 40% of children aged 6 to 59 months, 37% of pregnant women, and 30% of women aged 15 to 49 years suffer from anemia worldwide (WHO, 2017). Developing countries like India have a high prevalence of anemia in adolescent girls, namely 78.75% (Zodpey & Farooqui, 2018). Meanwhile, the prevalence of anemia in women in Indonesia reaches 23.9% compared to men (RISKESDAS, 2013). Women tend to have lower iron stores than men (Cogels, n.d.), menstrual disorders have an impact on the emergence of iron deficiency anemia. It's worse because anemia can cause nutritional problems or vice versa. Anemia is associated with poor reproductive function, high maternal mortality rates (10-20% of total deaths), high incidence of low-birth-weight babies (<2500g at birth), and malnutrition (WHO, 2013). If this continues in the long term, the physical and cognitive development of adolescents (De Benoist et al., 2008b), one of which will be weight loss and stunted growth in height (WHO, 2013, 2017).

Anemia results in poor reproductive function, high maternal mortality (10-20% of all deaths), low birth weight (<2500 g at birth), and malnutrition (WHO, 2013). If this continues in the long term, it will affect the physical and cognitive development of adolescents (De Benoist et al., 2008b), one of which is weight loss and stunted height growth (Silalahio et al., 2016). Indonesian young women are susceptible to iron deficiency anemia because menstruation occurs every month, causing the body's iron reserves to run low. This situation will be exacerbated by inadequate consumption patterns, poor housing hygiene, weak knowledge, and handling of menstruation (Sari & Novriyanti, 2023). Research was conducted on young women because women usually have smaller iron reserves than men (Cogels, n.d.), menstrual disorders experienced by young women can cause iron deficiency anemia.

Anemia in young women is caused by menstruation when they are teenagers. Menstruation is a physiological condition, the event of periodic expulsion of blood, mucus and cell debris originating from the uterine mucosa and occurs relatively regularly from menarche to menopause, except during pregnancy and lactation. Menstrual cycles are often irregular until adolescence, especially the interval from the first to the second cycle. Such disorganization can be caused by disturbances of central gonadotropin-releasing hormone as well as by significant weight loss, strenuous exercise, profound changes in sleeping or eating habits, and severe stressors (Warner et al., 2004). In general, menstruation will occur every 28 days and for 7 days. The bleeding time is around 3 – 5 days with a total amount of blood lost around 30 – 40cc (Manuaba, 2006). The average blood loss per menstrual period is 30 mL per cycle and chronic loss of more than 80 mL is associated with anemia. However, recent studies in adult women confirm that the perception of heavy menstrual flow correlates with a higher blood loss volume (De Benoist et al., 2008a).

Anemia is a global health problem because it has various negative impacts on countries' health and socio-economic development (Stevens et al., 2013). Therefore, this study aims to find a correlation between body mass index (as a determining indicator of nutritional status) and menstrual duration on hemoglobin levels in adolescent girls.

METHOD

A self-conducted cross-sectional survey was conducted on young women aged 16-18 years as many as 60 students were recruited using simple systematic random sampling at State Senior High School 04 Muaro Jambi. Inclusion criteria in this study were menstruating, not menstruating, no history of malaria and worms, willing to be a respondent. Informed consent was obtained from all individuals involved in this study. Incomplete questionnaires were issued. Ethical approval was obtained from the research ethics committee of the Jambi Ministry of Health Poltekkes (No.LB.026/2/575/2023).

BMI determination: Anthropometric measurements (height and weight) are carried out according to World Health Organization (WHO) standards. Body height was measured using a stadiometer and recorded to the nearest 0.1 cm. During measurements, the protruding body parts of girls (occipital, shoulders, buttocks, and heels) touch the stadiometer; shoes off and they stand in Frankfurt position. Weight was measured with a digital weight scale and recorded to the nearest 0.1 kg. Heavy clothing and shoes (if any) should be removed.

Menstruation length: data regarding the duration of menstruation were collected by interview and recorded in the observation sheet. **Hemoglobin Levels:** Determination of hemoglobin levels is carried out by taking peripheral capillary blood samples from the fingertips using aseptic techniques first to prevent infection. Blood was taken as much as ~10

microliters using a disposable blood lancet under sterile conditions. Determination of Hb levels using a portable photometer operated using a battery (Mission Hb Check).

Data Analysis Univariate Analysis is data analysis carried out to determine the frequency distribution of each variable from the independent variables (length of menstruation and body mass index) and the dependent variable (anemia in young women).

Bivariate analysis aims to see the relationship between two variables, namely: the dependent variable, namely the incidence of anemia in young women with the independent variables menstrual length and body mass index with an analysis test using a correlation test because the data is normally distributed. The significance test is carried out by comparing the significance value obtained with α , if $p < \alpha$ there is a significant relationship.

RESULT

Frequency Distribution of BMI for Adolescent Girls

This research was conducted on class XII young girls at State Senior High School 04 Muaro Jambi with a total of 60 young girls. This research was conducted on adolescent girls because women usually have smaller iron reserves than men. Menstrual disorders experienced by young women can cause iron deficiency anemia. Based on the classification of the Ministry of Health of the Republic of Indonesia (Ministry of Health of the Republic of Indonesia, 2020) 43.3% of the research subjects were in the normal BMI category, 23.3% of the research subjects were in the overweight BMI category and as many as 33.3% were in the underweight BMI category. Although most of the subjects have normal BMI, BMI will likely increase with age. Data on the frequency distribution of BMI for young girls at State Senior High School 04 Muaro Jambi can be seen in Table 1.

Table 1. Frequency Distribution of BMI for Adolescent Girls (n=60)

BMI Category	BMI	f (%)
Underweight range	<18.5	20 (33.3)
Normal	18.5-25	26 (43.4)
Overweight range	>25	14 (23.3)
Total		60 (100)

Frequency Distribution of Menstrual Length

Length of Menstruation From the results of interviews with 60 research respondents, it was found that 6.6% of female adolescents had menstrual periods <3 days, 71.7% of female adolescents had 3-8 days of menstruation and 21.7% of female adolescents had >8 days of menstruation. Data on the distribution of menstrual frequency for young women at State Senior High School 04 Muaro Jambi can be seen in Table 2.

Table 2. Frequency Distribution of Menstrual Length for Adolescent Girls (n=60)

Category	Menstrual Length (days)	f (%)
Short	0-3	4 (6.6)
Normal	3-8	43 (71.7)
Long	>8	13 (21.7)
Total		60 (100)

Correlation between Body Mass Index (BMI) and the incidence of anemia in adolescent girls

Based on Table 3., the statistical test results using Pearson's correlation showed that the H_0 results were greater. This figure shows that statistically, there is no significant relationship ($p > 0.05$) between nutritional status and the incidence of anemia. The p-value based on the results above is 0.717, meaning there is no correlation between body mass index and hemoglobin levels.

Table 3. Relationship between Body Mass Index (BMI) and the Incidence of Anemia in Adolescent Girls

BMI Category	The Incidence of Anemia		Total	p	r
	Normal	Anemia			
Underweight	5	15	20	0.717	-0,048
Normal	5	21	26		
Overweight	2	12	14		
Total	60 (100)				

Correlation between Body Mass Index (BMI) and the incidence of anemia in adolescent girls

Table 4. Relationship between the Duration of Menstruation and the Incidence of Anemia in Adolescents Girls

Menstrual Length	The Incidence of Anemia		Total	p	r
	Normal	Anemia			
Short	3	0	3	0.010	-0,331
Normal	9	34	43		
Long	0	14	14		
Total	60 (100)				

Table 4 shows a relationship between the length of menstruation and the incidence of anemia in female adolescents. Judging from the results, the p-value is 0.010, which means that the length of menstruation and anemia are correlated. The results of statistical tests using correlation obtained a p-value of 0.010 (p-value < 0.05), so Ho was rejected, there is a relationship between the length of menstruation and the incidence of anemia in adolescent girls and has a correlation coefficient value of -0.331, which means that the longer menstruation in adolescent girls will be.

DISCUSSION

Body mass Index (BMI) in young women must be attention. This is something that should be a concern, considering that young women are at risk of having a low BMI related to physical activity and daily eating patterns. Research subjects who fall into the category of Overweight and Underweight BMI need special attention, where excess and underweight can lead to other diseases, especially in female adolescents. Adolescent girls as prospective mothers who will give birth to the next generation. Women must be in optimal health before and during pregnancy and after childbirth, because the mother's health also affects the health of the baby during pregnancy and after birth. Adolescent girls as prospective mothers and mothers who have been malnourished since their teens are more likely to have low birth weight babies, have higher mortality rates, stunted growth, impaired intellectual development and chronic diseases in their children. Based on the results of an assessments and interviews with research respondents at State Senior High School 04 Muaro Jambi who had a normal BMI, the research respondents participated in sports activities at school such as basketball and martial arts. Everyday research respondents exercise for approximately 60 minutes both at home and at school. This is relevant to the theory which says that weight loss or prevention of weight gain can be done by physical activity for about 60 minutes a day (Arisman, 2014).

This is because in adolescents with a low body weight (underweight) it affects the body's fat cells to produce the hormone estrogen. An imbalance in the hormone estrogen causes menstruation to be abnormal. Adolescent girls are a transition from adolescents to adults, marked by physical and mental changes (Djaeni, 2014). Physical changes are marked by the functioning of the reproductive organs such as menstruation (age 10-19 years) (Ministry of Health of the Republic of Indonesia, 2008) Menstruation is a biological process associated with achieving sexual maturity, fertility, normality, body health, and even the renewal of the body itself. From the research results, there were 43 respondents who had normal menstruation. This was because malnutrition in teenage girls could affect sexual education, growth, organ function, and would disrupt reproductive function. This will have an impact on health problems but will improve if the nutritional intake is good. Inadequate nutritional intake can affect menstrual irregularities in most young women (Adnyani, 2021).

Based on table III, the results of statistical tests using Pearson's correlation showed that the Ho results were greater. This figure shows that statistically there is no significant relationship (p > 0.05) between nutritional status and the incidence of anemia. The p value based on the results above is 0.717, which means there is no correlation between body mass index and HB levels.

The results of this research are in line with research in 2016 (Wahyu & Permatasari, 2016), In this study, it was found that the majority of respondents had normal nutritional status but many experienced anemias. This may be because young women do not consume enough animal protein and iron. Previous research (Fiti Indriati, 2021; Wahyu & Permatasari, 2016) states that the level of protein and iron consumption is related to anemia status in young women, and if the amount of protein in the body is deficient, the ability to transport iron into red blood cells is reduced, resulting in impaired absorption and transport of iron will cause anemia. Meanwhile, iron influences the formation of blood hemoglobin.

The results of this study did not significantly influence BMI due to various other factors that influenced one of them: the health status of adolescents, menstrual cycles and duration, rest patterns and unbalanced food consumption, and the environment. The diet of young women from happy families tends to be better than those from disharmonious families. Checking hemoglobin levels affects eating patterns that are sometimes irregular throughout the day and implementing a diet program. Anemia often occurs in teenagers, and teenagers tend to maintain their appearance by avoiding excessive weight gain. Body conditions that do not meet expectations make teenagers go on a diet. As a result, nutritional intake is not met, and anemia is easy. Apart from that, young women who have entered puberty will experience menstruation every month, which makes them susceptible to anemia. This study showed no relationship between BMI and the incidence of anemia, based on the research conducted on adolescents whose physical activity was very high, and the needs and activities of each adolescent were different. The diet and nutrition patterns are prepared to meet the different nutritional needs of each family. This makes a difference between young women in receiving nutritional intake which affects the weight and height of each teenager, so to determine the incidence of anemia from BMI it does not have a significant effect.

Lower hemoglobin levels or increase the incidence of anemia. This is in line with research conducted by Amelia & Sari, YM (Mustika Sari & Amelia Univeritas Adiwangsa Jambi Jambi, 2023) where the p value was 0.023, which means that the length of menstruation and anemia are related. Anemia in young women is caused by blood loss with menstruation, it can be affected by the cycle, length, and number of menstruations. The menstrual cycle is the distance between the start of the previous menstruation and the next menstruation. This is in accordance with the theory put forward by Arisman (Arisman, 2014), which states that young women who have menstruated are at risk of developing iron deficiency anemia because the amount of blood lost during one menstrual period is around 20-25 cc. This amount implies iron loss of 12.5-15 mg/month, or roughly the same as 0.4-0.5 mg/day. If this amount is added to the basal loss, the total iron lost is 1.25 mg/day.

CONCLUSION

There are many factors that can cause a young woman to experience anemia, such as the length of menstruation, physical activity, and history of food consumption. Although this research does not discuss physical activity and food consumption patterns in detail, findings in the field also reveal the habit of some female students sleeping late at night and also strictly controlling the amount of food that enters the body in order to get a slim body.

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