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Research Article

Relationship Between Menstruation and Nutritional Status to Anemia in Female High School Students in Mentawai Islands, 2018

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ABSTRACT

Anemia is a significant health concern, especially among adolescent females in Indonesia. Menstruation and poor nutrition are major contributors to anemia, since menstruation leads to red blood cell loss and poor nutrition hinders production. This study examines the relationship between menstrual characteristics, nutritional status, and anemia among high school female students in Muara Siberut Village, Mentawai Islands. This cross-sectional observational study involved 97 female high school students. We assessed nutritional status using BMI percentiles and categorized menstrual characteristics according to standard gynecological classifications. Anemia was diagnosed via hemoglobin measurements using a digital hemoglobinometer. Statistical analyses ($p<0.05$) with odds ratio (OR) and 95% confidence interval (CI) utilized Chi-square or Fisher's exact tests to explore associations between menstrual characteristics, nutritional status, and anemia. No significant correlation was observed between nutritional status and anemia ($p=0.394$). Conversely, a significant correlation was found between the menstrual cycle and anemia ($p=0.023$) as well as between menstrual length and anemia ($p=0.017$). Furthermore, a subgroup analysis revealed individuals with a normal menstrual cycle were at a higher risk of experiencing anemia compared to those with oligomenorrhea (OR=4, 95%CI=0.988–16.199). Additionally, the results indicated that individuals with normal menstrual length were at a higher risk of experiencing anemia compared to those with hypomenorrhea (OR=4.624, 95%CI=1.174–18.202). This study provides valuable insights into the predictors of anemia among female adolescents, emphasizing the need for targeted health education and interventions.

INTRODUCTION

Anemia is a global health problem, affecting 29.9% of women aged 15 – 49 years, according to the World Health Organization (WHO). The highest prevalence of anemia is in children aged 6 – 59 months, with a rate of 39.8%, followed by pregnant women with a rate of 36.5% (WHO, 2021). In Indonesia, the prevalence of anemia in children aged 5 – 14 years is 26.8%, increasing to 32% in adolescents aged 15 - 24 years (RI, 2018). The prevalence of anemia in West Sumatra Province is higher than the national average of 14.8%, as stated in the Minister of Health's decree, with a rate of 29.8% in women. West Sumatra is the fourth-highest province regarding anemia, following Maluku, Southeast Sulawesi, and Gorontalo (Mayasari *et al*., 2022). Symptoms of anemia include fatigue, weakness, and decreased performance. Various behavioral and cognitive difficulties can occur in children of school age, which could result in poor academic performance (Partearroyo *et al*., 2022).

In addition, anemia is associated with increased illness and death in women and children, negative birth outcomes, decreased productivity, and impaired cognitive and behavioral development in children (Chaparro and Suchdev, 2019).

Menstruation plays a significant role in the development of anemia among female adolescents. A typical menstrual cycle lasts between 3 and 7 days, occurring every 21 to 35 days. However, around 14 – 25% of females experience irregular menstrual cycles, where cycles >35 days (oligomenorrhea) or <21 days (polymenorrhea) (Attia *et al*., 2023). Menstrual lengths of <3 days (hypomenorrhea) and >7 days (hypermenorrhea) are considered as abnormal menstrual length. Abnormal menstrual cycle and abnormal menstrual length are categorized as abnormal uterine bleeding (AUB). Due to the significant loss of red blood cells during menstruation, AUB can lead to iron deficiency anemia. Nutritional status is another factor influencing anemia incidence among female adolescents. Micronutrient deficiencies known to cause or contribute to anemia include vitamins A, B2, B6, B9, B12, C, D, and E, and zinc, each acting through different mechanisms. Malnutrition, which contributes to the incidence of anemia, affects 85.5% of the female adolescent population in Indonesia (Sari *et al*., 2022).

In Indonesia, anemia is not widely known, and it is detected only on a sporadic basis. Although female adolescents receive nutrition education at school, they generally lack knowledge about anemia and its potential consequences during pregnancy unless they have been diagnosed with it. Among the various factors influencing the incidence of anemia, female adolescents are at the highest risk of developing this condition, as their iron requirements increase due to rapid growth and the onset of menstruation (Gillespie *et al*., 2023). This heightened risk is further exacerbated by the unhealthy eating habits commonly observed among female adolescents, who often have a focus on ideal body shape, behaviors such as consuming tea after eating, improper eating patterns, and consuming less iron from animal sources, leading to malnutrition and an increased risk of anemia (Puspitasari *et al*., 2022). Considering these factors, researchers have conducted a study on cases of anemia in female adolescents in Muara Siberut Village, Mentawai Islands. This study aims to identify the relationship between menstruation and nutritional status towards anemia, raise awareness about early treatment, and prevent the incidence of anemia amongst female high school students.

METHODS

Study design and respondents

This observational analytic study was conducted with a cross-sectional design to identify the relationship between menstruation and nutritional status to anemia. The study was conducted in December 2018 and enrolled female high school students from three high schools in Muara Siberut Village, Mentawai Islands. The study was approved by the Medical and Health Research Ethics Committee of the Faculty of Medicine and Health Science at Atma Jaya Catholic University of Indonesia (NO: 09/08/KEP-FKUAJ/2018).

The respondents were selected using the proportional stratified random sampling method, with strata based on education level. We included the respondents who had experienced menstruation and provided informed consent by signing the research permission forms. Those suffering from helminth infection, as indicated by symptoms such as severe itching in the anal area at night, decreased appetite, and weight loss, were excluded from the study.

Outcome variables

The nutritional status of the respondents was evaluated using the body mass index (BMI) percentile calculator from the Centers for Disease Control and Prevention (CDC). We measured weight using a scale and height using a stature meter. We then entered body weight (kg), height (cm), and sex into the calculator to determine the BMI percentile. The result of the BMI percentile is determined and classified based on the CDC's classification, which includes thin (BMI <5th percentile), normal (BMI ≥5th – <85th percentile), overweight (BMI ≥85th – <95th percentile), and obesity (BMI ≥95th percentile) (CDC, 2023). Respondents were asked to provide information about their menstrual cycles based on criteria from Williams Gynecology. Menstrual cycles are categorized as polymenorrhea (<21 days), normal (21 – 35 days), and oligomenorrhea (>35 days) (Hoffman, 2016). In collecting menstrual length data, respondents were queried according to criteria outlined in Ilmu Kebidanan, which categorized it as hypomenorrhea (<3 days), normal (3 – 7 days), and hypermenorrhea (>7 days) (Prawirohardjo, 2011). Anemia is measured using a digital hemoglobinometer (Easy Touch), which involves obtaining a blood sample from the fingertip and testing it using a specialized

strip to determine hemoglobin (Hb) levels in the blood. The WHO classifies anemia based on the following degrees: non-anemia (≥12 g/dL), mild anemia (11 – 11.9 g/dL), moderate anemia (8 – 10.9 g/dL), and severe anemia (<8 g/dL) (WHO, 2011).

Statistical analysis

Microsoft Excel (Microsoft Corp., Redmond, Wash., USA) was used to collect the data and tabulate respondent characteristics, which were expressed as frequencies and percentages. The nutritional status data were divided into two groups: normal and abnormal (thin, overweight, and obese). Menstrual cycle data were categorized into two groups: normal and abnormal (polymenorrhea and oligomenorrhea). Furthermore, menstrual length data were classified into two groups: normal and abnormal (hypomenorrhea and hypermenorrhea). Additionally, the anemia group was divided into two groups: non-anemia and anemia (mild, moderate, and severe).

The correlation test employed a bivariate method, specifically the Chi-Square or Fisher's Exact test. The results of the correlation test revealed a statistically significant difference if the P-value was less than 0.05. Furthermore, an Odds Ratio (OR) test with 95% Confidence Interval (CI) was conducted to evaluate the strength of association between risk factors and outcomes in the study.

RESULTS AND DISCUSSION

A total of 97 female high school students from Muara Siberut Village, Mentawai Islands, participated in this study (Table 1). Out of these, 13 respondents (13.4%) were aged between 11 and 15 years, while 84 respondents (86.6%) were aged between 16 and 20 years. Most respondents were first-grade high school students, consisting of 42 respondents (43.3%). We have tried to do proportional stratified random sampling. However, the distribution of respondents based on their education level was uneven because many students had completed their semester exams and returned home, making them unavailable for the study. Therefore, other high school students randomly selected and present at the school where the study was conducted replaced them as respondents. There were 84 of them (86.6%) with normal nutritional status. This could be attributed to their good condition, which is a result of the beneficial nutrients provided by their inhabited area. Muara Siberut Village, located in the Mentawai Islands, relies mainly on marine and forest resources such as fish, shellfish, coconut, cacao, sago, and banana. Sago is the main staple food in Muara Siberut Village due to its high nutritional value and fiber content. Fish or shellfish caught using nets serve as a source of animal protein, ensuring that the nutritional needs are met (Delfi, 2018). Meanwhile, 61 respondents (62.9%) had abnormal menstrual cycles. Menstrual irregularities are common and can occur under the age of 23, especially during adolescence when females first start menstruating. The most common reason for AUB during the first 19 months of menstruation is the anovulatory cycle, which happens due to the immaturity of the hypothalamic-pituitary-ovarian (HPO) axis (Mittiku *et al*., 2022).

Table 2 presents the correlation between menstrual cycle, menstrual length, and nutritional status with anemia state. The results of the correlation test between nutritional status and anemia showed no correlation between the two variables (p-value 0.394). The results of this study are in line with the research conducted by Gasong *et al*., which was conducted on adolescent females in Kupang and found no correlation between nutritional status and anemia (p-value 0.916) (Gasong *et al*., 2019). The body's nutritional status, as indicated by BMI, is primarily influenced by the consumption of macronutrients, which include carbohydrates, fats, and proteins, serving as the primary sources of energy. If energy intake falls below the required level for an extended period, it can lead to a decrease in nutritional status. However, the intake of micronutrients, such as vitamins and minerals, which play a role in the formation of Hb levels, does not directly correlate with nutritional status based on BMI because they provide minimal energy. It is possible for people with good nutritional status to develop anemia due to an imbalanced diet (Sari *et al*., 2023). Female adolescents are in a critical period of nutritional vulnerability due to the increased nutritional demands for growth and development, particularly for iron demand due to the onset of menstruation and changes in dietary habits influenced by the family and peers. Female adolescents with anemia can have a negative impact on their individual development and may also influence the next generation (Li *et al*., 2022). The eating habits of female adolescents can influence the absorption of iron. Several compounds that reduce iron absorption in the body, such as phytate, oxalate, polyphenols, and tannins, can be found in tea and coffee. On the other hand, ascorbic acid, citrate,

and gastric acid can enhance iron absorption (Kumar *et al*., 2022).

The correlation test between menstrual cycle and anemia revealed a significant correlation between the two variables (p-value 0.023). Furthermore, an OR value of 3.733 (95% CI = 1.141 – 12.220) was obtained, suggesting that the risk of an individual experiencing anemia is three times higher in individuals with a normal menstrual cycle. The findings of this study do not

Table 1. Characteristics of Respondents

Characteristics of Respondents	Frequency
Age	
11 – 15 years old	13 (13.4%)
16 – 20 years old	84 (86.6%)
Education Level	
First Grade of High School	42 (43.3%)
Second Grade of High School	15 (15.5%)
Third Grade of High School	40 (41.2%)
Nutritional Status	
Thin (BMI <5th Percentile)	1 (1%)
Normal (BMI ≥5th – <85th Percentile)	84 (86.6%)
Overweight (BMI ≥85th – <95th Percentile)	11 (11.3%)
Obesity (BMI ≥95th Percentile)	1 (1%)
Menstrual Cycle	
Oligomenorrhea (>35 Days)	39 (40.2%)
Normal (21 – 35 Days)	36 (37.1%)
Polymenorrhea (<21 Days)	22 (22.7%)
Menstrual Length	
Hypomenorrhea (<3 Days)	46 (47.4%)
Normal (3 – 7 Days)	41 (42.3%)
Hypermenorrhea (>7 Days)	10 (10.3%)
Anemia State	
Non – Anemia (≥12 gr/dL)	83 (85.6%)
Mild (11 – 11.9 gr/dL)	8 (8.2%)
Moderate (8 – 10.9 gr/dL)	6 (6.2%)

Table 2. Correlation between Menstrual Cycle, Menstrual Length, and Nutritional Status to Anemia State

	Anemia	Non – Anemia	*P*-value	OR (95% CI)
Nutritional Status				
Normal	11 (11.3%)	73 (75.3%)	0.394	-
Abnormal	3 (3.1%)	10 (10.3%)		
Menstrual Cycle				
Normal	9 (9.3%)	27 (27.8%)	0.023*	3.733 (1.141 – 12.220)
Abnormal	5 (5.2%)	56 (57.7%)		
Menstrual Length				
Normal	10 (10.3%)	31 (32%)	0.017*	4.194 (1.211 – 14.519)
Abnormal	4 (4.1%)	52 (53.6%)		

*p-value <0.05.

Table 3. Correlation between Menstrual Cycle and Menstrual Length to Anemia State

	Anemia	Non – Anemia	*P*-value	OR (95% CI)
Menstrual Cycle				
Normal	9 (15.5%)	27 (46.6%)	0.178	-
Polymenorrhea	2 (3.4%)	20 (34.5%)		
Menstrual Cycle				
Normal	9 (12%)	27 (36%)	0.041*	4 (0.988 – 16.199)
Oligomenorrhea	3 (4%)	36 (48%)		
Menstrual Length				
Normal	10 (19.6%)	31 (60.8%)	0.428	-
Hypermenorrhea	1 (2%)	9 (17.6%)		
Menstrual Length				
Normal	10 (11.5%)	31 (35.6%)	0.020*	4.624 (1.174 – 18.202)
Hypomenorrhea	3 (3.5%)	43 (49.4%)		

*p-value <0.05.

align with the research conducted by Pibriyanti *et al*., which was carried out on adolescent females at an Islamic Boarding School and found a correlation between abnormal menstrual cycles and anemia (p-value 0.024) with an OR value of 5.45, indicating that the risk of an individual experiencing anemia is five times higher in individuals with an abnormal menstrual cycle (Pibriyanti *et al*., 2021). Therefore, a subgroup analysis was conducted between the menstrual cycle (polymenorrhea, oligomenorrhea, and normal) with anemia state (Table 3). The correlation test indicated that there was no significant correlation between normal menstrual length and polymenorrhea with anemia (p-value 0.178). The correlation test between normal menstrual cycle and oligomenorrhea with anemia found that there was a significant correlation between the two variables (p-value 0.041) with an OR value of 4 (95% CI = 0.988 – 16.199), indicating that the risk of an individual experiencing anemia is four times higher in individuals with a normal menstrual cycle than oligomenorrhea. Every female experiences menstruation, which is bleeding that occurs in the uterus periodically. Menstruation is caused by the desquamation of the endometrium due to ovarian hormones, specifically estrogen and progesterone. The normal menstrual cycle typically lasts between 21 to 35 days (Pibriyanti *et al*., 2021). During menstruation, a bleeding process takes place, which can lead to a decrease in iron levels and ferritin in the body, ultimately causing Hb levels to drop below the normal limit (Sigit *et al*., 2024). Individuals with oligomenorrhea will experience less frequent bleeding compared to those with a normal menstrual cycle, which means the risk of anemia in individuals with oligomenorrhea will be lower.

The correlation test between menstrual length and anemia (Table 2) revealed a significant correlation (p-value 0.017). The OR test result was 4.194 (95% CI = 1.211 – 14.519), indicating that the risk of an individual experiencing anemia is four times higher in individuals with normal menstrual length. The findings of this study do not align with the research conducted by Pibriyanti *et al*., which was carried out on adolescent females at an Islamic Boarding School and found a correlation between abnormal menstrual length and anemia (p-value 0.026) with an OR value of 8.2, indicating that the risk of an individual experiencing anemia is eight times higher in individuals with an abnormal menstrual length (Pibriyanti *et al*., 2021). This research is also not in line with research by Andyarini *et al*., which was conducted on adolescent females at an Islamic University and found correlation between abnormal menstrual length with anemia (Andyarini and Hidayati, 2018). A subgroup analysis was conducted in Table 3, examining the relationship between menstrual length (hypermenorrhea, hypomenorrhea, and normal) with anemia state. The correlation test indicated that there was no correlation between normal menstrual length and hypermenorrhea

with anemia (p-value 0.428). However, the correlation test between normal menstrual length and hypomenorrhea with anemia showed a significant correlation (p-value 0.020) with an OR value of 4.624 (95% CI = 1.174 – 18.202), suggesting that the risk of an individual experiencing anemia is four times higher in individuals with normal menstrual length than hypomenorrhea. Menstrual length is influenced by various factors, such as psychological factors, environment, age, and hormonal (Thiyagarajan *et al*., 2022). The typical duration of menstrual length is 3 – 7 days in a normal woman (Prawirohardjo, 2011). If menstrual length becomes longer, more blood loss will occur, increasing the likelihood of anemia. During menstruation, individuals experience a blood loss of approximately 30 mL, which is equivalent to the need for an additional 0.5 mg of iron per day. If female adolescents are unable to maintain a positive iron balance, have insufficient iron supply, and have low iron absorption in the body, the body's mechanism cannot replace the iron lost during menstruation, increasing their susceptibility to anemia (Pibriyanti *et al*., 2021).

The results showed that individuals experiencing anemia were at higher risk during a normal menstrual cycle. This is because the proportion of respondents who experienced polymenorrhea was relatively small compared to those who experienced normal and oligomenorrhea menstrual cycles. Similarly, a normal menstrual length was also riskier for individuals with anemia, as the number of respondents who experienced hypermenorrhea was also small compared to those with normal and hypomenorrhea cycles. However, after further analysis, it was discovered that the risk of oligomenorrhea and hypomenorrhea to cause anemia was also smaller compared to the normal group. This discrepancy is likely due to the combination of the classification of abnormal menstrual cycle (polymenorrhea and oligomenorrhea) and abnormal menstrual length (hypermenorrhea and hypomenorrhea), which may have initially led to correlation test results that appeared to contradict the theory. AUB refers to irregular menstrual cycles and abnormal menstrual duration. PALM-COEIN is a classification system developed by The International Federation of Gynecology and Obstetrics (FIGO) for non-pregnancy-related AUB. It includes various causes such as polyps, adenomyosis, leiomyoma, malignancy and hyperplasia, coagulopathy, ovulatory dysfunction, endometrial disorders, iatrogenic causes, and unclassified causes. It is essential to determine whether the AUB in individuals is acute or non-acute bleeding. Managing individuals with AUB involves assessing hemodynamics and anemia, pinpointing the source of bleeding, and ruling out pregnancy (Barros *et al*., 2022). This early identification and treatment are crucial, starting from adolescence, since anemia incidence in women can impact pregnancy outcomes. Failure to promptly identify and treat AUB can lead to complications such as premature birth, low birth weight, postpartum hemorrhage, and irreversible neurodevelopmental delays in newborns (Munro, 2023). It is important to note that this study has several limitations. First, it employed a cross-sectional study design, which only measures variables at a single point in time without follow-up on the observation results. Second, a laboratory examination of feces for the diagnosis of helminth infection was not conducted due to limited equipment. Third, the volume of bleeding during menstruation was not examined, which can increase the risk of anemia.

CONCLUSIONS

The study indicates that most respondents maintain normal nutritional status and are non-anemic. However, analysis of menstrual cycle patterns reveals a higher prevalence of abnormal cycles, particularly oligomenorrhea. A relationship exists between menstrual cycle characteristics and menstrual lengths and anemia. Specifically, normal menstrual cycles and normal menstrual lengths may pose a greater risk of anemia than oligomenorrhea and hypomenorrhea (p-value <0.05). Future research should focus on detailed quantification of menstrual blood loss and the influence of micronutrient intake to further elucidate the interplay between diet, menstrual health, and anemia.

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