

Factors related to the incidence of anemia in adolescent girls at Senior High School X Kendari in 2025

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Abstract

Anemia is one of the most common health problems among adolescent girls and can affect their growth, development, and learning performance. This study aimed to determine the factors associated with the incidence of anemia among adolescent girls at Senior High School X Kendari in 2025. This research applied an observational analytic method with a cross-sectional design. Data were collected through structured questionnaires and measurements of hemoglobin (Hb) levels using a digital haemometer, as well as weight and height measurements using scales and a microtoise. The study population consisted of all grade X female students (262 individuals), with a sample of 159 respondents selected using the proportionate stratified random sampling technique. Data were analyzed bivariately using the Chi-Square test. The results showed that out of 159 respondents, 52 (32.7%) respondents experienced anemia, while 107 (67.3%) respondents did not. Statistical analysis revealed significant associations between physical activity ($p=0.015$), dietary patterns ($p=0.000$), and sleep quality ($p=0.003$) with the incidence of anemia, while disease history ($p=1.000$) was not significantly related. Thus, it can be concluded that physical activity, dietary patterns, and sleep quality are associated with anemia among female adolescents, while disease history is not. Schools are expected to enhance nutrition education, promote healthy eating habits, and improve students' awareness of adequate rest while strengthening the iron tablet supplementation program in collaboration with local health centers.

Keywords: Anemia; Physical Activity; Dietary Patterns; Medical History; Sleep Quality; Adolescent Girls

1. Introduction

Adolescence is a crucial transitional period, during which physical growth, cognitive development, and emotional changes occur that drive the physiological changes necessary to transform individuals into adults. Adolescent health is one of the important aspects in building quality human resources. In adolescence, individuals experience a variety of physical, emotional, and social changes that affect their overall health that not only impact their growth and development, but also contribute to the future health of the community. As the next generation, this group is the main asset or capital of Human Resources (HR) for the development of the nation in the future (1).

It is estimated that a quarter of people in the world suffer from anemia and cases are increasing in women, pregnant women, young women, and children under five years of age. 1.92 billion people worldwide suffered from anemia in 2021. Over the past thirty years, this number has increased to 420 million cases (2). Data from WHO in 2023 states that Anemia is estimated to affect 500 million women aged 15-49 years worldwide with a prevalence of 30.7% identified with anemia with the most affected areas being the WHO region in Africa and Southeast Asia, it is estimated that around 106 million women are affected by anemia in Africa and 244 million in Southeast Asia (WHO, 2023). The results of the

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2022 Ministry of Health survey show that as many as 26.8% of children aged 5 to 14 years and 32% of adolescents aged 15 to 24 years have anemia (3).

In Indonesia, based on data from the Indonesian Health Survey (SKI) in 2023, the prevalence rate of anemia in adolescent girls aged 15-24 years reached 15.5%. This is due to increased nutritional needs during adolescent growth, iron loss due to menstruation, an unbalanced diet and lack of consumption of iron-rich food sources such as meat, fish, and eggs (4).

Based on data obtained from the Southeast Sulawesi Provincial Health Office, the prevalence of anemia in adolescent girls in Southeast Sulawesi was recorded at 23.6% in 2023 and decreased to 20.2% in 2024. Meanwhile, in Kendari City itself, the prevalence of anemia in adolescent girls was recorded at 14.3% in 2023 and increased to 20.2% in 2024 (5). The highest cases occurred in the working area of the Lepo-Lepo Health Center, where 20% of adolescent girls were identified as suffering from anemia (6). Based on data obtained from the Lepo-Lepo Health Center, there are six schools in this area, with the highest prevalence of anemia occurring at Senior High School X Kendari, which is 49% (7).

The causes of anemia in adolescent girls are often related to iron deficiency which can be caused by nutritional deficiencies, inadequate diet (or inadequate absorption of nutrients), menstrual blood loss, unhealthy lifestyle, infections, inflammation, chronic diseases, gynecological and obstetric conditions, inherited red blood cell abnormalities, as well as lack of knowledge about good nutrition (WHO, 2025). The main cause of anemia in 2021 was dietary iron deficiency, which accounted for 66.2% of total anemia cases. Inadequate iron intake may be the single most common cause of anemia, but many other conditions are the main drivers of anemia (2).

This research will be conducted at Senior High School X Kendari which is one of the leading high schools located in Baruga sub-district in the working area of the Lepo-lepo health center, Kendari city, Southeast Sulawesi province. The number of students in this school is quite large from within and outside the region. In the high school environment, there are full day learning hours, so students spend a lot of time at school. In addition, students also participate in various extracurricular activities at the school.

Based on a preliminary survey that has been conducted on 10 students of Senior High School X Kendari, data was obtained that there are 6 (60%) students who show signs of suffering from anemia because they often feel dizzy and weak, tired easily, and have difficulty concentrating in class. In addition, from the results of interviews conducted with 10 students, it was found that the students did not take blood-boosting tablets, had irregular eating and sleep, felt weak during menstruation and did a lot of activities at school every day where these things could be factors that caused anemia. Therefore, based on the above background, the researcher is interested in conducting research on factors related to the incidence of anemia in adolescent girls at Senior High School X Kendari.

2. Materials and Methods

This type of research is observational analytical research with a cross-sectional research design. The population in this study is 262 10th grade students of Senior High School X Kendari. The samples in this study were taken using the Slovin formula with the results of 159 female students. The sampling technique used is proportionate stratified random sampling, which is a technique by determining a set sample from the grouping of population members through a certain level group. The data used are primary and secondary data. This research instrument consists of 4 data collection tools, namely a digital haemometer to test Hb levels in the blood, a microtoist to measure height, a digital scale to measure weight, all measurements of which are carried out directly on female students at Senior High School X Kendari, and a questionnaire to collect primary data consisting of disease history, diet, physical activity, and the quality of sleep of Senior High School X Kendari students.

The criteria used in determining the sample in this study include inclusion criteria and exclusion criteria. Inclusion criteria are a number of specific criteria that must be present or met by the research subject. Exclusion criteria are characteristics that respondents should not have because they can be confusing in the research.

3. Results and Discussion

Table 1 shows the distribution of respondents based on the incidence of anemia. Of the total 159 respondents, most of the respondents did not experience anemia as many as 107 (67.3%) respondents, while as many as 52 (32.7%) respondents experienced anemia. Distribution of respondents based on disease history. Of the total 159 respondents, most of the respondents had no history of disease as many as 104 (65.4%) respondents, while as many as 55 (34.6%)

respondents had a history of disease. Distribution of respondents based on physical activity level. Of the total 159 respondents, most of the respondents were in the category of heavy physical activity (>3000 MET-minutes/week) as many as 114 (71.7%) respondents. Furthermore, as many as 27 (17%) respondents had moderate physical activity (600–3000 MET-minutes/week), and 18 (11.3%) respondents were in the category of light physical activity (<600 MET-minutes/week). The distribution of respondents was based on diet. Of the total 159 respondents, most of the respondents had a poor diet as many as 84 (52.8%) respondents, while as many as 75 (47.2%) respondents had a good diet. The distribution of respondents was based on sleep quality. Of the total 159 respondents, most of the respondents had poor sleep quality as many as 131 (82.4%) respondents, while 28 (17.6%) respondents had good sleep quality.

Table 1 Univariate Analysis of Anemia Incidence, Disease History, Physical Activity, Diet and Sleep Quality on the Incidence of Anemia in Adolescent Girls at Senior High School X Kendari in 2025

Variable	Number (n)	Percentage (%)
Incidence of Anemia		
Anemia	52	32,7
No Anemia	107	67,3
Quantity	159	100
Disease History		
Ever	55	34.6
Never	104	65.4
Quantity	159	100
Physical Activity		
Weight (> 3000 MET-minutes/week)	114	71.7
Medium (600-3000 MET minutes/week)	27	17
Lightweight (< 600 MET-minutes/week)	18	11.3
Quantity	159	100
Diet		
Good	75	47.2
Not Good	84	52.8
Quantity	159	100
Sleep Quality		
Good	28	17.6
Bad	131	82.4
Quantity	159	100

Table 2 Bivariate Analysis of Disease History, Physical Activity, Diet and Sleep Quality on the Incidence of Anemia in Adolescent Girls at **Senior High School X** Kendari in 2025

Variable	Incidence of Anemia				Quantity		p-value
	Anemia		No Anemia				
	N	%	n	%	N	%	
Disease History							
Ever	18	32.7	37	67.3	55	100	1.000
Never	34	32.7	70	67.3	104	100	
Quantity	52	32.7	107	67.3	159	100	
Physical Activity							
Weight (> 3000 MET-minutes/week)	45	39.5	69	60.5	114	100	0.015
	4	14.8	23	85.2	27	100	

Medium (600-3000 MET minutes/week)	3	16.7	15	83.3	18	100	
Lightweight (< 600 MET-minutes/week)							
Quantity	52	32.7	107	67.3	159	100	
Diet							0.000
Good	13	17.3	62	82.7	75	100	
Not Good	39	46.4	45	56.5	84	100	
Quantity	52	32.7	107	67.3	159	100	
Sleep Quality							0.003
Good	2	7.1	26	92.9	28	100	
Bad	50	38.2	81	61.8	131	100	
Quantity	52	32.7	107	67.3	159	100	

Based on table 2, bivariate analysis, it shows that of the 55 respondents (100.0%) who had a history of disease, there were 18 (32.7%) respondents who had anemia and 37 (67.3%) respondents who did not have anemia. Meanwhile, of the 104 (100.0%) respondents who had no history of disease, there were 34 (32.7%) respondents who had anemia and 70 (67.3%) respondents who did not have anemia. Based on the results of the Chi-Square statistical test at a confidence level of 95% (0.05) shows that the p value is 1,000 (p value > 0.05) thus H0 is accepted and H1 is rejected. This shows that there is no relationship between disease history and the incidence of anemia in adolescent girls at Senior High School X Kendari.

Based on bivariate analysis, it showed that out of 18 (100.0%) respondents with light physical activity category, there were 3 (16.7%) respondents who experienced anemia and 15 (83.3%) respondents did not experience anemia. In the moderate physical activity category, out of 27 (100.0%) respondents, there were 4 (14.8%) respondents who experienced anemia and 23 (85.2%) respondents did not experience anemia. Meanwhile, in the category of heavy physical activity from 114 (100.0%) respondents, there were 45 (39.5%) respondents who experienced anemia and 69 (60.5%) respondents did not experience anemia. Based on the results of the Chi-Square statistical test at a confidence level of 95% (0.05) shows that p value = 0.015 (p-value < 0.05), thus H0 is rejected and H1 is accepted. This shows that there is a relationship between physical activity and the incidence of anemia in adolescent girls at Senior High School X Kendari.

Table 5.11 Based on bivariate analysis, it was shown that out of 75 (100.0%) respondents with a good diet category, there were 13 (17.3%) respondents who had anemia, and 45 (56.5%) respondents did not have anemia. Meanwhile, in the category of poor diet of 84 (100.0%) respondents, there were 39 (46.4%) respondents who experienced anemia and 45 (56.5%) respondents did not experience anemia. The results of the Chi-Square statistical test at the 95% confidence level showed that the p value = 0.000 (p value < 0.05) thus H0 was rejected and H1 was accepted. This shows that there is a relationship between diet and the incidence of anemia in adolescent girls at Senior High School X Kendari.

Based on bivariate analysis, it showed that out of 28 (100.0%) respondents with good sleep quality, there were 2 (7.1%) respondents who experienced anemia and 26 (92.9%) respondents did not experience anemia. Meanwhile, in the category of poor sleep quality of 131 (100.0%) respondents, there were 50 (38.2%) respondents who had anemia and 81 (61.8%) respondents did not experience anemia. The results of the Chi-Square statistical test at the 95% confidence level show that the p value = 0.003 (p value < 0.05) thus H0 is rejected and H1 is accepted. This shows that there is a relationship between sleep quality and the incidence of anemia in adolescent girls at Senior High School X Kendari.

3.1. The Relationship between Disease History and the Incidence of Anemia in Adolescent Girls at Senior High School X Kendari

Disease history is information obtained from patients regarding symptoms, previous medical conditions, and factors that can affect their health (8). The disease history in this study included infectious diseases experienced by respondents in the past month, such as dengue hemorrhagic fever (DHF), typhoid, and malaria, all three of which were included in infectious diseases. Infectious diseases affect the metabolism and utilization of iron required in the formation of hemoglobin in the blood (D. I. N. Lestari, 2018). These diseases cause impaired iron absorption and an increase in the body's need for nutrients during the healing process. In addition, high fever, loss of appetite, and weak immunity during illness can also worsen anemia status, especially in adolescent girls who are menstruating.

Based on the results of bivariate analysis using the Chi-Square test, it was found that there was no relationship between disease history and the incidence of anemia in adolescent girls at Senior High School X Kendari with a p-value of 1,000 ($p > 0.05$). Of the 159 respondents, 55 (34.6%) respondents had a history of disease, and 104 (65.4%) respondents had no history of disease. In the group with a history of disease, there were 18 (32.7%) respondents who experienced anemia, while in the group without a history of the disease, there were 34 (32.7%) respondents who experienced anemia. The same percentage of anemia incidence in both groups showed that a history of infectious disease had no significant effect on the incidence of anemia.

The low incidence of infection indicates that most adolescents are in good health so that the infection that occurs is not severe enough or long enough to significantly lower hemoglobin levels. Although a small percentage of respondents had experienced dengue, typhoid, or malaria in the past month, the proportion of anemia between the groups with and without a history of the disease was relatively similar. This suggests that the infection condition experienced may be mild and short-lived, so that the body is still able to compensate physiologically for changes in hemoglobin levels, for example by increasing the production of red blood cells.

These results are in line with Haidir's (2022) research with the result that there is no relationship between disease history and anemia. In addition, the research of Kurniasih et al. (2021) found that there was no relationship between physical activity patterns and disease history and the incidence of anemia. This condition can be explained by Camaschella's (2019) theory which states that acute infectious diseases generally only cause anemia of acute inflammation which is temporary. In this phase, there is an increase in the hormone hepcidin which suppresses the absorption of iron in the intestines. However, after the infection subsides, hepcidin levels return to normal and iron absorption is restored so that hemoglobin levels stabilize again. Therefore, infections that are mild and acute are not long enough to cause significant anemia.

3.2. The Relationship of Physical Activity and the Incidence of Anemia in Adolescent Girls at Senior High School X Kendari

Physical activity is everything we do that involves bodily movements produced by skeletal muscles that require the expenditure of energy in daily activities and the existence of a place to do it (Wanti et al., 2023). In general, physical activity is divided into 3 categories based on the intensity and amount of calories used, namely light physical activity, moderate physical activity, and heavy physical activity. These activities include activities carried out at school, at work, activities in the family/household, activities while traveling and other activities carried out to fill daily leisure time (9).

Based on the results of bivariate analysis (Chi-Square Test), it was found that there was a relationship between physical activity and the incidence of anemia in adolescent girls at Senior High School X Kendari with a p-value of 0.015 ($p < 0.05$). In the results of filling out the questionnaire from a total of 159 respondents, there were 114 (71.7%) respondents who did physical activity in the Heavy category with 45 (39.5%) of them experiencing anemia, 27 (17%) respondents who did moderate physical activity with 4 (14.8%) of them experiencing anemia and 18 (11.3%) respondents who did light physical activity with 3 (16.7%) of them experiencing anemia. This shows a strong relationship between the intensity of physical activity and the incidence of anemia.

In terms of the frequency of anemia, people with anemia were most present in the group of respondents with heavy physical activity compared to moderate and light activities. The results of observations in the field show that most of the students do quite high physical activity while in the school environment. The students used to run down the school hallway, up and down the stairs to get to the canteen, the field, or back to class, because most of the classrooms, especially class X, were in the upper and back buildings of the school.

The more intense physical activity is done, the greater the need for hemoglobin in the blood to bind and distribute oxygen throughout the body. However, high physical activity without being balanced with adequate nutritional intake can cause the body to lack energy and iron, increasing the risk of anemia. The imbalance between the energy that comes out (due to strenuous activity) and the energy that comes in (from food) is one of the main causes of decreased hemoglobin levels.

The results of this study are in line with a study conducted by Rafiul Darajah and Kurniawati (2025) which showed that female students with high physical activity had a greater risk of anemia compared to female students with low activity ($p = 0.002$). Similar findings were also reported by Tantriana (2024) who found that female students with moderate to high physical activity had a 2.31 times greater chance of developing anemia compared to female students with low activity ($p = 0.018$; OR = 2.31; CI 95% 1.15–4.64).

Strenuous physical activity without a balanced nutritional intake can increase the risk of anemia, as the body needs more energy and nutrients to replace damaged red blood cells due to increased metabolism. Some female students after exercising more often consume fizzy drinks (such as Sprite, Fanta, and Coca-Cola), tea, packaged milk, and canteen snacks such as siomay, nuggets, bread, noodles, meatballs, batagor, fried foods, and light snacks. This habit can inhibit iron absorption and cause unbalanced nutritional intake, potentially exacerbating the risk of anemia even though the level of physical activity is high.

3.3. The Relationship of Diet and the Incidence of Anemia in Adolescent Girls at Senior High School X Kendari

Diet is defined as the frequency, jump, and time interval of individual meals (Agustina et al., 2020). In this study, the operational definition of good and bad eating refers to the guidelines from Kurniawati (2016), namely: A good diet is if a person eats the main meal three times a day (morning, noon, night) with a menu that contains carbohydrates, animal protein, vegetable protein, vegetables, and fruits, and has a frequency of consumption of the main nutritional sources at least once a day for each food group. A poor diet is if the main meal frequency is less than three times a day, often skipping breakfast, or not regularly consuming animal protein sources, vegetables, and fruits.

Based on the results of bivariate analysis with the Chi-Square test, a p value = 0.000 (p-value = 0.000 (p<0.05) was obtained, which showed that there was a significant relationship between diet and the incidence of anemia in adolescent girls at Senior High School X Kendari. Of the 159 respondents, as many as 84 respondents had a poor diet, and 39 (46.4%) of them had anemia. Meanwhile, among respondents with a good diet of 75 respondents, only 13 (17.3%) respondents experienced anemia. This indicates that diet plays an important role in the status of hemoglobin levels in adolescent girls.

Based on the results of data analysis, it is known that the type of food that is most often consumed by female students is rice as the main staple food (77.4% of female students consume more than one meal a day). Animal side dishes such as chicken eggs and chicken meat are the main sources of protein, while tempeh and tofu are the most commonly consumed sources of plant-based protein. For vegetables, kale and spinach are the most chosen, while the most commonly eaten fruits are papaya, mango, apple, and banana.

This condition shows that although food intake may be quantitatively sufficient, the quality and type of food consumed do not meet the needs of balanced nutrients. Irregular eating habits, low consumption of heme iron sources, and high consumption of processed foods play a major role in increasing the risk of anemia in adolescent girls. determine hemoglobin status and risk of anemia in adolescent girls. This study is in line with the results of a study (Dewi et al., (2024) on junior high school students in Bandung, which showed that an unbalanced diet was significantly associated with anemia (p = 0.000; OR = 0.261).

An unbalanced diet, low in iron and vitamin C, and high consumption of processed foods, are the main factors that affect hemoglobin levels. Although the MBG program has been implemented, delays in distribution, students' tastes, and snack habits in the canteen have caused the nutritional intake of the program to be not optimal.

3.4. The Relationship of Sleep Quality and the Incidence of Anemia in Adolescent Girls at Senior High School X Kendari

Sleep quality is a state in which the sleep that an individual lives produces freshness and fitness when waking up, a person's satisfaction with sleep, so that a person does not show feelings of tiredness and restlessness (Spedale et al., 2021). Adolescent girls in the growing period need 8–10 hours of sleep per night, so sleep deprivation can disrupt metabolism, decrease growth hormone secretion, and inhibit hemoglobin production (Ipsiroglu et al., 2024; McWilliams et al., 2024).

Based on the results of bivariate analysis (Chi-Square Test), it was found that there was a relationship between sleep quality and the incidence of anemia in adolescent girls at Senior High School X Kendari with a p-value of 0.003 (p<0.05). Of the total 159 respondents, as many as 131 (82.4%) respondents had poor sleep quality with 50 (38.2%) of them experiencing anemia, while of the 28 (17.6%) respondents with good sleep quality, only 2 (7.1%) people experienced anemia. This suggests a significant association between sleep quality and the incidence of anemia, where adolescent girls with poor sleep quality have a higher risk of anemia compared to those with good sleep quality.

The results of the questionnaire showed that most respondents had poor sleep quality, with an average sleep duration of less than 6 hours per night. Based on the interview results, the main causes of short sleep duration and poor sleep quality are the habit of staying up late because of playing on mobile phones, watching videos on TikTok or Instagram,

playing online games, and sleeping calls or chatting with friends late at night. In addition, there are also students who stay up late to study or complete assignments so that their grades do not decrease at school.

According to Fitriani et al. (2022), adolescents tend to have sleep patterns that shift to nighttime due to changes in circadian rhythms during puberty, where the production of the hormone melatonin, which regulates drowsiness, occurs more slowly. This condition is exacerbated by exposure to blue light from cell phone screens, which suppresses melatonin secretion and causes adolescents to stay awake late at night (Shochat et al., 2020). This study is in line with a study conducted by Rosdiana & Suryani (2025) in Pekanbaru which found that 85.7% of adolescent girls have poor sleep quality, and statistical tests show a significant relationship between sleep quality and the risk of anemia ($p=0.037$; $OR=1.61$).

In addition to sleep quality factors, menstrual conditions also affect the incidence of anemia in adolescent girls. During menstruation, the body loses blood which means it loses iron, so adolescent girls are recommended to take blood supplement tablets (TTD) regularly to maintain iron levels. The government through the adolescent nutrition program has implemented a program to give TTD once a week in schools, including at Senior High School X Kendari in collaboration with the Lepo-Lepo Health Center in carrying out anemia prevention programs in adolescents and Hb levels checks in grade 10 students. However, the obstacle found is that many students do not consume TTD.

4. Conclusion

Anemia in adolescent girls is one of the health problems that still occur frequently. In this study, out of a total of 159 respondents of class XI students of Senior High School X Kendari, it was found that as many as 52 students (32.7%) had anemia, while 107 students (67.3%) were not anemic. This shows that almost one-third of the young women in the school experience anemia, which can have an impact on health, study concentration, and daily productivity. Based on the results of bivariate analysis using the Chi-Square test, the following conclusions were obtained: a. There was a significant relationship between physical activity and the incidence of anemia in adolescent girls at Senior High School X Kendari ($p = 0.015$). b. There was a significant relationship between diet and the incidence of anemia in adolescent girls at Senior High School X Kendari ($p = 0.000$). c. There was a significant relationship between sleep quality and the incidence of anemia in adolescent girls at Senior High School X Kendari ($p = 0.003$). d. There was no significant association between disease history and the incidence of anemia in adolescent girls at Senior High School X Kendari ($p = 1,000$).

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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