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Research Article

The Relationship Between Body Mass Index and Hemoglobin Levels in Female Adolescents at SMK N 1 Bakauheni, South Lampung

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ABSTRACT

One of the adolescent health problems that are the focus of the government is the prevention of anemia in adolescent girls. Based on a preliminary survey conducted at SMK N 1 Bakauheni, 20 students surveyed found 13 BMI students in the thin category who had anemia as many as 9 children. The purpose of this study was to determine the relationship between Body Mass Index and Hemoglobin Levels in Adolescent Girls at SMK N 1 Bakauheni South Lampung. This research method is quantitative with a cross sectional approach. The number of samples is 71 people with the sampling technique used is simple random sampling. From the test results using the Chi Square test, a significance value of 0.000 was obtained (p value 0.05). There is a relationship between body mass index and hemoglobin levels in adolescent girls at SMK N 1 Bakauheni, Lampung Selatan in 2022

INTRODUCTION

Young generations play an important role in continuing the development and progress of the nation. The future direction of the country is in their hands. Therefore, the health and nutritional status of adolescents must be prepared from an early age. Healthy adolescents are a valuable investment for the future, capable of producing productive, creative, and competitive future generations. One of the adolescent health issues that has become the government's focus is

addressing anemia among adolescent girls. Anemia in adolescent girls is the precursor to further anemia during the reproductive age. It is defined as a condition in which hemoglobin (Hb) levels in the blood are ≤12 g/dl (Ministry of Health RI, 2013).

If not properly addressed, the high prevalence of anemia in adolescents can persist into adulthood and contribute to complications such as miscarriage, premature birth, bleeding, fetal death in utero, birth defects, and low birth weight infants (Pujiningsih, 2014).

Iron-deficiency anemia in adolescent girls is often caused by nutritional problems. Malnutrition accounts for approximately 85.5% of anemia cases. When the body experiences poor nutritional intake, it slowly adapts by reducing tissue mass (wasting), slowing metabolism, and decreasing the need for energy and oxygen. Consequently, the red blood cells required to transport oxygen are also reduced. Thus, a reduction in red blood cell mass is a natural consequence of reduced body mass. Moreover, inadequate nutritional intake limits the availability of certain micronutrients necessary for red blood cell formation (Shara et al., 2014). Malnutrition in adolescents often occurs due to dietary restrictions that ignore principles of nutrition and health, resulting in both quantitative and qualitative deficiencies in nutrient intake compared to the Recommended Dietary Allowance (RDA). Such dietary limitations negatively impact adolescents' nutritional status (Kusumajaya in Shara et al., 2014).

The 2013 Indonesian Basic Health Research (Riskesdas) showed that the prevalence of anemia in Indonesia was 21.7%, with anemia found in 26.4% of individuals aged 5–14 years and 18.4% in those aged 15–24 years. Adolescent girls are among the most at-risk groups for anemia (Ministry of Health, 2013). Based on the 2018 Riskesdas, the nutritional status data for adolescents aged 13–15 years showed that 35.1% had short stature (based on height-for-age), consisting of 13.8% very short and 21.3% short. The prevalence of underweight (BMI-for-age) in this group was 11.1%, including 7.8% underweight and 3.3% severely underweight. The prevalence of overweight among adolescents aged 13–15 years was 11.1%, comprising 8.3% overweight and 2.5% obese. Among adolescents aged 16–18 years, 31.4% had short stature (7.5% very short and 23.9% short), while 9.4% were underweight (1.9% severely underweight and 7.5% underweight).

Several studies have found a correlation between nutritional status and the incidence of anemia. Martini (2015) concluded that there is a significant relationship between nutritional status and anemia among Grade XI students at MAN 1 Metro, East Lampung ($p=0.009 < 0.005$). Adolescents classified as underweight had a 3.1 times higher risk of experiencing anemia compared to those with normal nutritional status (OR = 3.059, 95% CI: 1.425–6.761). Additionally, a study by Cahya Daris Tri Wibowo, Harsoyo Notoatmojo, and Afiana Rohmani using Chi-square testing showed a p-value = 0.000, indicating a significant relationship between nutritional status and anemia.

SMK N 1 Bakauheni, located in South Lampung, is one of the schools in the Bakauheni area with the highest number of female students among other vocational high schools, totaling 269 students. A preliminary survey conducted during the distribution of iron supplementation tablets at the school revealed that out of 20 adolescent girls surveyed, 13 were categorized as underweight based on BMI, and 9 of them were anemic. Meanwhile, the remaining 7 girls had a normal nutritional status and hemoglobin levels ≥12 g/dl. From interviews, 10 adolescent girls reported symptoms such as dizziness and fatigue, and 3 showed signs of anemia such as pale palms and conjunctiva.

Based on the background and preliminary survey mentioned above, the researcher is interested in conducting a study titled: "The Relationship Between Body Mass Index and Hemoglobin Levels in Female

Adolescents at SMK N 1 Bakauheni, South Lampung in 2022."

METHOD

This study is a quantitative research with a cross-sectional approach. The population in this study consisted of all female students at SMK N 1 Bakauheni, South Lampung, totaling 269 individuals. The sample size was 71 students, determined using the Isaac and Michael formula, and the sampling technique used was simple random sampling.

Data were collected using a questionnaire. Body Mass Index (BMI) data were obtained by measuring the students' weight and height using a weighing scale and microtoise. These measurements were then entered into the WHO AnthroPlus application to calculate BMI based on z-score values. Hemoglobin levels were measured using a digital Easy Touch device.

The collected data were processed using the SPSS software and analyzed to determine the relationship between Body Mass Index and hemoglobin levels. Bivariate analysis was conducted using the Chi-square test.

RESULTS

Based on the research conducted at SMK N 1 Bakauheni, South Lampung, with a sample size of 71 female students, the results are as follows:

Table 1. Frequency Distribution of Respondents' Body Mass Index (BMI)

No	BMI	f	(%)
1	Underweight	26	36,6
2	Normal weight	33	46,5
3	Gemuk / Overweight	12	16,9
Total		71	100

Based on the BMI distribution table, it was found that 26 respondents (36.6%) were underweight, 33 respondents (46.5%) had normal nutritional status, and 12 respondents (16.9%) were overweight.

Table 2. Frequency Distribution of Respondents' Hemoglobin Levels

No	Hemoglobin Level	f	(%)
1	Abnormal / Anemia	31	43,7
2	Normal / Non-anemia	40	56,3
Total		71	100

Based on the hemoglobin distribution table, it was found that 40 respondents (56.3%) had normal hemoglobin levels (non-anemia), while 31 respondents (43.7%) had low hemoglobin levels (anemia).

Table 3. Cross-tabulation of Body Mass Index and Hemoglobin Levels in Female Adolescents at SMK N 1 Bakauheni, South Lampung

BMI Category	Hemoglobin Levels				Total		p Value
	Anemia		Non-Anemia				
	f	%	f	%	f	%	
Underweight	19	61,3	7	17,5	26	36,6	
Normal weight	12	38,7	21	52,5	33	46,5	0.000
Overweight	0	0,0	12	30	12	16,9	
Total	31	43,7	40	56,3	71	100	

Based on Table 3, it can be seen that among respondents who were underweight, 19 (61.3%) had anemia and 7 (17.5%) did not. Among those with normal nutritional status, 12 (38.7%) had anemia and 21 (52.5%) did not. Meanwhile, all 12 respondents who were overweight (30%) did not have anemia.

The results of the Pearson Chi-Square test showed a significance value of 0.000, which is less than 0.05. Since $p \leq 0.05$, the null hypothesis (H_0) is rejected and the alternative hypothesis (H_1) is accepted. This indicates a significant relationship between Body Mass Index (BMI) and Hemoglobin Levels (Hb) in female adolescents at SMK N 1 Bakauheni, South Lampung.

DISCUSSION

1. Body Mass Index (BMI)

The study found that 26 respondents (36.6%) had a low or underweight BMI. When asked

about the possible reasons for their BMI being below normal, respondents stated that they were undergoing dieting programs and had irregular eating patterns.

According to the researcher, adolescent girls with low BMI tend to limit their food intake in order to avoid gaining weight and to appear slim. As a result, their bodies do not receive sufficient nutrients. Nutritional intake greatly influences a person's BMI and supports optimal development when the body receives adequate nutrients. This aligns with Mitayani and Wiwi (2013), who stated that optimal nutritional status enables proper physical growth, brain development, work capacity, and good health.

2. Hemoglobin (Hb) Levels

The hemoglobin level distribution table showed that out of 71 respondents, 31 (43.7%) were anemic, while the remaining 40 (56.3%) were non-anemic.

Age and gender are important factors that influence hemoglobin levels. Hemoglobin levels are generally higher in adults than in children, and they increase during puberty. Females tend to have lower hemoglobin levels than males due to monthly iron loss through menstruation.

Interviews with the anemic respondents revealed that many of them had irregular eating habits due to their busy schedules, preferred fast food over vegetables, and did not take the iron supplement tablets distributed monthly due to side effects like nausea. The researcher assumes that the anemia was caused by poor dietary intake, incorrect dieting habits, and frequent consumption of junk food. Poor nutrient intake can lead to anemia. Additionally, adolescent girls experience monthly menstruation, which contributes to the risk. This is supported by Patimah (2017), who noted that anemia among adolescent girls is primarily caused by monthly menstrual bleeding and poor dietary habits.

Iron-deficiency anemia prevention and treatment among women of reproductive age has so far focused primarily on pregnant women, who are given 90 iron tablets during pregnancy. However, such interventions should also target adolescent girls, as they are future mothers. The Ministry of Health (2014) recommends that adolescent girls take one iron tablet per week and daily during menstruation.

3. Relationship Between Body Mass Index and Hemoglobin Levels

The study found that 31 respondents (43.7%) were anemic, while 40 respondents (56.3%) were not. Among the anemic group, 19 individuals (61.3%) were underweight, and 12 (38.7%) had normal BMI.

This may be due to insufficient intake of iron-rich and nutritious food. Respondents who preferred fast food over nutrient-dense meals might not absorb enough iron, impairing hemoglobin production and oxygen supply, ultimately causing anemia.

According to Table 4.5, most respondents with normal BMI (21 respondents or 52.5%) were non-anemic. This suggests that normal BMI is a protective factor against anemia. The researcher believes that these respondents consumed a balanced diet with adequate nutrients, leading to better nutritional status. This finding supports Wibowo (2013), who stated that nutrient balance contributes up to 85% in preventing anemia.

Among the underweight respondents, 19 (61.3%) were anemic. The researcher attributes this to poor nutritional intake, particularly low iron levels. Iron is a critical component in hemoglobin production. Insufficient iron impairs red blood cell formation and disrupts oxygen transport, resulting in anemia. This is consistent with Martini's (2015) study, which found that underweight adolescents are 3.1 times more likely to suffer from anemia than those with normal BMI.

All 12 respondents (30%) who were overweight were non-anemic. This suggests that better nutritional status may reduce anemia risk. This is in line with research by Yu Qin et al. (2013) in China, which found that

hemoglobin levels tend to increase with rising BMI, and that overweight individuals have a lower risk of anemia compared to those with normal BMI.

However, it should be noted that being overweight or obese poses other health risks. According to Par'i (2016), excess energy is stored as fat, and obesity is a risk factor for various diseases.

CONCLUSIONS AND RECOMMENDATION

Based on the results of the study, it can be concluded that there is a significant relationship between Body Mass Index (BMI) and Hemoglobin (Hb) levels among female adolescents at SMK N 1 Bakauheni, South Lampung, with a p-value of 0.000 ($p < 0.05$).

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