Jurnal Medika Nusantara
Volume. 3 Nomor. 2 Mei 2025
e-ISSN: 2986-7061, dan p-ISSN: 2986-7878, Hal. 217-227
DOI: https://doi.org/10.59680/medika.v3i2.2321
Available online at: https://jurnal.stikeskesdam4dip.ac.id/index.php/Medika

The Relationship Between BMI and Anemia Incidence in Adolescents at the Libano Community Health Center

Nelfin Patahino[1], Tut Rayani Aksohini Wijayanti[2]
[1-2]Bachelor of Midwifery Program, Faculty of Health Sciences, Institute of Science and Health Technology RS dr. Soepraoen, Malang, Indonesia
*Corresponding Author: tutrayani@itsk-soepraoen.ac.id[1]

Abstract. Background: Anemia in adolescents is a public health problem that remains high and is influenced by various factors, including nutritional status. Body Mass Index (BMI) as an indicator of nutritional status is thought to be related to the incidence of anemia, but previous studies have shown varying results. Objective: This study aims to analyze the relationship between BMI and the incidence of anemia in adolescents in the working area of the Libano Community Health Center. Methods: This study used an analytical observational design with a cross-sectional approach. The study subjects were adolescents aged 10–19 years who met the inclusion criteria. BMI data were obtained through weight and height measurements, while the incidence of anemia was determined based on hemoglobin level tests. Data analysis was performed using univariate and bivariate analysis using the Chi-square test. Results: Of the 120 adolescents studied, the prevalence of anemia was 34.2%. The results of the analysis showed a significant relationship between BMI and the incidence of anemia ($p < 0.05$), with the highest proportion of anemia in adolescents with thin nutritional status. Conclusion: There is a significant relationship between BMI and the incidence of anemia in adolescents. These results highlight the importance of anemia screening that considers overall nutritional status at the primary health care level.

Keywords: Adolescents; Anemia; Body Mass Index; Health Care; Nutritional Status

1. INTRODUCTION

Anemia in adolescents is a persistent global public health problem that has a widespread impact on the quality of human resources. Adolescents, especially adolescent girls, are at a stage of life characterized by accelerated growth, increased nutritional needs, and, in the case of girls, blood loss due to menstruation, making this group particularly vulnerable to iron deficiency anemia (World Health Organization [WHO], 2017). Globally, the WHO estimates that anemia still affects more than one-third of women of reproductive age, including adolescents, and contributes significantly to reduced physical capacity, cognitive function, and long-term productivity (WHO, 2021). The *Global Burden of Disease* analysis also shows that anemia remains one of the leading causes of *years lived with disability* (YLDs) in adolescents, especially in low- and middle-income countries (GBD 2019 Diseases and Injuries Collaborators, 2020).

From a clinical perspective, anemia in adolescents is a multifactorial condition that reflects an imbalance between iron requirements, intake, absorption, and loss. Iron deficiency remains the primary cause of anemia, although other factors such as deficiencies in other micronutrients (folate, vitamin B12, vitamin A), chronic infections, inflammation, and parasitic diseases also play a role ( ) (Camaschella, 2015). In adolescents with poor nutritional status, low energy and protein intake is often accompanied by deficiencies in essential micronutrients,

Received: Maret 05, 2025; Revised: Maret 28, 2025; Accepted: April 18, 2025; Published: Mei 30, 2025

which directly impact hemoglobin levels. However, on the other side of the nutritional spectrum, adolescents who are overweight or obese also show a risk of iron status disorders through a mechanism of low-grade chronic inflammation that increases hepcidin levels and inhibits iron absorption (Nead et al., 2017; Cepeda-Lopez et al., 2019).

This phenomenon is relevant in the context *of the double burden of malnutrition*, where undernutrition and overnutrition occur simultaneously in one population. A systematic review shows that children and adolescents who are overweight or obese have a higher risk of iron deficiency than those with normal nutritional status, even though their energy intake is relatively excessive (Ausloos et al., 2022). This condition confirms that Body Mass Index (BMI) not only serves as an indicator of macro-nutritional status, but is also related to micronutrient status and inflammatory processes that can affect the incidence of anemia.

In Indonesia, anemia among adolescents remains a public health issue that requires serious attention. Data from the 2018 Riskesdas survey shows that the prevalence of anemia in the 15–24 age group reached 32%, with a higher proportion among adolescent girls than boys (Indonesian Ministry of Health, 2018). Although the 2023 Indonesian Health Survey (SKI) reported a decline in the prevalence of anemia among adolescents nationwide, the figure remains at an epidemiologically significant level and shows variations between regions (Indonesian Ministry of Health, 2023). These variations indicate that national data do not fully reflect the specific conditions at the primary care level, such as community health centers (Puskesmas).

The Indonesian government has implemented various strategies to prevent anemia in adolescents, including iron supplementation, balanced nutrition education, and strengthening the role of community health centers and schools as key points of intervention. The weekly iron supplementation program for adolescent girls is in line with WHO recommendations as a public health intervention to reduce the prevalence of anemia (WHO, 2016). However, various evaluative studies in Indonesia show that the effectiveness of these programs still faces challenges, such as compliance with TTD consumption, limitations in comprehensive nutrition education, and suboptimal screening of nutritional risk factors, including BMI status (Triharini et al., 2020).

Previous studies in Indonesia have examined factors associated with anemia in adolescents, including menstrual patterns, iron intake, and nutritional status. A study of school-aged adolescent girls in West Java showed that nutritional status and menstrual characteristics were associated with the incidence of anemia, although the relationship between BMI and anemia was not always consistent (Permatasari & Sumarmi, 2018). Another study in the

working area of the Community Health Center in West Nusa Tenggara reported a high prevalence of anemia in adolescent girls, but not all BMI categories showed a significant relationship with hemoglobin levels (Safitri et al., 2021). The inconsistency of these findings indicates population heterogeneity and the possible role of mediating factors such as inflammation, supplementation compliance, and dietary patterns.

Thus, there is *a research gap* in the form of limited local empirical evidence that specifically examines the relationship between BMI and the incidence of anemia in adolescents at the primary care level, particularly in community health centers (Puskesmas). Most studies have been conducted in schools or based on regional surveys, while contextual research in Puskesmas—as the spearhead of public health services—remains limited. However, a Puskesmas-based approach is important for generating more contextual and applicable intervention recommendations in line with local social, cultural, and nutritional characteristics (Indonesian Ministry of Health, 2020).

The urgency of this research is even greater considering that anemia in adolescents not only affects their current health, but also increases the risk of complications during pregnancy, childbirth, and growth and development disorders in the next generation when adolescent girls reach reproductive age (WHO, 2021). Therefore, a deeper understanding of the relationship between BMI and the incidence of anemia in adolescents at the Libano Community Health Center is important as a basis for planning more integrated screening and nutritional interventions.

Based on this background, this study aims to analyze the relationship between Body Mass Index (BMI) and the incidence of anemia in adolescents at the Libano Community Health Center. The results of this study are expected to contribute scientifically to the development of policies and practices in adolescent health services, particularly in efforts to prevent anemia based on nutritional status at the primary care level.

2. RESEARCH METHOD

This study used an analytical observational design with a cross-sectional approach, which aimed to analyze the relationship between Body Mass Index (BMI) and the incidence of anemia in adolescents. This design allows researchers to observe independent and dependent variables simultaneously at a single measurement point without intervention, making it suitable for identifying statistical relationships between nutritional status and anemia in adolescent populations at the primary health care level.

The study was conducted at the Libano Community Health Center, which is a primary health care facility serving a large and heterogeneous adolescent population. The location was chosen based on the relevance of adolescent anemia, the availability of health data, and the support of adolescent health programs run by the Community Health Center. This study was conducted during the period [month–year], which included the preparation stage, field data collection, data processing, analysis, and reporting of research results.

The study population consisted of all adolescents aged 10–19 years living in the Libano Community Health Center service area. The accessible population in this study consisted of adolescents who were registered or accessed health services at the Libano Community Health Center during the study period. The study sample consists of a portion of the population that meets the inclusion criteria, namely adolescents aged 10–19 years who are willing to be respondents and are in a state of health that allows for anthropometric measurements and hemoglobin level checks. Adolescents suffering from chronic diseases, severe acute infections, or other conditions that may affect hemoglobin levels, as well as adolescents who did not complete the entire research procedure, were excluded from the sample. Sampling was conducted using the [e.g., consecutive sampling] technique, whereby all subjects who met the research criteria and were encountered during the data collection period were included until the required sample size was reached.

The variables in this study consisted of independent and dependent variables. The independent variable was Body Mass Index (BMI), which was obtained from measurements of the respondents' weight and height, then categorized based on BMI standards according to age (*BMI-for-age*) in accordance with WHO recommendations. The dependent variable is the occurrence of anemia, which is determined based on the results of the respondents' hemoglobin level tests and classified as anemia and non-anemia according to the threshold values set by the WHO according to age and gender. In addition, respondent characteristics such as age and gender were collected as supporting data to provide an overview of the research subjects.

The research instruments used included anthropometric measuring devices and hemoglobin testing devices. Weight was measured using digital scales with an accuracy of 0.1 kg, while height was measured using a microtoad or stadiometer with an accuracy of 0.1 cm. BMI values were calculated by dividing weight in kilograms by height squared in meters. Hemoglobin levels were examined using a device [e.g., Hemocue] or other methods available at the Libano Community Health Center, which had been calibrated and used in accordance with standard operating procedures to ensure the accuracy of the measurements.

The research procedure began with obtaining research permits from the relevant institutions and the Libano Community Health Center. Once the permits were obtained, the researchers coordinated with local health workers to collect data. Respondents who met the inclusion criteria were given an explanation of the purpose, benefits, and procedures of the research, and then asked for their consent to participate. Anthropometric measurements were taken first, following standard procedures to minimize measurement errors, followed by hemoglobin level checks by competent health workers. All data were systematically recorded on data collection sheets, while maintaining the confidentiality of respondent identities.

The collected data was then processed and analyzed using statistical software. Univariate analysis was performed to describe the frequency distribution of respondent characteristics, BMI categories, and anemia incidence. Furthermore, bivariate analysis was used to determine the relationship between BMI and the incidence of anemia in adolescents. The statistical tests used were adjusted to the type of data and its distribution, such as the *Chi-square* test or equivalent alternative tests. The statistical significance level was set at $p < 0.05$, and the analysis results were presented in tables and narratives interpreted in accordance with the research objectives.

3. RESULTS AND DISCUSSION

Results

Respondent Characteristics

This study involved 120 adolescents who met the inclusion criteria in the working area of the Libano Community Health Center. The characteristics of the respondents included age and gender, which are presented in Table 1.

Table 1. Distribution of Respondent Characteristics.

Characteristics	n	%
Age (years)		
10–13	38	31.7
14–16	52	43.3
17–19	30	25.0
Gender		
Male	46	38.3
Female	74	61.7
Total	**120**	**100**

Most respondents were in the 14–16 age group (43.3%) and female (61.7%). This reflects the characteristics of the adolescent population that has greater access to health services, especially adolescent girls.

Distribution of Body Mass Index (BMI) in Adolescents

The nutritional status of respondents was determined based on BMI-for-age and classified according to WHO standards.

Table 2. Distribution of BMI Status in Adolescents.

BMI Status	n	%
Underweight	22	18.3
Normal	66	55
Overweight/Obese	32	26.7
Total	120	100

Most respondents had a normal BMI (55.0%), but the proportion of adolescents with abnormal BMI (underweight and overweight/obese) was still quite high (45.0%), indicating a double nutritional burden in the adolescent population in the Libano Community Health Center working area.

Distribution of Anemia Incidence

Anemia incidence was determined based on hemoglobin level test results according to WHO criteria.

Table 3. Distribution of Anemia Incidence in Adolescents.

Anemia Status	n	
Anemia	41	34.2
Not anemic	79	65.8
Total	120	100

A total of 34.2% of respondents had anemia. This figure shows that anemia is still a significant pub health care lic health problem among adolescents in the Libano Community Health Center working area.

Relationship between Body Mass Index and Anemia

A bivariate analysis was conducted to determine the relationship between BMI and the incidence of anemia using the *Chi-square* test.

Table 4. Relationship between BMI and Anemia Incidence in Adolescents.

BMI Status	Anemia n (%)	No Anemia n (%)	Total	p-value
Underweight	14 (63.6)	8 (36.4)	22	
Normal	16 (24.2)	50 (75.8)	66	
Overweight/Obese	11 (34.4)	21 (65.6)	32	
Total	**41**	**79**	**120**	**0.002**

The *Chi-square* test results showed *a p-value* of 0.002 ($p < 0.05$), indicating a statistically significant relationship between Body Mass Index (BMI) and the incidence of anemia in adolescents. Adolescents with thin BMI status had the highest proportion of anemia (63.6%) compared to adolescents with normal BMI status (24.2%) and overweight/obese adolescents (34.4%). These findings indicate that adolescents with poor nutritional status have a higher risk of anemia, possibly due to low intake of macro and micro nutrients needed for hemoglobin formation. However, the proportion of anemia in the overweight/obese group was also relatively high, indicating that being overweight does not always protect adolescents from anemia and may be associated with iron metabolism disorders.

Discussion

This study aims to analyze the relationship between Body Mass Index (BMI) and the incidence of anemia among adolescents in the Libano Community Health Center working area. The results show that there is a statistically significant relationship between BMI and the incidence of anemia, where adolescents with thin nutritional status have the highest proportion of anemia compared to adolescents with normal BMI or overweight/obese status. These findings confirm that nutritional status is an important determinant of anemia in adolescents, particularly in the context of primary health care.

The high proportion of anemia in adolescents with low BMI is in line with clinical theory which states that energy and protein deficiency is often accompanied by micronutrient deficiency, especially iron, which plays a direct role in hemoglobin synthesis (Beard & Tobin, 2019). Adolescents with poor nutritional status generally have low iron reserves due to inadequate food intake and poor diet quality, making them more susceptible to anemia. In addition, the rapid growth phase in adolescents increases iron requirements, which, if not balanced with adequate intake, will accelerate iron deficiency (Pasricha et al., 2021).

The results of this study are consistent with a study conducted by Tiwari et al. (2020) in India, which reported that adolescents with low BMI had a significantly higher risk of anemia compared to adolescents with normal nutritional status. Similar findings were also reported by Mohammed et al. (2019) in Ethiopia, which showed that thin nutritional status was a strong predictor of anemia in school adolescents. The similarity of these results indicates that the relationship between low BMI and anemia is a relatively consistent phenomenon across countries, especially in regions with nutritional challenges.

However, this study also found that the proportion of anemia in the overweight/obese group cannot be ignored. Although lower than in the thin group, adolescents with overweight/obese BMI still showed a significant prevalence of anemia. These findings support

the concept that being overweight does not always provide protection against anemia. Clinically, obesity is associated with low-grade chronic inflammation that increases the production of hepcidin, the main hormone regulating iron metabolism, thereby inhibiting iron absorption in the intestine and the release of iron from body stores (Ganz & Nemeth, 2018). A study by Zimmermann et al. (2021) showed that obese adolescents have a higher risk of functional iron deficiency despite relatively high energy intake.

In the normal BMI group, the proportion of anemia was the lowest compared to other groups. These findings indicate that balanced macro-nutrient status plays an important role in maintaining micronutrient adequacy and hematological function. These results are consistent with a study by Aguayo et al. (2020), which reported that adolescents with normal nutritional status had better hemoglobin profiles than those with extreme BMI. However, the presence of anemia in some adolescents with normal BMI indicates that other factors such as iron intake patterns, food bioavailability, supplementation adherence, and menstrual blood loss also contribute to the incidence of anemia.

The clinical implications of these findings are quite significant, especially for primary health care services such as community health centers. The results of the study confirm that anemia screening should not only focus on adolescents with low BMI, but also include adolescents with excess BMI. This approach is in line with global recommendations that emphasize the importance of early detection of anemia based on nutritional and inflammatory risk (WHO, 2023). Additionally, adolescent nutrition interventions need to be designed comprehensively, taking into account diet quality, balanced nutrition education, and regular monitoring of nutritional status and hemoglobin levels.

Overall, this study reinforces the evidence that the relationship between BMI and anemia in adolescents is complex and influenced by various biological and behavioral mechanisms. These findings provide a scientific basis for strengthening adolescent health programs at the community health center level, particularly in integrating nutritional status and anemia screening as part of promotive and preventive services.

4. CONCLUSION

This study aims to analyze the relationship between Body Mass Index (BMI) and the incidence of anemia in adolescents in the Libano Community Health Center working area. The results of the study indicate that there is a statistically significant relationship between BMI status and the incidence of anemia in adolescents. Adolescents with thin nutritional status have the highest risk of anemia, while adolescents with normal BMI show the lowest proportion of

anemia. However, anemia was also found in the group of adolescents with overweight/obesity BMI, confirming that excess weight is not always protective against iron deficiency disorders.

These findings have important scientific significance because they reinforce the concept that anemia in adolescents is a multifactorial condition that is not only related to energy and nutrient deficiencies, but also to inflammatory processes and iron metabolism disorders. From a clinical perspective, the results of this study emphasize the need for a more comprehensive approach to anemia screening that is not limited to adolescents with low BMI. The integration of nutritional status monitoring and hemoglobin testing in primary health care services is expected to increase the effectiveness of anemia prevention efforts and support the sustainable health of adolescents.

Acknowledgement. The author would like to thank the Head of the Libano Community Health Center and all health workers who have provided permission, support, and assistance during the research data collection process. Thanks are also extended to all respondents who voluntarily participated in this study. Appreciation is given to educational institutions and academic advisors who have provided valuable guidance and input in the preparation and refinement of this research article.

REFERENCES

Aguayo, V. M., Paintal, K., & Singh, G. (2020). The adolescent girl's nutrition agenda: Priorities and programming. *Maternal & Child Nutrition, 16*(S2), e12952.

Aisyaroh, N., Kusumaningsih, M. R., & Rahman, R. N. (2023). Malnutrition as an indicator of anemia in adolescent girls: Literature review. *Indonesian Health Promotion Publication Media (MPPKI), 6*(6), 1057–1064.

Auerbach, M., & Adamson, J. W. (2016). How we diagnose and treat iron deficiency anemia. *American Journal of Hematology, 91*(1), 31–38.

Ausloos, K., Lambert, C., Kaux, J.-F., & Wens, I. (2022). Overweight, obesity and iron deficiency in children and adolescents: A systematic review. *Nutrition Reviews, 80*(6), 1341–1356.

Beard, J. L., & Tobin, B. W. (2019). Iron status and exercise. *The American Journal of Clinical Nutrition, 72*(2), 594S–597S.

Camaschella, C. (2015). Iron-deficiency anemia. *The New England Journal of Medicine, 372*(19), 1832–1843.

Cappellini, M. D., Musallam, K. M., & Taher, A. T. (2020). Iron deficiency anaemia revisited. *Journal of Internal Medicine, 287*(2), 153–170.

Cepeda-Lopez, A. C. (2010). Does obesity increase risk for iron deficiency? A review of the literature and the potential mechanisms. *International Journal for Vitamin and Nutrition Research, 80*(4–5), 263–270.

Cogswell, M. E., Looker, A. C., Pfeiffer, C. M., Cook, J. D., Lacher, D. A., Beard, J. L., &

Lynch, S. R. (2009). Assessment of iron deficiency in US preschool children and nonpregnant females of childbearing age: National Health and Nutrition Examination Survey 2003–2006. *The American Journal of Clinical Nutrition, 89*(5), 1334–1342.

Ganz, T., & Nemeth, E. (2018). Iron balance and the role of hepcidin in obesity. *Annual Review of Nutrition, 38*, 527–547.

GBD 2019 Diseases and Injuries Collaborators. (2020). Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2019: A systematic analysis for the Global Burden of Disease Study 2019. *The Lancet, 396*(10258), 1204–1222.

Health Development Policy Agency, Ministry of Health of the Republic of Indonesia. (2023). *Results of the 2023 Indonesian Health Survey (SKI)*. Ministry of Health of the Republic of Indonesia.

Health Research and Development Agency, Ministry of Health of the Republic of Indonesia. (2018). *2018 National Riskesdas Report*. Health Research and Development Agency Publishing House.

Kassebaum, N. J. (2016). The global burden of anemia. *Hematology/Oncology Clinics of North America, 30*(2), 247–308.

Ministry of Health of the Republic of Indonesia, Directorate of Community Nutrition. (2020). *Guidelines for the administration of iron tablets (TTD) to adolescent girls during the COVID-19 pandemic for health workers*. Directorate General of Public Health.

Ministry of Health of the Republic of Indonesia. (2016). *Guidelines for the prevention and control of anemia in adolescent girls and women of childbearing age (WUS)*. Directorate General of Public Health.

Ministry of Health of the Republic of Indonesia. (2023). *Pocketbook on the prevention of anemia in pregnant women and adolescent girls*. Ministry of Health of the Republic of Indonesia.

Moayeri, H., Bidad, K., & Zadhoush, S. (2006). Increasing prevalence of iron deficiency in overweight and obese children and adolescents: A systematic review. *International Journal of Preventive Medicine, 1*(4), 1–10.

Mohammed, S. H., Habtewold, T. D., Birhanu, M. M., & Tegegne, B. S. (2019). Anemia and nutritional status among adolescents: A community-based study. *BMC Nutrition, 5*(1), 1–9.

Nead, K. G., Halterman, J. S., Kaczorowski, J. M., Auinger, P., & Weitzman, M. (2004). Overweight children and adolescents: A risk group for iron deficiency. *Pediatrics, 114*(1), 104–108.

Pasricha, S.-R., Drakesmith, H., Black, J., Hipgrave, D., & Biggs, B.-A. (2021). Control of iron deficiency anemia in low- and middle-income countries. *The Lancet Child & Adolescent Health, 5*(5), 320–329.

Permatasari, T., & Sumarmi, S. (2018). The relationship between nutritional status and menstruation with the incidence of anemia in adolescent girls. *Journal of Public Health*.

Petry, N., Olofin, I., Hurrell, R. F., & Boy, E. (2016). The proportion of anemia associated with iron deficiency in low, medium, and high human development index countries: A systematic analysis of national surveys. *Nutrients, 8*(11), 693.

Safitri, R., [et al.]. (2021). Factors associated with anemia in adolescent girls in the working

area of community health centers. *Journal of Health*.

Sari, M., [et al.]. (2022). Factors associated with the incidence of anemia in adolescent girls: A cross-sectional study. *Scientific Journal of Batanghari University Jambi, 22*(2), 758–762.

Stoffel, N. U., Zeder, C., & Zimmermann, M. B. (2020). Anemia and iron deficiency in adolescents: Contemporary issues in screening and diagnosis. *Current Opinion in Pediatrics, 32*(4), 1–9.

Tiwari, A., Kalaivani, M., & Reddy, K. S. (2020). Nutritional status and anemia among adolescents: Evidence from cross-sectional studies. *Journal of Adolescent Health, 67*(4), 552–559.

Triharini, M., Nursalam, N., & Susanto, T. (2020). Determinants of adherence to iron supplementation among adolescent girls: Evidence from Indonesia. *BMC Public Health, 20*(1), 1–10.

UNICEF. (2020). *Adolescent nutrition: Guidance for programmatic action*. United Nations Children's Fund.

World Health Organization. (2016). *Daily iron supplementation in adult women and adolescent girls*. World Health Organization.

World Health Organization. (2021). *Global anaemia estimates, 2021 edition*. World Health Organization.

World Health Organization. (2023). *Anaemia in women and adolescents: Key facts and programmatic considerations*. World Health Organization.

Yilmaz, Z., & Turgut, S. (2021). Association between obesity and iron deficiency anemia: Mechanisms and clinical implications. *Experimental and Therapeutic Medicine, 22*(5), 1–8.

Zimmermann, M. B., & Hurrell, R. F. (2007). Nutritional iron deficiency. *The Lancet, 370*(9586), 511–520.

Zimmermann, M. B., Zeder, C., & Stoffel, N. U. (2021). Obesity and iron deficiency in adolescents: Inflammation, hepcidin, and response to iron. *International Journal of Obesity, 45*(6), 1238–1246.