

Factors Associated with Anemia in Adolescent Girls: An Analysis of the Role of Diet, Physical Activity and Adherence to Iron Supplements at Sehati Vocational School, Karawang

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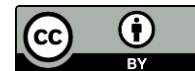
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ABSTRACT

Anemia remains an important public health concern among adolescent girls due to increased iron requirements, menstrual blood loss, and inadequate dietary and supplementation behaviors. Identifying modifiable factors is essential for strengthening school-based anemia prevention. Purpose: This study aimed to analyze the associations of dietary patterns, physical activity, and iron supplements adherence with anemia and identify the factors most strongly associated with anemia after adjustment for relevant covariates. Methods: An analytical observational cross-sectional study was conducted among 63 female students at SMK Sehati Karawang, West Java, Indonesia, in November–December 2025. Participants were selected proportionally by grade level and randomly within each stratum. Data were collected using structured questionnaires, anthropometric measurements, and capillary hemoglobin assessment. Associations were analyzed using Chi-square or Fisher's Exact Test and multiple logistic regression, with AOR, 95% CI, and a 5% significance level. Results: Anemia was identified in 28.6% of respondents. Poor dietary patterns and non-adherence to iron supplements were independently associated with anemia. Poor dietary patterns showed the strongest association (AOR=3.40; 95% CI: 1.20–9.62; p=0.021), followed by non-adherence to iron supplements (AOR=2.90; 95% CI: 1.04–8.10; p=0.041). Physical activity, nutritional status, menstrual duration, and nutritional knowledge were not independently associated with anemia. Implications: School-based prevention should prioritize dietary improvement and strengthen monitoring and behavioral support for regular iron supplements. Conclusion: Dietary



patterns and iron supplements adherence were the main factors associated with anemia. Larger longitudinal studies with specific iron-status biomarkers are warranted.

Keywords: Adolescent Girls Anemia, Dietary Patterns, Iron Supplements, School Health

INTRODUCTION

Anemia remains an important nutritional and public health problem, particularly among women of reproductive age and adolescent girls. Globally, anemia affects more than one-third of women of reproductive age, with a substantial burden concentrated in Africa and Southeast Asia (World Health Organization, 2025). Although global anemia prevalence declined between 2000 and 2013, an increasing trend was subsequently observed among women aged 15–49 years during 2013–2019 (DeLoughery, 2024). Beyond its hematological consequences, anemia may impair physical capacity, concentration, learning performance, productivity, quality of life, and cognitive development. Therefore, anemia prevention among adolescents represents an important public health priority, particularly because adolescence is a period of rapid growth and increased nutritional requirements.

Adolescent girls are particularly vulnerable to anemia because rapid growth increases iron requirements, while menstruation contributes to regular iron loss. These physiological conditions, combined with inadequate dietary intake, may increase susceptibility to iron deficiency and anemia (Indrawatiningsih et al., 2021). Anemia during adolescence may also have consequences extending into the reproductive period, including an increased risk of maternal complications and adverse pregnancy outcomes (Sari et al., 2022). Consequently, adolescent girls represent a strategic population for early anemia prevention.

In Indonesia, anemia among adolescent girls remains a public health concern. The 2023 Indonesian Health Survey (SKI) reported an overall anemia prevalence of 16.2%, including 15.5% among individuals aged 15–24 years. The prevalence was higher among females (18.0%) than males (14.4%), indicating a continuing gender disparity in anemia burden (Ministry of Health, 2024). The government has implemented iron supplementation through the iron tablet (TTD) program for adolescent girls in secondary education. However, program availability does not necessarily translate into regular consumption, as the 2023 SKI indicated that many adolescent girls had never received iron tablets and that regular consumption remained suboptimal. This distinction between access to supplementation and actual adherence is important when evaluating factors associated with anemia.

Dietary patterns constitute an important behavioral and biological determinant of anemia. The risk of anemia is influenced not only by the amount of food consumed but also by energy and protein adequacy, the consumption of heme and non-heme iron sources, dietary diversity and meal frequency, and breakfast habits (Rahman & Fajar, 2024). Iron bioavailability is also affected by dietary components. Tea and coffee consumed with meals may inhibit non-heme iron absorption,



whereas vitamin C can enhance iron absorption (Ayuningtyas et al., 2022). Thus, the quality, diversity, frequency, and composition of dietary intake are relevant when examining anemia among adolescent girls.

Physical activity is another behavioral factor potentially associated with anemia. High levels of physical activity may increase energy and micronutrient requirements and, under particular physiological conditions, may contribute to iron loss through mechanisms involving sweat, menstruation, and other pathways (Irmayanti et al., 2025). Nevertheless, the association between physical activity and anemia may be influenced by dietary intake and nutritional or menstrual status. Therefore, within a cross-sectional study, physical activity should be interpreted as a potential associated factor rather than an independent causal determinant.

Adherence to iron supplementation is also critical because the effectiveness of supplementation programs depends on regular consumption rather than merely the availability or distribution of tablets. A systematic review identified several barriers to adherence among adolescent girls, including forgetfulness, perceived side effects, low perceived necessity, limited knowledge of benefits, and insufficient family or school support (Silitonga et al., 2023). In Indonesia, parental and teacher support have also been associated with adherence to iron supplementation among adolescent girls (Rodhiyana et al., 2022; Yulianti et al., 2023). These findings indicate that assessment of anemia prevention should consider both supplementation access and actual consumption behavior.

Dietary patterns, physical activity, and adherence to iron supplementation may operate simultaneously and may also be related to other characteristics, including age, nutritional status or body mass index, menstrual characteristics, nutritional knowledge, and socioeconomic conditions (Irmayanti et al., 2025; Lubis et al., 2026). Examining these factors simultaneously is therefore important to distinguish the factors that remain associated with anemia after potential confounding variables are considered. Schools provide an important setting for such assessment because they can facilitate nutrition education, iron supplementation, monitoring of consumption, anemia screening, and development of healthy dietary behaviors. However, the effectiveness of school-based prevention may vary according to student characteristics, family circumstances, local dietary practices, and school-level monitoring mechanisms (Sari et al., 2022).

SMK Sehati Karawang provides a relevant setting for examining these associations because vocational students may experience distinctive school routines, practical activities, dietary environments, and patterns of physical activity. Evidence specifically concerning adolescent girls in vocational high schools in Karawang remains limited. Previous research has frequently examined individual determinants of anemia separately, while fewer studies have simultaneously evaluated dietary patterns, physical activity, and adherence to iron supplementation while accounting for relevant covariates (Rahman & Fajar, 2024). This creates a substantive gap concerning the simultaneous contribution of multiple behavioral determinants, a contextual gap concerning adolescent girls in vocational schools in Karawang, and an analytical gap concerning the identification of factors that remain associated with anemia after adjustment for potential confounders.

Understanding these associations is important because the distribution of iron supplements alone may not ensure effective anemia prevention. Identifying modifiable factors that are most strongly associated with anemia can support more targeted school-based interventions, particularly interventions addressing dietary quality and regular adherence to iron supplementation. Therefore, this study aimed to analyze the associations of dietary patterns, physical activity, and adherence to iron supplementation with anemia among adolescent girls at SMK Sehati Karawang and to identify the factors most strongly associated with anemia after adjustment for relevant covariates.

METHODS

1. Study Design and Participants

This analytical observational study used a cross-sectional design to examine the associations of dietary patterns, physical activity, and adherence to iron supplementation with anemia among adolescent girls. The study was conducted at SMK Sehati Karawang, West Java, Indonesia, in November–December 2025. The study population comprised 600 female students in grades X–XII.

Participants were eligible if they were female students who were present during data collection, willing to participate, provided informed consent or assent according to age, and were not experiencing acute illness or fever during hemoglobin assessment. Students who independently consumed high-dose iron supplements, had a history of hematological or iron-metabolism disorders, or had questionnaires with more than 20% missing responses were excluded. Participants younger than 18 years followed the parental consent and participant assent procedure.

2. Sample Size and Sampling

The minimum sample size was estimated using the Lemeshow formula for an analytical cross-sectional study:

$$n = Z^2 P(1 - P)/d^2$$

Using a 95% confidence level ($Z = 1.96$), an expected anemia proportion of 18% ($P = 0.18$), and a precision of 10% ($d = 0.10$), the calculated minimum sample was 57 participants. An additional 10% was included to account for possible non-response and incomplete data, resulting in a final target sample of 63 participants. Students were selected using proportionate stratified random sampling according to grade level, followed by random selection within each stratum. A total of 63 female students participated in the study.

3. Data Collection and Measurement

Data were collected using a structured questionnaire, anthropometric measurements, and capillary hemoglobin assessment. The questionnaire collected information on respondent characteristics, dietary patterns, physical activity, adherence to iron supplementation, nutritional knowledge, menstrual characteristics, and socioeconomic status. Body weight and height were measured using calibrated instruments to determine body mass index (BMI). Hemoglobin concentration was measured by trained health workers using a digital hemoglobinometer and capillary blood according to standard operating procedures. Hemoglobin status was classified



according to the WHO cut-off for adolescent girls, with appropriate altitude adjustment when applicable.

Dietary patterns, physical activity, and adherence to iron supplementation were categorized according to the respective instrument scores and predefined criteria. Adherence to iron supplementation was determined from the proportion of tablets consumed relative to the recommended intake during the specified observation period. Age, grade level, BMI/nutritional status, menstrual characteristics, nutritional knowledge, and socioeconomic status were considered potential covariates and confounders.

The questionnaire instruments were pilot-tested among 20–30 respondents with characteristics similar to the study population but who were not included in the final sample. Validity and reliability testing were conducted before data collection. The final manuscript should report the specific instrument sources, validity coefficients, reliability coefficients, scoring procedures, and cut-off points used for each variable.

4. Data Analysis

Data were analyzed using statistical software with a significance level of 5% and 95% confidence intervals (CI). Descriptive analysis was used to summarize respondent characteristics and variable distributions using frequencies and percentages for categorical variables and appropriate measures of central tendency and dispersion for numerical variables. Bivariate associations between independent variables and anemia status were examined using the Chi-square test or Fisher's Exact Test when the assumptions of the Chi-square test were not met. Associations were expressed as odds ratios (OR) with 95% CI.

Variables with $p < 0.25$ in the bivariate analysis, together with theoretically relevant potential confounders, were considered for multivariable analysis. Multiple logistic regression was used to estimate adjusted odds ratios (AOR), 95% CI, and p -values and to identify factors independently associated with anemia after adjustment for covariates. Model fit, multicollinearity, and the stability of parameter estimates were assessed.

5. Ethical Considerations

Ethical approval was obtained from the authorized health research ethics committee. The ethical approval no.321/USI.EA/XXVI/2026 Written informed consent was obtained according to participant age, with parental consent and participant assent for respondents younger than 18 years. Participants were informed about the study purpose, procedures, potential benefits and discomforts, confidentiality, and their right to refuse or withdraw. Data were coded using unique identifiers and access was restricted to the research team. Respondents identified with hemoglobin levels below the normal threshold were advised to seek follow-up from health professionals or health facilities according to the mechanism established with the school.

RESULTS

1. Respondent Characteristics

A total of 63 adolescent girls participated in the study. Respondent characteristics included age, nutritional status, menstrual characteristics, nutritional knowledge, and the main study variables. In general, respondents were predominantly middle-aged adolescents with relatively normal nutritional status. However, a proportion of respondents still had conditions that could theoretically increase their susceptibility to anemia, particularly poor diet and suboptimal adherence to iron supplements.

Table 1. Characteristics of Research Respondents (n=63)

Characteristics	n	%
Age		
15–16 years	37	58.7
17–18 years	26	41.3
Nutritional status		
Abnormal	15	23.8
Normal	48	76.2
Menstruation		
Duration >7 days	14	22.2
Duration ≤7 days	49	77.8
Nutritional knowledge		
Sufficient	24	38.1
Good	39	61.9
Dietary pattern		
Not good	25	39.7
Good	38	60.3
Physical activity		
Moderate	33	52.4
Sufficient	30	47.6
Iron supplementation adherence		
Non-adherent	28	44.4
Adherent	35	55.6
Anemia status		
Anemia	18	28.6
No anemia	45	71.4

A total of 63 adolescent girls participated in the study. Most respondents were aged 15–16 years and had normal nutritional status. More than half had good nutritional knowledge and dietary patterns, whereas low physical activity and non-adherence to iron supplementation remained relatively common. Anemia was identified in 18 respondents. Overall, the distribution indicates that anemia occurred despite the predominance of normal nutritional status and adequate nutritional



knowledge, highlighting the relevance of behavioral factors, particularly dietary patterns and adherence to iron supplementation.

2. Distribution of Dietary Patterns, Physical Activity, and Iron Tablet Compliance Based on Anemia Status

Subsequent analysis was conducted to examine the distribution of each key factor by anemia status. The results showed a consistent pattern between exposure characteristics and anemia status.

Table 2. Distribution of Main Factors Based on Anemia Status

Variables	Anemia n (%)	No anemia n (%)	Total
Dietary habit			
Not good	12 (48.0)	13 (52.0)	25
Good	6 (15.8)	32 (84.2)	38
Physical activity			
Moderate	12 (36.4)	21 (63.6)	33
Sufficient	6 (20.0)	24 (80.0)	30
Iron supplementation adherence			
Non-adherent	12 (42.9)	16 (57.1)	28
Adherent	6 (17.1)	29 (82.9)	35

The distribution of the main study variables showed a clear pattern across anemia status. Anemia was more frequent among respondents with poor dietary patterns than among those with good dietary patterns. A similar pattern was observed for iron supplementation adherence, with anemia occurring more frequently among non-adherent respondents. Physical activity also showed a higher proportion of anemia among respondents with low activity, although the difference was less pronounced than for dietary patterns and supplementation adherence. These descriptive patterns indicate that dietary patterns and adherence to iron supplementation were the exposures most consistently differentiated according to anemia status.

3. Bivariate Analysis

The relationship between independent variables and anemia incidence was analyzed using the Chi-Square test. The magnitude of the association was assessed using the odds ratio (OR) and 95% CI. Variables with $p < 0.25$ were considered candidates for multivariate logistic regression, according to the analysis procedures specified in the method.

Table 3. Relationship between Diet, Physical Activity, and Iron Supplements Compliance with the Anemia Status

Variables	OR	95% CI	p-value
Dietary habit	4.92	1.60–15.15	0.009
Physical activity	2.29	0.80–6.57	0.170
Adherence to a Supplement Regimen	3.63	1.21–10.86	0.030
Nutritional status	2.94	0.91–9.51	0.090

Menstrual duration >7 days	2.31	0.73–7.30	0.190
Nutritional knowledge	2.00	0.69–5.79	0.210

Bivariate analysis identified dietary patterns and adherence to iron supplementation as significantly associated with anemia. Respondents with poor dietary patterns had higher odds of anemia than those with good dietary patterns (OR=4.92; 95% CI: 1.60–15.15; $p=0.009$). Non-adherence to iron supplementation was also associated with higher odds of anemia (OR=3.63; 95% CI: 1.21–10.86; $p=0.030$).

Physical activity, nutritional status, menstrual duration, and nutritional knowledge were not statistically significant at the 5% level. However, these variables met the predefined $p<0.25$ criterion and were therefore retained as candidates for multivariable analysis.

4. Multivariate Analysis

Multiple logistic regression was performed to determine the most dominant factors associated with anemia incidence after considering confounding variables. Variables that met the bivariate selection criteria and had a theoretical basis were included in the model. This approach aligns with research methods that specify the use of AOR, 95% CI, and p -value as the primary parameters for model interpretation.

Table 4. Multiple Logistic Regression of Factors Associated with the Anemia Status

Variables	B	SE	AOR	95% CI	p-value
Poor diet	1.224	0.532	3.40	1.20–9.62	0.021
Low physical activity	0.405	0.514	1.50	0.55–4.12	0.430
Not complying with Blood Addition Tablets	1.065	0.520	2.90	1.04–8.10	0.041
Abnormal nutritional status	0.693	0.591	2.00	0.63–6.36	0.240
Menstrual duration >7 days	0.470	0.566	1.60	0.53–4.84	0.410
Lack of nutritional knowledge	0.336	0.501	1.40	0.52–3.77	0.500

After adjustment for the covariates included in the model, poor dietary patterns remained the factor most strongly associated with anemia (AOR=3.40; 95% CI: 1.20–9.62; $p=0.021$). Non-adherence to iron supplementation also remained independently associated with anemia (AOR=2.90; 95% CI: 1.04–8.10; $p=0.041$).

In contrast, low physical activity, abnormal nutritional status, menstrual duration >7 days, and lack of nutritional knowledge were not independently associated with anemia in the adjusted model. These findings indicate that, within this study population, dietary patterns and adherence to iron supplementation showed the most consistent associations with anemia after consideration of the selected covariates. Because of the cross-sectional design, these findings should be interpreted as associations and not as evidence of causal relationships.

DISCUSSION

This study found that poor dietary patterns and non-adherence to iron supplementation were independently associated with anemia among adolescent girls at SMK Sehati Karawang. After adjustment for physical activity, nutritional status, menstrual duration, and nutritional knowledge,



poor dietary patterns remained the strongest factor associated with anemia (AOR = 3.40; 95% CI: 1.20–9.62; $p = 0.021$), followed by non-adherence to iron supplementation (AOR = 2.90; 95% CI: 1.04–8.10; $p = 0.041$). In contrast, physical activity, nutritional status, menstrual duration, and nutritional knowledge were not independently associated with anemia. These findings indicate that anemia among adolescent girls in this setting is particularly related to modifiable dietary and supplementation behaviors.

1. Dietary Patterns and Anemia

The significant association between dietary patterns and anemia indicates that adolescent girls with poor dietary patterns were more likely to experience anemia than those with better dietary patterns. The association remained significant after adjustment for other measured characteristics, suggesting that dietary intake represents an important factor in the nutritional context of anemia among the study participants.

This finding is consistent with Ma et al. (2023), who emphasized the importance of dietary intake in maintaining adequate micronutrient availability and preventing iron deficiency. Inadequate dietary patterns may limit the intake of iron and other nutrients required for erythropoiesis, particularly when adolescents have increased nutritional requirements during growth. Dietary quality may also affect the availability of nutrients involved in iron metabolism and hematopoiesis. Therefore, the observed association may reflect the cumulative contribution of inadequate dietary intake to hemoglobin status.

The finding also supports the broader evidence that adolescent girls are particularly vulnerable to anemia because nutritional requirements increase during adolescence while menstrual blood loss may further contribute to iron requirements (DeLoughery, 2024). In the Indonesian context, dietary behavior among adolescents may also be shaped by food preferences, meal patterns, and the availability of nutritious foods. Previous studies have reported associations between dietary characteristics and anemia among adolescent girls (Indrawatiningsih et al., 2021; Sari et al., 2022). Thus, improving dietary quality should be considered an important component of school-based anemia prevention.

2. Adherence to Iron Supplementation and Anemia

Non-adherence to iron supplementation was also independently associated with anemia. Adolescent girls who were non-adherent to iron supplementation had higher odds of anemia than those who adhered to supplementation. This finding is consistent with previous studies reporting the importance of adherence to iron supplementation in reducing the likelihood of anemia among adolescent girls (Efendi et al., 2025; Taufiqurrahman et al., 2025; Lestari & Handayani, 2023).

The relationship can be interpreted through the Health Belief Model (HBM), particularly the role of perceived susceptibility, perceived benefits, perceived barriers, and cues to action in shaping health behavior. Adherence to supplementation is not determined solely by the availability of iron tablets but also by adolescents' perceptions, knowledge, motivation, and experiences related to supplementation. Barriers such as forgetting to take supplements, unpleasant taste or side effects, and limited understanding of their preventive benefits may reduce adherence. Therefore, the

provision of iron supplementation should be accompanied by continuous education, appropriate communication, monitoring, and reinforcement of adherence behavior.

The present findings suggest that school-based supplementation programs may benefit from approaches that address both access and behavioral adherence. Education should emphasize the purpose of iron supplementation and its relevance to adolescent health, while schools and health services can strengthen reminder and monitoring mechanisms. Such strategies may be more effective than relying solely on the distribution of supplements.

3. Physical Activity and Anemia

Physical activity was not independently associated with anemia in the multivariable analysis. Although anemia was more frequently observed among participants with low physical activity in the descriptive analysis, the association did not remain statistically significant after adjustment for other variables. This finding suggests that physical activity alone may not be a primary determinant of anemia in this study population.

The absence of an independent association may reflect the multifactorial nature of anemia. Hemoglobin status is influenced by dietary intake, iron availability, supplementation, physiological requirements, menstrual blood loss, and other nutritional or health-related factors. Consequently, differences in physical activity may not translate directly into differences in anemia status when more proximal nutritional factors are considered. This interpretation is consistent with the finding that dietary patterns and supplementation adherence showed stronger independent associations with anemia.

4. Nutritional Status, Menstrual Duration, and Nutritional Knowledge

Nutritional status, menstrual duration, and nutritional knowledge were not independently associated with anemia in the final multivariable model. Although these variables showed some differences in the descriptive and bivariate analyses, their associations did not reach statistical significance after adjustment. These findings should not be interpreted as evidence that these factors are irrelevant to anemia. Rather, within the characteristics and sample size of this study, their independent associations could not be demonstrated.

Menstrual blood loss remains biologically relevant to iron requirements among adolescent girls. DeLoughery (2024) described iron loss through menstruation as an important consideration in iron deficiency, while Larsuphrom and Latunde-Dada (2021) highlighted the role of hepcidin in regulating iron absorption and systemic iron availability. Differences in menstrual duration may therefore contribute to iron balance; however, the relatively small sample and categorization of menstrual duration in the present study may have limited the ability to detect an independent statistical association.

Similarly, nutritional knowledge does not necessarily translate into appropriate dietary behavior or supplementation adherence. Adolescents may possess adequate knowledge but still encounter practical, social, or behavioral barriers to implementing recommended practices. This



distinction may help explain why nutritional knowledge was not independently associated with anemia, whereas dietary patterns and supplementation adherence showed stronger associations.

5. Implications for Anemia Prevention

The findings have practical implications for adolescent anemia prevention in school settings. Interventions should move beyond the distribution of iron supplements alone and incorporate strategies to improve dietary quality and sustained supplementation adherence. Schools, health workers, and families can collaborate to strengthen nutrition education, promote iron-rich food consumption, provide reminders and monitoring for supplementation, and identify barriers to adherence.

The findings also support an integrated approach in which behavioral interventions are combined with routine screening and health education. Because anemia has multiple determinants, school-based programs should consider dietary practices, supplementation behavior, menstrual characteristics, and nutritional status rather than focusing on a single factor. Such an approach is consistent with the multifactorial framework of anemia described in previous literature (DeLoughery, 2024).

6. Strengths and Limitations

This study examined several behavioral and individual characteristics simultaneously and used multivariable logistic regression to identify factors independently associated with anemia. Nevertheless, several limitations should be considered. First, the cross-sectional design prevents determination of temporal relationships or causal effects between the identified factors and anemia. Therefore, the observed associations should not be interpreted as causal relationships. Second, dietary patterns, physical activity, nutritional knowledge, and supplementation adherence were assessed using questionnaire-based measures and may therefore be subject to recall or reporting bias. Third, the study was conducted at a single vocational school with a relatively small sample, which limits the generalizability of the findings to other adolescent populations. Finally, hemoglobin status alone does not establish iron deficiency; additional biomarkers such as serum ferritin would provide a more comprehensive assessment of iron status.

Overall, the findings indicate that poor dietary patterns and non-adherence to iron supplementation were the two factors most strongly associated with anemia among adolescent girls in this study. These results reinforce the importance of combining nutritional improvement with strategies that promote sustained adherence to iron supplementation in school-based anemia prevention programs.

CONCLUSIONS

Poor dietary patterns and non-adherence to iron supplementation were independently associated with anemia among adolescent girls at SMK Sehati Karawang. Poor dietary patterns showed the strongest adjusted association with anemia, followed by non-adherence to iron supplementation. Physical activity, nutritional status, menstrual duration, and nutritional

knowledge were not independently associated with anemia in the final multivariable model. These findings highlight the importance of strengthening school-based anemia prevention through improved dietary practices and sustained adherence to iron supplementation. Because of the cross-sectional design, the findings indicate associations rather than causal relationships. Further longitudinal studies involving multiple schools and more comprehensive indicators of iron status, including serum ferritin, are recommended to clarify temporal relationships and underlying mechanisms.

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REFERENCES

- Apriningsih, Madanijah, S., Dwiriani, C. M., & Kolopaking, R. (2020). Determinant Of Highschool Girl Adolescent' Adherence To Consume Iron Folic Acid Supplementation In Kota Depok. *Journal of Nutritional Science and Vitaminology*, 66, S369–S375. <https://doi.org/10.3177/jns.v66.s369>
- Ayuningtyas, I. N., Tsani, A. F. A., Candra, A., & Dieny, F. F. (2022). Analisis Asupan Zat Besi Heme Dan Non Heme, Vitamin B12 Dan Folat Serta ASUPAN Enhancer Dan Inhibitor Zat Besi Berdasarkan Status Anemia Pada Santriwati. *Journal of Nutrition College*, 11(2), 171–181. <https://doi.org/10.14710/jnc.v11i2.32197>
- DeLoughery, E. P. (2024). Global Prevalence Of Anemia Among Women Of Reproductive Age, 2000–2019. *European Journal of Haematology*, 113(2), 253–256. <https://doi.org/10.1111/ejh.14227>
- Efendi, K. A., Yuniastuti, A., & Zainafree, I. (2025). Perceptions And Beliefs Of Adolescent Girls Regarding Adherence To Iron Supplementation: An Analysis Using The Health Belief Model. *Nursing and Health Sciences Journal (NHSJ)*, 5(3), 364–372. <https://doi.org/10.53713/nhsj.v5i3.570>
- Indrawatiningsih, Y., Hamid, S. A., Sari, E. P., & Listiono, H. (2021). Faktor-Faktor yang Mempengaruhi Terjadinya Anemia pada Remaja Putri. *Jurnal Ilmiah Universitas Batanghari Jambi*, 21(1). <https://doi.org/10.33087/jiubj.v21i1.1116>
- Irmayanti, I., Amir, S., & Hasnidar, H. (2025). Analisis Hubungan Gaya Hidup Sedentari Dan Pola Makan Dengan status gizi pada remaja di SMA negeri 1 bone. *Action Research Literate*, 9(10), 2147–2163. <https://doi.org/10.46799/ar.v9i10.3051>
- Kemendes. (2024). *Survei kesehatan Indonesia (SKI) 2023*. Badan Kebijakan Pembangunan Kesehatan. <https://www.badankebijakan.kemkes.go.id/hasil-ski-2023/>



- Larsuphrom, P., & Latunde-Dada, G. O. (2021). Association Of Serum Hepcidin Levels With Aerobic And Resistance Exercise: A Systematic Review. *Nutrients*, 13(2), 393. <https://doi.org/10.3390/nu13020393>
- Lestari, R. A., & Handayani, O. W. K. (2023). Analisis multilevel Hubungan Ekologi Sekolah Terhadap Kepatuhan Konsumsi Tablet Tambah Darah Pelajar SMA Putri Kota Semarang. *Jurnal Kesehatan*, 16(3), 255–267. <https://doi.org/10.23917/jk.v16i3.2529>
- Lubis, M. M., Azzahra, S., & Apriningsih, A. (2026). Determinants Of Anemia Among Adolescent Girls: A Systematic Literature Review. *Jurnal Kesmas Jambi*, 10(1), 1–9. <https://doi.org/10.22437/jkmj.v10i1.53616>
- Ma, J., Huang, J., Zeng, C., Zhong, X., Zhang, W., Zhang, B., & Li, Y. (2023). Dietary Patterns And Association With Anemia In Children Aged 9–16 Years In Guangzhou, China: A Cross-Sectional Study. *Nutrients*, 15(19), 4133. <https://doi.org/10.3390/nu15194133>
- Rahman, R. A., & Fajar, N. A. (2024). Analysis of Anemia Risk Factors Among Adolescent Women: Literature Review. *Jurnal Kesehatan Komunitas (Journal of Community Health)*, 10(1), 133–140. <https://doi.org/10.25311/keskom.vol10.iss1.1403>
- Rodhiyana, R., Budi Amalia, R., & Adityawarman, A. (2022). The Effect Of Supporting On Adherence To Fe Tablet Consumption In Adolescent Women. *Indonesian Midwifery and Health Sciences Journal*, 6(3), 319–328. <https://doi.org/10.20473/imhsj.v6i3.2022.319-328>
- Sari, P., Herawati, D. M. D., Dhamayanti, M., & Hilmanto, D. (2022). Anemia Among Adolescent Girls In West Java, Indonesia: Related Factors And Consequences On The Quality Of Life. *Nutrients*, 14(18), 3777. <https://doi.org/10.3390/nu14183777>
- Silitonga, H. T. H., Salim, L. A., Nurmala, I., & Wartiningsih, M. (2023). Compliance Of Iron Supplementation And Determinants Among Adolescent Girls: A Systematic Review. *Iranian Journal of Public Health*, 52(1). <https://doi.org/10.18502/ijph.v52i1.11664>
- Taufiqurrahman, Hafid, F., Mujayanto, M., Nuswantari, A., Ratno, R., Rahayuningtyas, R., Prasetyawan, A. E., & Sri Rahayu, Y. (2025). Iron Supplement Adherence, Dietary Intake, And Anemia Risk Among Adolescent Girls In Madiun Regency, Indonesia. *Journal of Health and Nutrition Research*, 4(3), 1354–1363. <https://doi.org/10.56303/jhnresearch.v4i3.723>
- World Health Organization. (2025). *WHO global anaemia estimates*. World Health Organization. <https://www.who.int/publications/i/item/9789240113930>
- Yulianti, F., Herdhianta, D., & Ediyono, S. (2023). Faktor-Faktor Yang Memengaruhi Kepatuhan remaja Putri Dalam Mengonsumsi Tablet Tambah Darah Di Kota Bandung. *Ikesma*, 19(4), 282. <https://doi.org/10.19184/ikesma.v19i4.43850>