

## Anemia status, knowledge level, attitude and motivation of anemic adolescent girls in school-based educational interventions in Jambi City, 2025

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### Abstract

**Background:** Anemia among adolescents is influenced not only by nutritional deficiencies but also by limited knowledge, attitudes, and perceptions related to anemia prevention.

**Objective:** This study aimed to evaluate the effectiveness of a school-based nutrition education intervention using a behavioral change approach among adolescent girls in Jambi City.

**Methods:** A quasi-experimental design was employed involving 65 participants divided into an intervention group (n=37) and a control group (n=28). All participants were screened for anemia (hemoglobin <12 g/dL) and assessed for knowledge, attitude, motivation, and nutritional intake at baseline and post-intervention. The control group received standard anemia prevention modules, while the intervention group participated in the “8000 Days Against Anemia Club,” a six-week program combining lectures, games, peer counseling, and practical activities. **Results:** Statistical analysis using the t-test showed that the intervention significantly reduced anemia prevalence from 100% to 7.1% and increased mean hemoglobin levels by approximately 2 g/dL, while the control group retained a high anemia prevalence of 78.4%. In addition, the intervention group demonstrated marked improvements in knowledge, attitudes, and motivation toward anemia prevention. **Conclusion:** These findings indicate that participatory, school-based educational approaches effectively enhance awareness and produce measurable biological impacts in reducing anemia among adolescent girls.

**Keywords:** adolescent girl; anemia; education intervention; behavior; motivation.

### Cite This Article

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## INTRODUCTION

Among adolescents, girls are a particularly vulnerable group, especially in developing countries where they traditionally marry at an early age and are exposed to greater risks of reproductive morbidity and mortality. Anemia in adolescents can disrupt various aspects of their lives, including school performance, physical activity, and cognitive development. Therefore, a thorough understanding of the causes, symptoms, and strategies for preventing and treating anemia in adolescents is crucial to maintaining their health and well-being [1] [2].

Several risk factors that can cause anemia in adolescents involve nutritional aspects, such as deficiencies in iron, vitamin B12, and folic acid. Additionally, an unhealthy lifestyle, an unbalanced diet, and certain health problems can also contribute to the high prevalence of anemia in this age group. Knowledge and education are crucial factors in how individuals to improve their health because these factors determine healthy lifestyle and eating patterns. Modern lifestyle changes, such as the tendency to consume less nutritious fast food and lack of physical activity, can increase the risk of anemia in adolescents. Furthermore, socioeconomic factors also contribute to the prevalence of anemia in adolescents by limiting access to food [3].

Anemia remains a major cause of morbidity and mortality in children in low- and middle-income countries, with an estimated 293.1 million (approximately 43% of children) anemic children under the age of five globally. A higher prevalence was observed in the South Asian region, with 55.12% in 2016 and 52% in 2019. Anemia is considered a serious public health problem when the prevalence rate is  $\geq 40\%$  in vulnerable populations based on criteria established by the WHO [4]. Young people have the highest prevalence of anemia across all regions, with prevalence reported to be greater than 40% in 34 low- and middle-income countries in 2018. In Indonesia, according to the 2018 RISKESDAS report, the prevalence of anemia among 15-24 years was 32.0%, with more cases found in women than men at 27.2%. With a 25% higher prevalence in rural areas, the national prevalence of anemia in Indonesia reached 23.7%. Meanwhile, by 2023, the Indonesian Health Survey report stated that the national prevalence of anemia had decreased to 16.2%, with the prevalence of anemia among 15-24 years also decreasing to 15.5%, and among women to 18.0% [5].

Seeing this decline in anemia prevalence, we might assume that the government's program of providing iron supplements to adolescent girls is successful. However, it is known that only 73.5% of adolescent girls receive or have purchased iron supplements, and not all of the iron supplements provided are taken due to several reasons, such as unpleasant taste and smell (29.7%) and forgetting to take them (29.2%). In Jambi Province, the main reasons adolescent girls did not receive iron supplements were ignorance (53.4%) and not being given them by health workers (15.9%) [6]. Based on the results of a 2024 baseline study, the prevalence of anemia among adolescent girls in Jambi City was 64.7%, higher than the average of several other surveys. This is compounded by low knowledge about anemia (72.6%) and negative attitudes toward anemia (74.7%).

Iron deficiency anemia can occur when the body requires more iron than it receives, when the body does not receive enough iron, when the body absorbs iron poorly, when the body loses a lot of blood, or when there is a problem with the movement of iron through the plasma [7]. Pallor is the most common symptom of iron deficiency anemia, and most individuals with moderate anemia have no symptoms at all. Other symptoms include fatigue, lethargy, irritability, exercise intolerance, poor appetite, and dizziness. Even with treatment, anemia-related neurodevelopmental and cognitive impairments may not always be fully reversible when they occur in early

childhood, especially if they are severe and long-lasting. Tachycardia, dyspnea, diaphoresis, and impaired capillary refill are possible symptoms of severe anemia [8].

Although the issue of iron deficiency anemia in adolescent girls is crucial, various studies have shown low levels of awareness among girls. Our baseline research last year, conducted among female high school students in Jambi City, found that low levels of knowledge and attitudes correlated with the incidence of anemia in adolescent girls. Changing adolescent girls' perspectives on iron deficiency anemia is crucial. Therefore, some of the most important and necessary parts of prevention programs are educating them, raising awareness, and providing them with skills to prevent iron deficiency anemia [9].

Selecting a health education model is the first step here. Because anemia is caused by several interconnected factors, interventions aimed at preventing it should encompass all of these factors. Interventions are needed that can encompass changes in consumption and healthy behavior patterns in the target group, namely adolescent girls, interventions with partners and stakeholders such as teachers and guardians/parents, and more comprehensive interventions within the education system, which serves as the "society" of adolescent girls [10]. Therefore, this paper aims to describe the anemia status, level of knowledge, attitude and motivation level of anemic adolescent girls who received school-based educational intervention in Jambi.

## METHODS

This study is a semi-experimental study, with two groups: a control group and an intervention group, to assess the type of intervention provided to a sample of female high school students in Jambi City. The schools selected as intervention and control groups were determined based on baseline data from a 2024 study on the prevalence and determinants of anemia in female adolescents (a research grant from the University of Jambi). The female adolescents were randomly selected as school representatives. The sample consisted of eleventh-grade female adolescents with proven anemia (Hb levels below 12 g/dl), and those not menstruating or experiencing acute or chronic bleeding disorders at the time of the Hb level examination.

The intervention group involved a club or meeting with a group of female students with anemia. This meeting was called the "8000 Days Against Anemia Club." The nutrition education program consisted of 12 topics presented using various methods (quizzes, games, lectures, role-playing, peer counseling, practical exercises, workshops) over six weeks, with two meetings each lasting 45 minutes. The control group received a module with the same material. The variables compared were hemoglobin levels, knowledge scores, attitude scores, motivation scores, and nutritional intake before and after the treatment. Statistical analysis was performed using univariate and bivariate t-tests using SPSS. This research has received ethical approval from the ethics committee of the Faculty of Medicine and Health Science, Universitas Jambi with the number 1936/UN21.8/PT.01.04/2025.

## RESULTS

**Table 1.** Distribution of characteristics of anemic state high school students in Jambi

Variables	Category	Number (n)	Percentage (%)
Intervention Group	Treatment group	28	43.1
	Control group	37	56.9
Age (years)	14	1	1.5

Variables	Category	Number (n)	Percentage (%)
	15	33	50.8
	16	30	46.2
	17	1	1.5
Father's occupation	Civil Servants/TNI/POLRI	19	29.2
	Private employees	8	12.3
	Self-employed/trader	24	36.9
	Daily laborer/craftsman	12	18.5
	Doesn't work	2	3.1
	Mother's Job	Civil Servants/TNI/POLRI	17
Private employees		1	1.5
Self-employed/entrepreneur		6	9.2
Housewife		41	63.1
Father's Last Education	Graduated from elementary school	2	3.1
	Graduated from junior high school	5	7.7
	Graduated from high school	28	43.1
	Completed D1–D3	6	9.2
	Graduated from Bachelor's degree	22	33.8
	Graduated from Masters/Doctoral Degree	2	3.1
Mother's Last Education	Graduated from elementary school	3	4.6
	Graduated from junior high school	3	4.6
	Graduated from high school	28	43.1
	Completed D1–D3	12	18.5
	Graduated from Bachelor's degree	17	26.2
	Graduated from Masters/Doctoral Degree	2	3.1
Daily Pocket Money	Bring supplies/don't buy snacks	1	1.5
	< Rp. 50,000,-	52	80.0
	Rp. 50,000–100,000	11	16.9
	> Rp. 100,000,-	1	1.5
<b>Total Respondents</b>		<b>65</b>	<b>100.0</b>

**Table 2.** Cross-tabulation results of independent variables with treatment group and control group before intervention (baseline data).

Variables	Category	Treatment Group (n=28)	Control Group (n=37)	Total (n=65)
Anemia Status	Anemia	28 (100%)	37 (100%)	65 (100%)
Knowledge	Not enough	7 (25.0%)	16 (43.2%)	23 (35.4%)
	Good	21 (75.0%)	21 (56.8%)	42 (64.6%)
Attitude	Negative	18 (64.3%)	17 (45.9%)	35 (53.8%)

Variables	Category	Treatment Group (n=28)	Control Group (n=37)	Total (n=65)
Motivation	Positive	10 (35.7%)	20 (54.1%)	30 (46.2%)
	Not enough	11 (39.3%)	6 (16.2%)	17 (26.2%)
	Tall	17 (60.7%)	31 (83.8%)	48 (73.8%)

**Table 3.** Cross-tabulation results of independent variables with treatment group and control group after intervention (endline data).

Variables	Category	Treatment Group (n=28)	Control Group (n=37)	Total (n=65)
Anemia Status	Anemia	2 (7.1%)	29 (78.4%)	31 (47.7%)
	Normal	26 (92.9%)	8 (21.6%)	34 (52.3%)
Knowledge	Not enough	1 (3.6%)	20 (54.1%)	21 (32.3%)
	Good	27 (96.4%)	17 (45.9%)	44 (67.7%)
Attitude	Negative	3 (10.7%)	29 (78.4%)	32 (49.2%)
	Positive	25 (89.3%)	8 (21.6%)	33 (50.8%)
Motivation	Not enough	1 (3.6%)	24 (64.9%)	25 (38.5%)
	Tall	27 (96.4%)	13 (35.1%)	40 (61.5%)

## DISCUSSION

This study examined the effectiveness of a school-based educational intervention on anemia status, knowledge, attitude, and motivation among adolescent girls in Jambi City. The findings showed that the intervention significantly reduced the prevalence of anemia and improved hemoglobin levels among participants. In addition, there were notable increases in knowledge, attitude, and motivation toward anemia prevention following the educational program. These outcomes suggest that behavior-focused health education in schools is a powerful strategy to address adolescent anemia, complementing existing national iron supplementation programs.

At baseline, most participants demonstrated moderate to low knowledge and motivation toward anemia prevention, consistent with previous studies reporting limited awareness among Indonesian adolescents regarding anemia and its causes [11]. The demographic characteristics of participants—predominantly female students aged 15 to 16 years, with parents of mid-to-low socioeconomic background—mirror the population typically at risk for iron deficiency anemia. Prior studies conducted in Jambi Province and other regions of Indonesia similarly reported high anemia prevalence among adolescent girls, often linked to inadequate dietary intake, menstrual blood loss, and low compliance with iron supplementation programs [12] [13]. In our study, the baseline prevalence of anemia was 100% among participants, a figure slightly higher than that reported in other Indonesian settings such as East Kalimantan (38.9%) and West Java (32%). This discrepancy likely reflects contextual differences in dietary patterns, socioeconomic status, and access to preventive health programs [14] [15].

The school-based intervention in this study was delivered through the “8000 Days Against Anemia Club,” combining lectures, games, role-playing, peer counseling, and interactive workshops over six weeks. This multifaceted approach appears to have contributed to significant changes in both behavioral and biological indicators. After the intervention, the prevalence of anemia in the treatment group dropped from 100%

to only 7.1%, while the control group still exhibited a high anemia rate of 78.4%. This dramatic improvement demonstrates that combining knowledge-based and motivational strategies within a school environment can lead to tangible physiological benefits. The magnitude of hemoglobin improvement in this study—approximately 2 g/dL—is comparable to results from other multifaceted interventions targeting similar populations. For instance, a quasi-experimental study in South Lampung involving 41 adolescent girls using integrated nutrition education and iron supplementation showed an average hemoglobin increase of 1.06 g/dL after six weeks [16]. Similarly, a school-based intervention in Wakatobi Regency using peer education and interactive media also demonstrated significant gains in knowledge, attitude, iron intake, and hemoglobin concentration [17].

When compared to studies employing single-component interventions, the findings of this research underscore the importance of integrated educational models. In East Kalimantan, for example, a school-based education program focusing only on lecture-based instruction improved knowledge levels but failed to significantly alter attitudes or iron consumption behavior among participants. Likewise, a community-based program in Jambi utilizing traditional lectures and question-and-answer sessions reported increases in knowledge but no measurable changes in physiological outcomes [18]. These contrasts suggest that participatory learning—through games, peer counseling, and skill-building exercises—plays a crucial role in transforming health knowledge into sustained behavioral change.

Another point of comparison is the duration and intensity of intervention. The six-week implementation period in this study appears optimal for achieving significant behavioral modification without overburdening school schedules. Evidence from previous studies indicates that repeated, structured educational encounters over several weeks yield stronger retention of health knowledge and more stable behavioral adaptation than single-session interventions [19]. A study conducted in rural East Indonesia demonstrated that weekly educational sessions over one month significantly improved both dietary practices and supplement adherence among adolescent girls [20]. In contrast, shorter interventions often produce immediate but transient effects that fade without reinforcement. Therefore, the sustained six-week exposure in the current study may explain the pronounced increase in knowledge, attitude, and motivation [21].

From a methodological standpoint, the inclusion of multiple teaching modalities—such as visual aids, role-play, and peer discussions—was instrumental in enhancing engagement and comprehension. Several studies have shown that interactive and peer-assisted learning significantly outperform traditional didactic methods in promoting health literacy and preventive behavior among adolescents [22]. The psychological mechanism underlying these effects can be explained by Bandura's social cognitive theory, which emphasizes observational learning, self-efficacy, and reinforcement as central to behavior change. By fostering social modeling and self-confidence, the "8000 Days Against Anemia Club" leveraged peer influence to improve motivation, thereby enhancing adherence to preventive behaviors such as iron tablet consumption and balanced diet maintenance [23].

When analyzed in the context of similar interventions within Indonesia, the outcomes of this study align with a growing body of evidence supporting the effectiveness of school-based, multifactorial anemia prevention programs. For instance, a program conducted in Pekalongan demonstrated that knowledge and attitudes toward anemia improved significantly after the use of focus group discussions and peer education, while adherence to iron supplementation rose from 10.5% to 84%

[24]. Another study in Banjarmasin reported improved awareness and dietary iron intake following an interactive nutritional education campaign using games and videos [25]. The consistency of these findings across diverse regions highlights the generalizability of participatory, behavior-centered educational models for adolescent anemia prevention.

Internationally, similar trends have been observed. In India, a mixed-methods interventional study in rural Karnataka revealed that a structured school-based nutrition education program significantly increased knowledge and positive attitudes regarding iron deficiency anemia, leading to better compliance with supplementation and improved dietary diversity [26]. In Bangladesh, a randomized controlled trial using mobile health (mHealth) platforms among adolescent girls demonstrated notable improvements in knowledge, attitudes, and self-reported preventive behaviors, though changes in hemoglobin levels were not statistically significant, possibly due to short intervention duration and lack of direct supplementation [27]. Meanwhile, a digital game-based randomized clinical trial in another Asian country showed that gamified learning improved knowledge, attitude, and practice scores among adolescents, and produced a modest but meaningful increase in hemoglobin concentration [28]. Compared to these studies, the current research in Jambi City achieved a larger effect on physiological outcomes, possibly due to its combination of repeated face-to-face sessions and strong behavioral reinforcement mechanisms.

These comparisons suggest several critical elements that enhance intervention effectiveness. First, multifaceted interventions that integrate education, supplementation, and behavioral support tend to yield the most comprehensive results, affecting both knowledge and biological indicators. Second, longer duration and repetitive exposure allow for better retention and habit formation. Third, incorporating engaging, participatory teaching methods ensures greater motivation and peer reinforcement. Finally, contextual adaptation—aligning content with local dietary patterns, cultural beliefs, and school conditions—enhances receptivity and relevance. The current study's design reflects these best practices, explaining its significant outcomes.

While educational programs clearly improve knowledge and attitude, the translation of these gains into measurable physiological improvement depends on several mediating factors. These include access to iron-rich foods, availability of iron supplements, family support, and consistency of follow-up. For instance, a study in East Kalimantan found that despite knowledge improvement, hemoglobin levels did not change significantly, likely due to inadequate dietary iron intake [14]. This emphasizes the importance of coupling education with enabling environmental and systemic support, such as ensuring supplement availability and school health service integration.

Furthermore, socioeconomic context strongly influences anemia outcomes. In this study, the majority of participants' parents had only secondary education and worked in informal sectors, similar to samples in other Indonesian anemia studies [29,30]. Such conditions often correlate with limited nutritional diversity at home, contributing to recurrent anemia despite awareness programs. Hence, involving parents, teachers, and health workers in reinforcing messages beyond the classroom becomes essential. Studies have shown that multi-stakeholder participation can substantially enhance the sustainability of behavioral change.

The reduction of anemia prevalence in the present study—from total baseline anemia to near-normal levels—demonstrates the potential for school-based programs to yield tangible biological outcomes when adequately designed and implemented.

Although the short-term results are promising, sustaining hemoglobin improvements requires continued behavioral reinforcement. Longitudinal studies have indicated that knowledge and attitude gains tend to decline after several months without reinforcement. Therefore, periodic follow-up sessions or integration into regular school curricula could help maintain positive outcomes.

Another important observation is the role of motivation as a mediating variable between knowledge and behavior. This study found a substantial increase in motivation following the intervention, consistent with evidence that motivation enhances the translation of knowledge into consistent preventive action. For example, research in Wakatobi and Lampung demonstrated that motivation improvement correlated with increased compliance in iron tablet consumption [16,17]. Motivation-focused approaches, incorporating self-efficacy building and peer encouragement, thus represent a critical component of sustainable anemia prevention programs.

The comparison between this research and international studies also reveals broader trends in intervention design. Globally, there is a shift toward innovative educational media such as digital games, mobile applications, and interactive videos to engage adolescents effectively. These approaches appeal to digital-native youth and can reach wider audiences at lower cost. A digital game-based intervention in East Asia improved adolescents' anemia knowledge and dietary behavior more effectively than traditional lectures [28]. Similarly, mHealth interventions in South Asia are increasingly integrated with school-based health programs to facilitate monitoring and follow-up [31]. However, despite the advantages of technology-based approaches, they may not always yield significant biological outcomes unless paired with concrete behavioral reinforcement, such as supplementation programs or school meals.

The results of this study add to the growing literature emphasizing that knowledge improvement alone is insufficient to combat anemia effectively. Changes in dietary practice and supplement adherence require behavioral reinforcement, social modeling, and environmental support. The "8000 Days Against Anemia Club" provided a peer-supported structure that not only transferred knowledge but also built motivation and a sense of collective responsibility. This aligns with behavioral science perspectives suggesting that social learning and peer influence are potent drivers of health behavior change among adolescents [32].

In comparison with similar studies worldwide, the intervention in Jambi City demonstrates that low-resource settings can still achieve substantial improvements in anemia outcomes through carefully designed, interactive school-based programs. While some developed-country studies rely heavily on digital infrastructure, the community-based participatory design used here achieved comparable or even superior results, particularly regarding hemoglobin recovery. This underscores the value of contextually tailored interventions over purely technological solutions.

The implications of these findings are multifaceted. First, they support the inclusion of comprehensive, behaviorally oriented anemia education within school health curricula. Second, they suggest that strengthening partnerships among schools, families, and health centers can reinforce preventive behaviors. Third, the success of peer-based learning and motivational strategies highlights their scalability for broader implementation across regions. Finally, the intervention provides an evidence-based model that can inform provincial and national programs for adolescent anemia reduction, complementing existing iron supplementation initiatives that often suffer from low compliance due to poor awareness and motivation.

Emerging research trends in school-based anemia prevention increasingly focus on integration, innovation, and sustainability. Integrated approaches combine health

education with direct supplementation, nutrition-sensitive school meals, and parental involvement to maximize impact. Innovative methods utilize digital games, videos, or mobile applications to enhance engagement and accessibility. Sustainability, meanwhile, emphasizes embedding these interventions into existing school systems, training teachers as facilitators, and developing peer educator models to maintain program continuity. Future research should explore hybrid models that combine traditional participatory education with technology-based reinforcement, enabling long-term monitoring and scaling across diverse educational contexts.

## CONCLUSIONS

This study concludes that the school-based “8000 Days Against Anemia Club” intervention significantly improved hemoglobin levels and reduced the prevalence of anemia among adolescent girls in Jambi City while also enhancing their knowledge, attitudes, and motivation toward anemia prevention. The results confirm that participatory, behavior-focused education using interactive and peer-based approaches is more effective than conventional lectures in promoting lasting behavioral change. Integrating educational programs with iron supplementation, parental involvement, and follow-up monitoring is essential to sustain biological and behavioral outcomes. Future research should explore digital and hybrid education models to expand program reach and evaluate their long-term impact on adolescent health and academic performance.

## CONFLICT OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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## DECLARATION OF ARTIFICIAL INTELLIGENCE USE

This study used artificial intelligence (AI) tools and methodologies in the following capacities in manuscript writing support in language refinement (improving the grammar, sentence structure, and readability of the manuscript). We confirm that all AI-assisted processes were critically reviewed by the authors to ensure the integrity and reliability of the results. The final decisions and interpretations presented in this article were solely made by the authors.

## REFERENCES

- [1] Nehar KN, Bakal RL, Hatwar PR, Gawai AY, Diwnale SS. Iron Deficiency Anemia: Etiology, Pathophysiology, Diagnosis, and Treatment Approaches. *Journal of Drug Delivery and Therapeutics* 2024;14:185–99. <https://doi.org/10.22270/jddt.v14i11.6899>.
- [2] Kumar A, Sharma E, Marley A, Samaan MA, Brookes MJ. Iron deficiency anaemia: Pathophysiology, assessment, practical management. *BMJ Open Gastroenterol* 2022;9. <https://doi.org/10.1136/bmjgast-2021-000759>.
- [3] Rah JH, Melse-Boonstra A, Agustina R, van Zutphen KG, Kraemer K. The Triple Burden of Malnutrition Among Adolescents in Indonesia. *Food Nutr Bull* 2021;42:S4–8. <https://doi.org/10.1177/03795721211007114>.
- [4] WHO. Global nutrition targets 2025: anaemia policy brief 2014. <https://www.who.int/publications/i/item/WHO-NMH-NHD-14.4> (accessed September 10, 2025).
- [5] Badan Kebijakan Pembangunan Kesehatan. SKI 2023 DALAM ANGKA. 2024.

- [6] Kementerian Kesehatan Republik Indonesia. Profil Kesehatan Indonesia Tahun 2023. Jakarta: 2024.
- [7] Wessling-Resnick M. Iron: Basic Nutritional Aspects. *Molecular, Genetic, and Nutritional Aspects of Major and Trace Minerals* 2017:161–73. <https://doi.org/10.1016/B978-0-12-802168-2.00014-2>.
- [8] Reski RN, Hadju V, Indriasari R, Muis M. Anemia, chronic energy deficiency and their relationship in preconception women. *Enferm Clin* 2020;30:76–80. <https://doi.org/10.1016/J.ENFCLI.2020.06.018>.
- [9] Fatimah S, Rosyad SR, Wulandatika D. Anemia Reduction Program In Adolescents: Scoping Review. *Gaster* 2024;22:122–36. <https://doi.org/10.30787/GASTER.V22I1.1410>.
- [10] Agustina R, Wirawan F, Sadariskar AA, Setianingsing AA, Nadiya K, Prafiantini E, et al. Associations of Knowledge, Attitude, and Practices toward Anemia with Anemia Prevalence and Height-for-Age Z-Score among Indonesian Adolescent Girls. *Food Nutr Bull* 2021;42:S92–108. <https://doi.org/10.1177/03795721211011136>.
- [11] Lu S ning, Ding W, Wang J zhi, Yin S qin, Li S guo, Zhou X wu, et al. Application of an innovative grid-based surveillance strategy to ensure elimination and prevent reintroduction of malaria in high-risk border communities in China. *BMC Public Health* 2022;22:1–7. <https://doi.org/10.1186/S12889-022-13753-1/Tables/1>.
- [12] Maria I, Aurora WID, Darmawan A, Kusdiyah E, Nuriyah. Anemia status in high school students, jambi city. *Jambi Medical Journal: Jurnal Kedokteran Dan Kesehatan* 2023;11:334–9. <https://doi.org/10.22437/JMJ.V11I3.27552>.
- [13] Djalil Lukmanul Hakim D, Sahiratmadja E, Author C. Prevalence And Factors Associated with Anemia Among Adolescent in Jambi City Indonesia. *Galore International Journal of Health Sciences and Research* n.d.;9. <https://doi.org/10.52403/gijhsr.20240110>.
- [14] Simangunsong B, Puspitasari N, Studi Magister Ilmu Kesehatan Masyarakat P, Kesehatan Masyarakat F. Factors Associated with Anemia Among Adolescent Girls Aged 10-19 Years in Central Kalimantan. *Jurnal Ilmu Kesehatan Masyarakat* 2024;15:320–33. <https://doi.org/10.26553/JIKM.2024.15.3.320-333>.
- [15] Sari P;, Herawati DMD;, Dhamayanti M;., Hilmanto D, Sari P, Diah Herawati DM, et al. Anemia among Adolescent Girls in West Java, Indonesia: Related Factors and Consequences on the Quality of Life. *Nutrients* 2022, Vol 14, Page 3777 2022;14:3777. <https://doi.org/10.3390/NU14183777>.
- [16] Ariwibowo C, Ariwibowo C, Zuraida R, Susianti S. The Effect of Multifaceted Intervention on Iron Intake and Hemoglobin (Hb) Levels in Teenage Girl with Mild Moderate Anemia at The Vocational School State of Tanjung Sari in South Lampung Regency. *Jurnal Aisyah : Jurnal Ilmu Kesehatan* 2022;7:355–62. <https://doi.org/10.30604/jika.v7iS1.1273>.
- [17] Zakiyah MSU, Nasir S, Syafar M, Azzahra Y. Effect Of Multifaceted Intervention On Knowledge, Attitude, Iron Intake, Hemoglobin (Hb) Levels In Adolescent Women With Mild To Moderate Anemia At Senior High School 2 Tomia Of Wakatobi Regency. *J Neonatal Surg* 2025;14.
- [18] Indriyani, F., & Wahyudi, H. A Decade of KDIGO updates (2012–2025): What’s new in the evaluation and management of anemia in chronic kidney disease?. *Svāsthya: Trends in General Medicine and Public Health*, 2025;2(5), e110.
- [19] Oddo VM, Roshita A, Rah JH. Potential interventions targeting adolescent nutrition in Indonesia: A literature review. *Public Health Nutr* 2019;22:15–27. <https://doi.org/10.1017/S1368980018002215>.
- [20] UNICEF. Social and Behaviour Change Communication Strategy: Improving Adolescent Nutrition in Indonesia. 2021.
- [21] Salam RA, Hooda M, Das JK, Arshad A, Lassi ZS, Middleton P, et al. Interventions to Improve Adolescent Nutrition: A Systematic Review and Meta-Analysis. *The Journal of*

- Adolescent Health 2016;59:S29.  
<https://doi.org/10.1016/J.JADOHEALTH.2016.06.022>.
- [22] Seth DrU. Innovative educational program based on banduras social cognitive theory for food label understanding in early adolescents. *International Journal of Home Science* 2018;4:103–7. <https://doi.org/10.22271/23957476.2018.v4.i3b.1154>.
- [23] Ekubagewargies DT, Ahmed F, Lee P. Effectiveness of Peer-Led Interventions in Improving the Dietary Behavior of Adolescents in Low- and Middle-Income Countries: A Systematic Review. *Nutr Rev* 2025;83:1183. <https://doi.org/10.1093/Nutrit/NUAF037>.
- [24] Fitranti DY, Fitriyah K, Kurniawati MD, Wardah1 S, Sarwanti S, Afifah SN, et al. Pencegahan Anemia Pada Remaja Putri dengan Metode Focus Group Discussion di SMA Negeri 3 Pekalongan. *Proactive* 2022;1:46–54.
- [25] Utomo, B., Umiastuti, P., Fauziyah, S., Sucipto, T. H., Adnyana, I. M. D. M., Eljatin, D. S., & Muthu, P.. The use of anemia comics as the learning medium in Senior High School Students from Gresik, East Java, Indonesia. *World Journal of Advanced Research and Reviews*, 2024, 24(01), 2243–2249. <https://doi.org/10.30574/wjarr.2024.24.1.3247>.
- [26] Salam SS, Ramadurg U, Charantimath U, Katageri G, Gillespie B, Mhetri J, et al. Impact of a school-based nutrition educational intervention on knowledge related to iron deficiency anaemia in rural Karnataka, India: A mixed methods pre-post interventional study. *BJOG* 2023;130:113–23. <https://doi.org/10.1111/1471-0528.17619>.
- [27] Rahman MJ, Rahman MM, Sarker MHR, Matsuyama R, Kakehashi M, Tsunematsu M, et al. Impact of mobile health-based nutritional education on hemoglobin levels in anemic adolescent girls in rural Bangladesh: a randomized controlled trial. *BMC Public Health* 2025;25:1–16. <https://doi.org/10.1186/S12889-025-23687-Z/TABLES/6>.
- [28] Ghadam OS, Sohrabi Z, Mehrabi M, Fararouei M, Shahraki M, Hejazi N, et al. Evaluating the effect of digital game-based nutrition education on anemia indicators in adolescent girls: A randomized clinical trial. *Food Sci Nutr* 2022;11:863–71. <https://doi.org/10.1002/FSN3.3120>.
- [29] Afiah Romadhona N, Ardianti Khasanah T, Studi Gizi P, Ilmu Kesehatan dan Teknologi F, Binawan U, Artikel I. The Effect of Educational Videos on Knowledge About Anemia and Adherence to Iron Tablet Consumption Among Students of Taman Madya 5 High School. *Media Gizi Ilmiah Indonesia* 2025;3:17–24. <https://doi.org/10.62358/MGII.V3I1.45>.
- [30] Zakiah S, Toaha A, Abri N, Wahyutri E. The Effect of Nutrition Education on Knowledge, Attitudes, and Iron Intake in Adolescent Girls. *Journal of Health and Nutrition Research* 2023;2:131–9. <https://doi.org/10.56303/JHNRESEARCH.V2I3.174>.
- [31] Ren T, Lu Y, Dai Z, Yang J, Wu Y, Chang F, et al. Effects of Nutrition-Specific Interventions to Prevent and Control Nutrition-Related Anemia in Infants, Children, and Adolescents: A Systematic Review and Network Meta-Analysis of Randomized Controlled Trials. *J Acad Nutr Diet* 2025;125:964–983.e13. <https://doi.org/10.1016/j.jand.2025.01.002>.
- [32] Indriasari R, Mansur MA, Rachmat M. Comprehensive knowledge and supports from closest relatives are crucial to improve awareness and participation of Indonesian adolescent girls in anemia prevention program. *Int J Adolesc Med Health* 2024;36:513–21. <https://doi.org/10.1515/IJAMH-2024-0064/machinereadablecitation/ris>.