

School-Based Health Promotion and Knowledge of Iron Supplementation among Adolescent Girls: A Quasi-Experimental Study

Irmayanti Irmayanti^{a*}, Devi Darwin^a, Andi Sufiani^a, Citra Dewi Kafitri^a

^a Department of Midwifery and Midwifery, Faculty of Health, Universitas Kurnia Jaya Persada, South Sulawesi, Indonesia

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ABSTRACT

Introduction: Iron deficiency anemia remains a significant public health problem among adolescent girls due to increased iron requirements during rapid growth and menstruation. Inadequate knowledge about iron (Fe) tablet consumption contributes to low adherence to supplementation programs. School-based health promotion is considered a strategic approach to improving adolescents' understanding and preventive behaviors. This study aimed to determine the effect of health promotion on adolescent girls' knowledge of iron (Fe) tablet consumption at State Senior High School 2, Luwu, Indonesia.

Research Methodology: A quantitative pre-experimental study using a one-group pretest–posttest design was conducted from September to October 2024. A total of 46 adolescent girls were selected through total sampling. Knowledge was measured using a structured 10-item questionnaire administered before and one week after the intervention. The health promotion intervention was delivered through lectures supported by leaflet media. Data were analyzed using the Wilcoxon signed-rank test to assess differences in knowledge scores before and after the intervention.

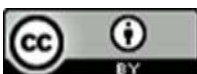
Results: Before the intervention, 65.2% of respondents had poor knowledge, while 34.8% had good knowledge. After health promotion, 100% of respondents achieved good levels of knowledge. The Wilcoxon signed-rank test showed a statistically significant improvement in knowledge scores ($p = 0.000 < 0.05$), with all participants demonstrating positive rank changes.

Conclusion: Health promotion delivered through lectures and leaflets significantly improved adolescent girls' knowledge of iron (Fe) tablet use. School-based educational interventions represent an effective strategy to strengthen anemia prevention programs and promote adherence to iron supplementation among adolescents.

Keywords: Adolescent; Anemia; Health Education; Iron; Knowledge.



*Correspondence author. Email: irmaanti4@gmail.com



INTRODUCTION

Adolescent girls are particularly susceptible to anemia due to increased iron requirements during periods of rapid growth and blood loss associated with menstruation. A cross-sectional study conducted in Banten in 2024 found a high prevalence of iron-deficiency anemia among adolescent girls. It highlighted the importance of monitoring hemoglobin and ferritin levels as indicators of anemia status (Aji et al., 2024). Consistent with these findings, a study in Mungkid District reported an anemia prevalence of 58.1%, which was strongly associated with inadequate knowledge and imbalanced dietary practices (Prasetyowati, 2024). Other studies have also demonstrated that adolescent girls' knowledge is significantly associated with adherence to iron (Fe) tablet consumption as a preventive measure against anemia (Muliani & Rakhimah, 2024; Sofiantin et al., 2025).

Furthermore, research on iron and vitamin C intake has confirmed that adequate nutritional intake and compliance with iron supplementation directly influence anemia status (Alfiah & Dainy, 2023). Educational interventions utilizing digital media platforms, such as TikTok, have been shown to improve adherence to iron tablet consumption among adolescent girls effectively (Nepal et al., 2025); meanwhile, face-to-face health education has also been shown to be effective in improving knowledge regarding the benefits of iron supplementation tablets (Caraka et al., 2025). Overall, the accumulated evidence indicates that iron deficiency not only impairs concentration and academic performance but also has long-term consequences for reproductive health. Therefore, health education and iron supplementation remain key strategies in the prevention of anemia among adolescent girls.

Findings from multiple studies indicate that anemia among adolescent girls remains a significant public health problem and is strongly influenced by low adherence to iron supplementation (Mufti & Farida, 2025; Mulianingsih et al., 2024; Sigit et al., 2024). Evidence from Indonesia further indicates that adolescents' acceptance of and adherence to iron supplementation programs remain suboptimal due to limited knowledge, negative perceptions of taste and side effects, and insufficient environmental support, ultimately hindering the effective implementation of these programs (Helmyati et al., 2024). Other studies have further confirmed that iron deficiency anemia remains widespread and is closely associated with dietary intake patterns, iron adequacy, and adherence to iron (Fe) supplementation (Mulianingsih et al., 2024). Findings from Banawa, Donggala, also indicate that adolescent girls with inadequate iron intake and irregular consumption of iron supplements are at a higher risk of developing anemia (Nasrul et al., 2025). In addition, research on adolescents' beliefs and perceptions suggests that limited awareness of supplementation's benefits and the perception that anemia is not a serious health issue constitute major barriers to adherence (Kamal Agus Efendi et al., 2025). Various intervention studies have demonstrated that nutrition education and health promotion programs designed using engaging methods and tailored to adolescents' characteristics can significantly improve knowledge, shape positive attitudes, and enhance adherence to iron supplementation. Consequently, such interventions represent a key strategy in the prevention of anemia among adolescent girls (Mufti & Farida, 2025).

Although numerous studies have demonstrated that adherence to iron supplementation is strongly associated with a reduced risk of anemia among adolescent girls, including a non-adherence rate of 59.3% among adolescents in Surabaya (Winarni et al., 2024), a national adherence rate of less than 25% based on a review of iron-folic acid supplementation programs in Indonesia (Helmyati et al., 2024), and meta-analytic findings showing that 43.5% of

adolescents do not adhere to iron tablet consumption (Simbolon et al., 2023), educational interventions that directly target knowledge improvement as a key determinant of adherence have not been widely or specifically evaluated. Most existing studies have primarily focused on the association between knowledge and adherence or on the effectiveness of iron supplementation in improving hemoglobin levels. In contrast, the specific role of health promotion as a standalone educational intervention in enhancing adolescents' readiness to consume iron supplementation tablets appropriately has not been adequately assessed. Therefore, the novelty of this study lies in its empirical evaluation of how health promotion interventions improve adolescent girls' knowledge of iron (Fe) tablet consumption as a preventive measure against anemia, thereby addressing the existing research gap regarding the effectiveness of educational strategies in promoting adherence-related behaviors.

RESEARCH METHODOLOGY

This study employed a quantitative research design using a pre-experimental, one-group, pretest–posttest design. This design was selected to assess changes in respondents' knowledge levels before and after the implementation of a health promotion intervention. The research design was structured as Y1–X–Y2, where Y1 represents the pretest, X denotes the health promotion intervention, and Y2 indicates the posttest. The study was conducted at State Senior High School 2, Luwu, which was selected because it has an adolescent female population suitable for the study objectives. The research was carried out from 5 September to 5 October 2024, encompassing the preparation, intervention implementation, and evaluation phases.

The study subjects were selected using a total sampling technique, involving all adolescent girls from Grade X Science 1 and Grade X Science 2 who met the inclusion criteria, resulting in a total of 46 respondents. This sampling technique was chosen because the population was relatively small and homogeneous, allowing all eligible individuals to be included to enhance data representativeness. Research information sources and supporting literature were obtained from textbooks, scientific journals, health guidelines, and other relevant documents to support instrument development and interpretation of the findings.

The research procedure began with obtaining ethical approval and research permission from the Health Research Ethics Committee. Subsequently, informed consent was obtained from each respondent to ensure voluntary participation and a clear understanding of the study objectives. The instrument used was a knowledge questionnaire consisting of 10 statements, with a score of 1 assigned to correct answers and 0 to incorrect ones. The pretest was administered before the intervention. Health promotion was delivered through a lecture, supported by leaflets outlining the benefits and proper use of iron (Fe) tablets. The posttest was conducted one week after the educational intervention to assess changes in knowledge. Respondents completed the questionnaire within 10 to 15 minutes at each measurement stage.

Data were analyzed using SPSS software. Univariate analysis was applied to describe the frequency distribution of respondents' characteristics and knowledge levels. Bivariate analysis was conducted to examine the effect of health promotion on knowledge using the Wilcoxon signed-rank test, as the data were not normally distributed. This study received ethical approval from the Research Ethics Committee of Stikes Panrita Husada Bulukumba, with approval number No. 005687/KEP Stikes Panrita Husada Bulukumba/2025.

RESULT

Table 1. Distribution of Respondents' Characteristics and Knowledge Levels Before and After Health Promotion (n = 46)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	13	19	41.3
	14	25	54.3
	15	2	4.3
Class Level	Grade 10 Science 1	22	47.8
	Grade 10 Science 2	24	52.2
Knowledge (Pretest)	Good	16	34.8
	Poor	30	65.2
Knowledge (Posttest)	Good	46	100.0

The majority of respondents were aged 14 years (54.3%), and the class distribution was relatively balanced between Grade 10 Science Class 1 (47.8%) and Class 2 (52.2%). Before the health promotion intervention, most respondents (65.2%) had limited knowledge about iron (Fe) tablet use. After the intervention, all respondents (100%) demonstrated good knowledge, indicating a marked improvement following the structured educational session.

Table 2. Wilcoxon Signed-Rank Test Results: Effect of Health Promotion on Knowledge of Iron (Fe) Tablets (n = 46)

Comparison	Category	n	Mean Rank	Sum of Ranks	p-value
Pretest vs Posttest	Negative Ranks	0	0.00	0.00	
	Positive Ranks	46	23.50	1081.00	
	Ties	0			

The Wilcoxon signed-rank test demonstrated that all respondents (n = 46) experienced an increase in knowledge scores following the health promotion intervention, as indicated by 46 positive ranks and no negative ranks or ties. The mean rank of 23.50 and the sum of ranks of 1081.00 reflect a consistent improvement in posttest scores compared to pretest scores. The p-value of 0.000 ($p < 0.05$) indicates a statistically significant difference between pre-intervention and post-intervention knowledge levels. Therefore, it can be concluded that the health promotion intervention delivered through lectures and leaflets was statistically effective in improving adolescent girls' knowledge about iron (Fe) tablet use.

This study demonstrates that structured health promotion significantly improved adolescent girls' knowledge regarding iron (Fe) tablet consumption. Before the intervention, most respondents exhibited inadequate knowledge, indicating limited understanding of the benefits, proper use, and importance of iron supplementation in preventing anemia. Considering that the majority of participants were in early adolescence (13–14 years), a developmental stage characterized by increased physiological iron requirements due to growth and menstruation, the initial knowledge gap represents a critical public health concern. Following the implementation of health promotion through lectures supported by leaflets, all respondents showed improvement in their knowledge levels. The Wilcoxon signed-rank test confirmed a statistically significant difference between pretest and posttest scores ($p < 0.05$), with 100% of participants demonstrating positive rank changes. This consistent increase across all respondents indicates that the educational intervention was both effective and uniformly impactful. Overall, the findings reinforce the importance of school-based health education as a strategic approach to strengthening adolescent health literacy. By improving knowledge as a key determinant of health behavior, structured educational interventions can serve as an essential preventive measure to enhance adherence to iron supplementation and reduce the risk of anemia among adolescent girls.

DISCUSSION

The age distribution of respondents in this study indicates that the majority were aged 13 to 14, corresponding to early adolescence. Early adolescence is a critical developmental phase characterized by accelerated physical growth, hormonal changes, and the onset of menstruation among adolescent girls. These biological changes increase iron requirements and place this age group at a higher risk of anemia if nutritional intake is inadequate. These findings are consistent with those of Nasrul *et al.* (2025), who reported that adolescents aged 12 to 15 years are at a higher risk of anemia, primarily because increased physiological demands are not accompanied by adequate consumption of iron-rich foods. In addition, found that adolescents in this age group often have limited knowledge of anemia prevention and the benefits of iron (Fe) supplementation, underscoring the critical need for educational interventions. These findings are further supported by Mufti and Farida (2025), who emphasized that health education delivered during early adolescence is more effective in shaping understanding and establishing long-term health behaviors. Therefore, the age composition of respondents in this study indicates that the health promotion intervention was strategically implemented at an optimal stage to enhance early awareness and knowledge among adolescent girls.

The relatively homogeneous class distribution, consisting of students from Grade 10 Science Class 1 and Grade 10 Science Class 2, represents a methodological strength of this study, as it allowed the health promotion intervention to be delivered consistently and evenly. This homogeneity facilitated the preparation of educational materials, scheduling the intervention, and controlling potential external variables that could influence the study outcomes. Which implemented the WIFAS program in secondary schools and reported that structured education delivered to comparable class groups resulted in a significant improvement in knowledge of iron supplementation. A study by Thifal *et al.* (2023) conducted in East Kalimantan further emphasized that education and supplementation programs are more effective when the target population is organized within well-structured class groups, as this facilitates monitoring and ongoing guidance.

The findings of this study indicate an overall improvement in adolescent girls' knowledge following the health promotion intervention, suggesting that structured education delivered through lectures and leaflet media effectively enhanced understanding and information retention regarding the importance of iron (Fe) tablet consumption. These results are consistent with evidence from a scoping review by Lusiana, Nugraheni, and Musthofa (2025), which highlighted that educational media, both print and digital, play a significant role in increasing knowledge and encouraging behavioral change among adolescents in anemia prevention. Visual media, in particular, were reported to attract greater attention, enhance learning motivation, and strengthen comprehension of health-related concepts. In addition, a systematic review by Septiana *et al.* (2025) demonstrated that various forms of educational media, including leaflets, educational videos, and social media platforms, consistently improve adolescents' self-awareness and adherence to iron supplementation. These findings underscore that repeated educational exposure through diverse media channels enhances knowledge and promotes healthier behaviors. Therefore, the observed improvement in knowledge in this study not only confirms the effectiveness of simple school-based health promotion methods but also contributes to broader public health efforts to prevent anemia by strengthening adolescent health literacy.

The results of this study demonstrated a highly significant improvement in adolescent girls' knowledge of iron (Fe) tablets, as reflected in the increase in mean pretest scores following

the health promotion intervention, with all respondents showing improved knowledge, as indicated by the positive ranks. These findings are consistent with those of Winarni *et al.* (2024), who reported a significant increase in adolescent girls' knowledge of anemia, iron, and dietary behaviors after receiving school-based health education interventions. The study further explained that educational sessions delivered in an easily understandable manner, supported by visual media, and targeted to homogeneous age groups can accelerate comprehension and enhance retention of health-related information. The observed improvement in knowledge is also consistent with Zakiah *et al.*'s (2023) findings, which reported that nutrition education significantly enhanced adolescent girls' understanding, attitudes, and iron intake compared with pre-intervention levels. Both studies emphasize that knowledge is a key determinant of health behavior change and that structured interventions, such as leaflets, classroom-based counseling, and group education, are effective in improving adolescents' health literacy. Consequently, the universal increase in knowledge scores observed in this study indicates that the health promotion intervention successfully enhanced adolescents' understanding of the importance of iron (Fe) tablets. These findings further strengthen the empirical evidence that school-based health education represents an effective strategy for preventing anemia among adolescents.

The Wilcoxon signed-rank test yielded a p-value of 0.000, which was less than the significance level of 0.05, indicating that the health promotion intervention delivered through lectures and leaflet media had a statistically significant effect on improving adolescent girls' knowledge of iron (Fe) tablets. This effectiveness can be attributed to the lecture method as a direct educational strategy, which enabled the researcher to present information in a structured manner, provide practical examples, and foster interaction, thereby enhancing participants' attention and engagement. Previous studies have shown that face-to-face educational methods, such as lectures, enhance adolescents' focus and information retention because participants can ask questions and receive immediate feedback (Salam *et al.*, 2023; Zuair, 2025). In addition, leaflets have been shown to reinforce adolescents' understanding, as information presented in a concise, visual format is easier to remember and review after educational sessions. These findings are consistent with evidence indicating that simple printed media, such as leaflets, improve students' memory and comprehension of health-related topics, particularly those related to anemia and iron supplementation (Apriyanti *et al.*, 2025; Olivia *et al.*, 2024; Safitri *et al.*, 2025). Meanwhile, Winarni *et al.* (2024) emphasized that adolescents are more responsive to a combination of lecture-based methods and visual media, as their learning styles often require audiovisual stimulation to enhance comprehension. Accordingly, the improvement in knowledge observed among all respondents in this study is consistent with scientific evidence indicating that health promotion interventions integrating interactive lectures and leaflet media are effective approaches for adolescent populations, particularly in enhancing literacy related to iron (Fe) tablet consumption and anemia prevention.

This study has several limitations that should be considered when interpreting the findings. From a methodological perspective, the researcher's limited experience as a novice investigator may have influenced the consistency of intervention delivery, instrument management, and data collection procedures. Therefore, the possibility of bias cannot be entirely excluded. In addition, the study was conducted in a school setting where student attendance was not always stable, which may have affected participant exposure to the intervention and the completeness of data collection. The absence of some respondents from Grade 10 Science Class 1 necessitated continuing data collection the following day, which may have resulted in differences in intervention timing and affected the uniformity of conditions among participants. This limitation

highlights the need for more structured scheduling and stricter supervision in future studies to ensure that intervention implementation and measurement procedures are conducted uniformly and with minimal bias.

CONCLUSION

The results of this study demonstrate that adolescent girls' initial knowledge of iron (Fe) tablets was relatively low, with most respondents showing limited understanding before the intervention. After receiving structured health promotion through lectures and leaflet media, all participants experienced a substantial improvement in knowledge, indicating that the educational intervention was highly effective. These findings directly answer the research question and confirm that health promotion plays a significant role in increasing adolescents' understanding of the importance of iron supplementation as a preventive measure against anemia. The results contribute to public health by highlighting the value of early, school-based educational strategies in shaping positive health behaviors and preventing nutritional deficiencies that commonly affect adolescent populations.

The implications of these findings extend to multiple stakeholders. Schools are encouraged to incorporate routine anemia-related education into their health programs to ensure continuous reinforcement of knowledge. Local and regional health authorities may adopt similar promotional approaches to strengthen adherence to iron supplementation programs among adolescents, particularly in areas with high anemia prevalence. Health professionals should continue to intensify counseling, monitoring, and motivational communication to enhance compliance with Fe tablet consumption. Meanwhile, adolescents themselves are encouraged to maintain healthy lifestyles and adhere to iron supplementation to safeguard their well-being. Future researchers are advised to expand this study by involving larger samples, diverse educational settings, and digital media interventions to compare the effectiveness of different promotional strategies and to strengthen the evidence for broader public health implementation.

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Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this study.

Authors' Contributions

Irmayanti contributed to the research through conceptualization, study design, participant enrollment, data collection and acquisition, field work, formal analysis, writing the original draft, and provided final approval of the manuscript. Devi Darwin contributed through study design, formal analysis, writing, review and editing, manuscript revision, and granted final approval of the final manuscript. Andi Sufiani contributed to conceptualization, writing, review and editing, and manuscript revision, and provided final approval of the manuscript. Citra Dewi Kafitri, as a student assistant, contributed to data collection, field assistance, research document organization, and participated in the final approval of the manuscript.

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