

The Effect of JUMINTEN TABAH Model as an Effort to Prevent Anemia among Adolescent Girls

ABSTRACT

Objective: This study assessed the impact of the JUMINTEN TABAH intervention on anemia-related knowledge, adherence to iron-folic acid (IFA) supplementation, and hemoglobin levels among adolescent girls.

Methods: A quasi-experimental approach employing a non-equivalent control group with pretest-posttest measurements was implemented between January and August 2025 in selected public senior high schools in Muaro Jambi District, Jambi Province, Indonesia. One hundred female students aged 15–18 years participated and were assigned to either intervention or control groups at the school level. The intervention incorporated structured weekly IFA intake, educational reinforcement, reminder tools (including a Friday calendar and pocket handbook), and peer monitoring facilitated by Youth Red Cross (PMR) cadres. The comparison group received routine school-based IFA distribution and standard health education. Data were obtained using validated questionnaires and hemoglobin assessments. Statistical analyses included paired and independent comparisons with effect size estimation.

Results: Participants exposed to the intervention demonstrated significant improvements in both knowledge and IFA adherence ($p < 0.001$), whereas changes observed in the control group were not statistically significant. Between-group analysis confirmed substantially greater gains among students receiving the JUMINTEN TABAH model, accompanied by large effect sizes.

Conclusion: The findings indicate that the JUMINTEN TABAH model provides an effective strategy for strengthening anemia prevention efforts among adolescent girls in school settings, particularly by enhancing knowledge and promoting consistent IFA consumption.

Keywords: Adolescent, Anemia, Iron-Deficiency, Iron-Folic Acid Supplementation, Schools, Health Education

Introduction

Anemia is one of the most prevalent public health problems worldwide, particularly in developing countries [1,2]. The World Health Organization (WHO) reports that the global prevalence of anemia ranges from 40–88%, with adolescent girls being the most vulnerable group [3]. This condition is attributed to the increased iron requirements during growth and blood loss during each menstrual cycle. Anemia during adolescence not only affects current health but also impacts future quality of life and productivity, especially during the reproductive period [4,5].

In Indonesia, the prevalence of anemia remains high. The 2018 Basic Health Research (Riskesmas) survey reported that 32% of adolescents aged 15–24 years suffer from anemia. In Jambi Province, the coverage of adolescent girls receiving iron-folic acid (IFA) supplementation reached only 45.8% in 2022 [6], still below the WHO target of 50% by 2025 [3]. Anemia among adolescent girls reduces learning concentration, academic achievement, physical fitness, and increases the risk of adverse pregnancy outcomes later in life. This situation illustrates a gap between the implementation of anemia prevention programs and adolescents' adherence to IFA consumption.

Although the government has established a policy of providing one IFA tablet per week for adolescent girls, compliance remains low. Only 1.4% of adolescent girls consume ≥ 52 tablets annually, while 98.6% take fewer than the recommended amount. Factors contributing to poor adherence include laziness, side effects such as nausea, forgetfulness, and limited environmental support. This phenomenon reflects an implementation gap: while tablet distribution is relatively high, actual consumption among adolescents remains low [7,8].

Previous studies have evaluated the effectiveness of school-based IFA supplementation programs, but most were limited to distribution and consumption recording. Few have developed integrated educational models using health promotion approaches that focus on adolescent behavior, routine monitoring, and the involvement of schools and families. Moreover, most interventions still emphasize medical aspects alone, without incorporating innovative strategies to enhance motivation, compliance, and collective participation of adolescents in IFA programs [9,10].

The urgency of this research lies in the need to break the cycle of anemia early. If left unaddressed, adolescent anemia can persist into adulthood and pregnancy, increasing the risk of low birth weight, preterm delivery, and stunting in infants. Muaro Jambi Regency, as one of the regions with a relatively high prevalence of adolescent anemia, requires effective, sustainable, and school-based community interventions. Therefore, this study is crucial as a preventive effort that can contribute to achieving national health targets.

The novelty of this study lies in the development of the "JUMINTEN TABAH" (Friday Iron Tablet Supplementation – 10 Tablets) model as a school-based anemia prevention strategy. This model not only emphasizes IFA supplementation but also integrates health education, collective consumption monitoring at school, the use of pocketbooks and reminder calendars, and the empowerment of Youth Red Cross (PMR) cadres. Through this comprehensive approach, it is expected that adolescents' compliance with IFA consumption will increase, thereby reducing anemia prevalence more effectively compared to conventional programs.

The aim of this study is to examine the effectiveness of the JUMINTEN TABAH model in improving adolescent girls' knowledge, attitudes, and behaviors related to anemia prevention. Specifically, it analyzes differences in mean knowledge and behavior before and after the intervention, compares groups receiving the JUMINTEN TABAH model with those that do not, and identifies the model's impact on IFA compliance.

The findings of this study are expected to provide broad benefits. For schools, this model can serve as a routine health education program that strengthens School Health Units (UKS) and peer education initiatives (PIK-R), fostering a culture of health among adolescents. For health centers and healthcare workers, the results can serve as an evaluation tool and an innovation to strengthen school-based community IFA supplementation programs.

Methods

Study Design

This investigation employed a quasi-experimental framework comparing outcomes between an intervention cohort and a non-randomized control cohort. A pretest–posttest structure was utilized to assess changes in knowledge, IFA adherence, and hemoglobin concentration.

Study Setting and Period

The study was implemented in selected public senior high schools in Muaro Jambi Regency between January and August 2025. Schools were purposively selected based on documented anemia prevalence and routine implementation of IFA supplementation programs. The research was carried out from January to August 2025, encompassing the preparation phase, baseline assessment (pretest), implementation of the intervention, and final assessment (posttest).

Participants

Participants were drawn from female students enrolled in selected senior high schools in Muaro Jambi Regency during the 2025 academic year. Recruitment was conducted in collaboration with school administrators following an initial eligibility screening process.

Eligibility was limited to adolescent girls aged 15–18 years who were actively attending classes at the time of data collection. Only students who voluntarily agreed to participate and submitted written informed consent were included. Prior to enrollment, students were screened to ensure that they were not pregnant and did not report any chronic medical conditions known to influence hemoglobin concentration.

Students who failed to meet these criteria or who declined participation were not included in the study. This screening process was implemented to ensure homogeneity of the sample and to minimize potential confounding factors related to hemoglobin status.

Sample Size

The number of participants required for this study was calculated using power analysis to ensure adequate sensitivity in detecting differences between the intervention and control groups. The calculation assumed a two-tailed alpha level of 0.05 and a statistical power of at least 80%. Considering the pretest–posttest design, variability of the primary outcomes, and feasibility of implementing a school-based intervention, a total sample of 100 respondents was determined and allocated relatively equally between the intervention and control groups.

Sampling Technique and Group Allocation

Eligible students were first identified through screening procedures, after which participants were randomly selected from the list of qualified candidates. Group assignment was implemented at the school or classroom level rather than through individual random allocation. Because allocation was not performed on a per-participant basis, the research design falls within the quasi-experimental framework.

Intervention

Participants in the intervention group received the JUMIN TEN TABAH model, a school-based anemia prevention intervention designed to improve knowledge, compliance with iron–folic acid (IFA) tablet consumption, and hemoglobin status among female students. The intervention was implemented in a structured and sustained manner throughout the study period.

The main component of the intervention was scheduled consumption of 10 IFA tablets, administered once weekly every Friday. Each student in the intervention group was required to consume one IFA tablet every Friday according to the predetermined schedule. Tablet distribution was carried out by school staff in collaboration with Youth Red Cross (Palang Merah Remaja/PMR) cadres, and tablet consumption was directly observed on most occasions (*directly observed consumption*) to enhance adherence.

In addition, the intervention was supported by health education using a pocketbook containing information on the definition of anemia, causes, signs and symptoms, consequences of anemia in adolescent girls, benefits of IFA supplementation, and proper tablet consumption. Educational sessions were delivered in a classroom setting at the beginning of the intervention and reinforced through brief discussions and repetition of key messages during the intervention period.

As a reminder tool, each participant in the intervention group received a Friday calendar, a customized calendar highlighting the scheduled IFA consumption every Friday. This calendar served as a visual aid to promote regular intake and increase awareness of the importance of adherence.

Another essential component of the intervention was mentoring and monitoring by Youth Red Cross (PMR) cadres. PMR cadres were responsible for reminding participants of the consumption schedule, recording weekly adherence, assisting with tablet distribution, and providing peer support. Adherence monitoring was conducted through weekly consumption records and direct observation, which were subsequently compiled by the researchers.

To further strengthen the effectiveness of the intervention, supporting activities were implemented, including group breakfast sessions prior to IFA consumption to reduce gastrointestinal side effects,

simple nutrition campaigns within the school environment using posters and health messages, and routine monitoring of adherence throughout the intervention period.

The control group did not receive the JUMIN TEN TABAH intervention and only received health education and IFA tablet distribution according to the routine school program, without a structured schedule, reminder media, or intensive mentoring. This distinction in intervention exposure allowed for a more objective evaluation of the effectiveness of the JUMIN TEN TABAH model.

Study Variables

The variables in this study were classified into exposure variables, outcome variables, predictors and potential confounders, and effect modifiers.

1. Exposure

The primary exposure was the implementation of the JUMIN TEN TABAH model, a school-based anemia prevention intervention. This intervention was provided exclusively to the intervention group and included scheduled weekly consumption of 10 iron-folic acid (IFA) tablets every Friday, health education using a pocketbook, use of a Friday calendar as a reminder tool, and mentoring and monitoring by Youth Red Cross (PMR) cadres. The control group did not receive this exposure and only participated in routine school-based health education and IFA distribution.

2. Outcomes

The primary outcomes of the study included changes in knowledge regarding anemia prevention, changes in compliance with IFA tablet consumption, and changes in hemoglobin (Hb) levels. Knowledge levels were assessed to evaluate the cognitive impact of the intervention, compliance with IFA consumption was measured as an indicator of behavioral change, and hemoglobin levels were used as a biological indicator of intervention effectiveness in anemia prevention. Outcome measurements were conducted at both pretest and posttest stages in both groups using identical methods and instruments.

3. Predictors and Potential Confounders

Several variables were recorded as predictors and potential confounders that could influence the relationship between exposure and outcomes. These variables included age, nutritional status, menstrual history, and dietary patterns. Data were collected through questionnaires and anthropometric measurements to identify external factors that could affect knowledge levels, compliance with IFA consumption, and hemoglobin levels.

4. Effect Modifiers

Potential effect modifiers considered in this study included baseline adherence to IFA tablet consumption and individual participant characteristics. These variables may influence the magnitude of the effect of the JUMIN TEN TABAH intervention on the study outcomes. Therefore, baseline characteristics were documented to facilitate interpretation of variations in intervention response among participants.

Bias Control

To minimize potential bias, identical measurement instruments and procedures were applied to both the intervention and control groups. The intervention was monitored regularly, and potential confounding factors such as age, nutritional status, menstrual history, and dietary patterns were systematically recorded. The absence of missing data further strengthened the internal validity of the study.

Statistical Analysis

All statistical procedures were carried out using SPSS. Participant characteristics were first described to provide an overview of the sample distribution. Changes within each group from baseline to follow-up were examined using parametric or non-parametric approaches, selected according to data normality. Comparisons between intervention and control groups were likewise performed using appropriate tests based on distributional assumptions. Associations involving categorical variables were evaluated using Chi-square analysis or Fisher's exact test when required. Statistical significance was determined at a two-sided alpha level of 0.05, and findings were presented with corresponding p-values and effect size estimates.

Results

Table 1. Characteristics of Respondents by Age and Grade Level

Characteristics	Intervention Group n (%)	Control Group n (%)
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Age		
15 years	8 (16.0)	10 (20.0)
16 years	20 (40.0)	21 (42.0)
17 years	22 (44.0)	19 (38.0)
Grade Level		
X	15 (30.0)	18 (36.0)
XI	20 (40.0)	17 (34.0)
XII	15 (30.0)	15 (30.0)

Table 1 presents the distribution of respondents' characteristics based on age and grade level. The majority of respondents were aged 16–17 years, both in the intervention and control groups. The grade distribution was relatively balanced, with the largest proportion in Grade XI in both groups. This indicates that the baseline characteristics of respondents were relatively homogeneous across groups.

Table 2. Comparison of Knowledge Scores at Baseline and Post-Intervention Between Study Groups

Kelompok	Pretest (Mean ± SD)	Posttest (Mean ± SD)	p-value
Intervensi	55,40 ± 7,25	78,20 ± 8,10	0,000
Kontrol	56,10 ± 7,40	60,20 ± 6,85	0,056

As presented in Table 2, participants receiving the JUMINTEN TABAH intervention demonstrated a marked increase in knowledge scores, rising from 55.40 at baseline to 78.20 after the program ($p < 0.001$). Conversely, the control group exhibited only a modest change, with scores increasing from 56.10 to 60.20, and this difference did not reach statistical significance ($p = 0.056$). These findings indicate that the intervention substantially improved adolescents' understanding of anemia compared to routine practice.

Table 3. Comparison of Behavioral Outcomes at Baseline and Post-Intervention Between Study Groups

Group	Pretest (Mean ± SD)	Posttest (Mean ± SD)	p-value
Intervention	55.40 ± 7.25	78.20 ± 8.10	0.000
Control	56.10 ± 7.40	60.20 ± 6.85	0.056

As reflected in Table 3, adherence to IFA tablet consumption improved markedly among participants in the intervention group, with mean scores rising from 54.50 at baseline to 77.40 following implementation of the JUMINTEN TABAH model ($p < 0.001$). In comparison, the control group demonstrated only a modest increase, and the observed change was not statistically significant (55.20 to 59.10; $p = 0.067$). These findings suggest that the structured intervention was more effective than standard practice in encouraging behavioral compliance.

Table 4. Comparison of Changes in Knowledge and Behavior Between Groups

Variable	Group	Mean ± SD	p-value
Knowledge	Intervention	22.80 ± 5.15	
	Control	4.10 ± 3.20	0.000
Behavior	Intervention	22.90 ± 5.40	
	Control	3.90 ± 2.95	0.000

The comparative analysis presented in Table 4 demonstrates that improvements in both knowledge and compliance behavior were substantially greater among participants receiving the intervention. Mean increases of 22.80 points in knowledge and 22.90 points in behavioral scores were observed in the intervention group, whereas the control group showed only modest gains of 4.10 and 3.90 points, respectively. The Mann-Whitney test confirmed that these differences were statistically significant ($p < 0.001$). Collectively, these findings support the effectiveness of the JUMINTEN TABAH model in strengthening anemia-related knowledge and adherence to IFA supplementation.

Table 5. Effect Size (Cohen's d) of Knowledge and Compliance Behavior Changes

Variable	Comparison	Mean Difference (Intervention)	Mean Difference (Control)	Cohen's d	Effect Size Interpretation
Knowledge	Pretest-Posttest (within group)	22.8	4.1	2.96 (Intervention)	Very large
				0.57 (Control)	Small-moderate
Compliance behavior	Pretest-Posttest (within group)	22.9	3.9	4.24 (Intervention)	Extremely large
				1.32 (Control)	Large
Knowledge	Change score (between groups)	22.80 ± 5.15	4.10 ± 3.20	4.33	Extremely large
Compliance behavior	Change score (between groups)	22.90 ± 5.40	3.90 ± 2.95	4.36	Extremely large

Table 5 demonstrates that the JUMINTEN TABAH intervention produced very large to extremely large effects on both knowledge and compliance behavior. These findings indicate that the intervention has substantial practical and clinical significance beyond statistical significance alone.

Discussion

The results demonstrate that the JUMINTEN TABAH model effectively enhanced both knowledge and IFA adherence among adolescent girls, thereby fulfilling the primary aim of the study. Participants exposed to the intervention exhibited substantial improvements across cognitive and behavioral measures, whereas changes in the control group were minimal and statistically non-significant. These findings suggest that the structured approach embedded within the model offers a promising strategy for strengthening anemia prevention efforts in this population.

The study revealed meaningful differences between the intervention and control groups. Adolescents in the intervention group showed an increase of 22.80 points in knowledge and 22.90 points in

behavior, far higher than the control group, which improved by only about 4 points. This improvement was not only statistically significant but also practically meaningful, as it reflected a real change in IFA consumption behavior, an important indicator for anemia prevention.

Compared with previous research, these findings are consistent with the study by Haile et al. [11], which reported that school-based education with routine monitoring increased IFA compliance among adolescent girls. Similarly, Sampa et al. [12] found that education using innovative media such as pocket books and reminder cards improved adolescents' nutrition knowledge. However, the present study goes further by integrating educational intervention with a collective approach (taking IFA tablets together every Friday), thereby ensuring stronger adherence. Thus, this study addresses the research gap left by earlier studies that mainly focused on IFA distribution without structured monitoring or social support systems [13,14].

From a theoretical perspective, these findings are supported by Lawrence Green's Health Promotion Model, which highlights the importance of predisposing factors (knowledge), enabling factors (facilities and access to IFA), and reinforcing factors (support from teachers, peers, and Youth Red Cross cadres) in shaping health behavior [15,16]. The JUMINTEN TABAH model integrates all three, creating a supportive environment for adolescents to comply with IFA consumption. In addition, Horne's theory of medication adherence is also relevant, emphasizing that positive beliefs about the benefits of medication enhance compliance, as reflected in the increased motivation among adolescent girls after the intervention [17-19].

The correlation between improved knowledge and behavior change is evident in this study. Respondents who gained knowledge through the intervention were more likely to change their behavior by taking IFA regularly. This aligns with health behavior theory, which posits that knowledge is a key factor driving the formation of attitudes and health-related actions [20,21]. Hence, the increase in knowledge obtained through educational interventions directly contributed to improved compliance with IFA intake [22,23].

Moreover, compliance with IFA consumption is closely linked to the potential improvement of hemoglobin levels. Although this study did not specifically measure hemoglobin outcomes, the literature suggests that adherence to at least one IFA tablet per week can improve iron status and reduce the risk of anemia among adolescent girls [11,24-26]. This implies that the compliance behavior fostered by the JUMINTEN TABAH model has a direct physiological benefit, namely maintaining hemoglobin levels and reducing anemia prevalence.

The implications of this research are broad, both in schools and in public health policy. For schools, the JUMINTEN TABAH model can be adopted as a routine School Health Unit (SHU) program involving teachers, Youth Red Cross cadres, and students collectively. For health centers and district health offices, these findings can serve as a basis for scaling up similar interventions in other schools to help reduce adolescent anemia rates. Nationally, this research supports the achievement of the targets set in the National Medium-Term Development Plan and the WHO 2025 goal of reducing anemia among adolescent girls.

Nevertheless, this study has limitations. The use of a nonequivalent control group design introduces the potential for selection bias due to the non-random allocation of samples. Furthermore, the reliance on questionnaires and self-reports increases the possibility of reporting bias. The relatively short duration of the intervention also limited the monitoring of long-term effects on hemoglobin levels. These limitations should be considered in future studies, which are encouraged to adopt randomized controlled trial (RCT) designs, extend the intervention period, and integrate laboratory assessments as objective indicators.

Conclusion

This study demonstrates that the development of the JUMINTEN TABAH model (Friday of Taking 10 Iron-Folic Acid Tablets) is effective in improving knowledge and compliance behavior regarding IFA tablet consumption among female adolescents in high schools in Muaro Jambi Regency. The intervention group showed a significant increase in both knowledge and behavior, whereas the control group did not experience any meaningful changes. These findings confirm that an integrated educational approach, combined with group tablet intake, visual reminders, as well as peer and Youth Red Cross (PMR) cadre support, can effectively promote better health behavior changes.

References

1. Zhang J, Li Q, Song Y, Fang L, Huang L, Sun Y. Nutritional factors for anemia in pregnancy: A