

When Knowledge Is Not Enough: The Role of Attitude in Anemia Preventive Behavior Among Adolescents

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ABSTRACT

Introduction: Adolescent anemia remains a significant public health concern affecting physical growth, cognitive performance, and long-term productivity. Despite ongoing school-based iron supplementation programs, preventive behaviors remain suboptimal. Behavioral determinants, particularly within the Knowledge Attitude Practice (KAP) framework, may explain this gap. This study aimed to identify factors associated with anemia preventive behavior among adolescents and to determine which behavioral determinant independently predicts preventive practice.

Research Methodology: A quantitative cross-sectional study was conducted among 84 12th-grade students in West Kalimantan, Indonesia. Data were collected using a validated 15-item KAP questionnaire adapted from FAO guidelines. Descriptive statistics were applied, followed by Chi-square and Fisher's Exact tests. Binary logistic regression was performed to identify independent predictors, with $p < 0.05$ as the threshold for statistical significance.

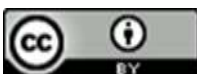
Results: Most respondents demonstrated good knowledge (89.3%), positive attitudes (91.7%), and good preventive practices (70.2%). Bivariate analysis showed that attitude was significantly associated with preventive practice ($p = 0.012$), whereas knowledge was not ($p = 0.293$). Multivariate analysis confirmed that attitude remained the only independent predictor ($OR = 6.624$; $p = 0.033$). Adolescents with positive attitudes were 6.6 times more likely to demonstrate good preventive behavior.

Conclusion: Attitude was independently associated with anemia-preventive behavior, whereas knowledge alone did not significantly influence practice. These findings imply that school-based and nursing interventions should prioritize strengthening positive attitudes and motivational engagement to promote sustainable anemia prevention behaviors.

Keywords: Adolescent; Anemia; Attitude; Health Behavior.



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INTRODUCTION

Adolescent anemia continues to affect health, academic performance, and long-term productivity, particularly in low and middle-income settings. Although iron deficiency is widely recognized as the primary contributor, the persistence of anemia suggests that biomedical explanations alone are insufficient to explain preventive behavior (Sari et al., 2022; Suprapti et al., 2025). According to the most recent Global Burden of Disease Study, the global prevalence of anemia across all ages in 2021 was approximately 24.3%, affecting nearly 2 billion individuals worldwide (Gardner et al., 2023). Recent national survey data indicate that the prevalence of anemia among adolescents aged 5–14 years reached 16.3%, while among those aged 15–24 years it reached 15.5% (Pertiwi et al., 2025). In Indonesia, 22.7% of adolescents experience anemia; however, adherence to iron supplementation programs remains suboptimal, with only 8.3 million of 12.1 million adolescents complying with the intervention (Puspitasari et al., 2025).

While biomedical interventions such as iron supplementation are essential, behavioral determinants play a critical role in influencing preventive practices. The Knowledge, Attitude, and Practice (KAP) framework has been widely used to assess behavioral factors related to anemia prevention (Subba & Araveti, 2025). Several studies have reported significant associations between knowledge and preventive practices (Niza et al., 2024). However, other research indicates that adequate knowledge does not consistently translate into sustained preventive behavior (Naim et al., 2025). Moreover, systematic evidence suggests that adherence to iron supplementation improves when supportive supervision, monitoring mechanisms, and peer engagement are implemented (Silitonga et al., 2024). These findings imply that affective and contextual factors may influence preventive behavior more strongly than cognitive awareness alone.

The explicit research gap, therefore, lies in the limited multivariate evidence on the dominant behavioral determinant of anemia-preventive practice among adolescents in school settings. Clarifying whether knowledge or attitude exerts an independent effect is essential to inform targeted intervention design. Without this evidence, programs risk allocating resources solely to cognitive education, neglecting the affective and motivational dimensions that may drive behavioral sustainability.

This study makes a novel contribution by employing multivariate logistic regression to determine which behavioral determinant independently predicts anemia-preventive practice among adolescents. Rather than describing KAP levels, this study analytically distinguishes the relative contribution of knowledge and attitude within a single statistical model. By situating the analysis within a real-world school-based supplementation context in West Kalimantan, the findings provide context-specific evidence to guide nursing and school health interventions. Accordingly, this study aimed to identify factors associated with anemia preventive behavior among adolescents and to determine which behavioral factor independently predicts preventive practice. By addressing this gap, the study seeks to inform evidence-based, attitude-centered strategies to strengthen sustainable anemia prevention efforts in school settings.

RESEARCH METHODOLOGY

Study Design

This study employed an analytical cross-sectional design. This design was selected to examine the association between behavioral determinants (knowledge and attitude) and anemia preventive practice at a single point in time. The cross-sectional approach is appropriate for

identifying statistically significant associations and estimating the relative contribution of independent variables to an outcome variable in a defined population.

Setting and Participants

The study was conducted at a public senior high school in West Kalimantan, Indonesia, from October to December 2025. The target population consisted of all 12th-grade students enrolled in three classes during the study period. Inclusion criteria were: (1) registered as an active 12th-grade student, (2) present during data collection, and (3) willing to participate with informed consent. Students who were absent during data collection or returned incomplete questionnaires were excluded from the analysis. Total sampling was applied because the entire accessible population met the eligibility criteria. A total of 84 students were included in the final analysis. Because the number of eligible students was limited and manageable, total enumeration was considered methodologically appropriate and minimized sampling bias. The achieved sample size met the minimum requirement for logistic regression analysis, fulfilling the rule of at least 10 outcome events per independent variable included in the model.

Variables and Measurement

The dependent variable was anemia preventive practice. Independent variables included knowledge and attitude toward anemia prevention. Covariates analyzed were age and class. Knowledge was operationally defined as the respondent's cognitive understanding of the causes, consequences, and prevention strategies of anemia. Attitude was defined as the respondent's affective evaluation and disposition toward anemia prevention behaviors, including adherence to iron supplementation. Preventive practice was defined as self-reported engagement in behaviors aimed at preventing anemia, including the use of iron tablets and nutrition-related practices. Data were collected using a 15-item Knowledge–Attitude–Practice (KAP) questionnaire adapted from the Food and Agriculture Organization (FAO) guidelines. The instrument consisted of five items per domain measured on a four-point Likert scale (1–4). Domain scores ranged from 5 to 20. Knowledge was categorized as poor (5–9), moderate (10–14), and good (15–20). Attitude was dichotomized based on the median score (positive vs. negative). Preventive practice was dichotomized using a 75% cut-off (≥ 15 = good; < 15 = poor). Instrument validity was assessed using item-total correlations in a pilot study involving 50 students outside the study sample. All items met the minimum correlation threshold. Reliability testing demonstrated acceptable internal consistency, with Cronbach's alpha values of 0.877 (knowledge), 0.895 (attitude), and 0.751 (practice). Data were obtained from primary sources through self-administered questionnaires.

Data Collection Procedures

Data collection was conducted in classroom settings under the supervision of the research team. Before administration, participants received standardized instructions regarding the study objectives and assurances of confidentiality. Questionnaires were completed anonymously within approximately 20 minutes. Quality control measures included pre-testing of the instrument, standardized briefing procedures, on-site supervision to minimize discussion among respondents, and immediate review of questionnaires to ensure completeness. Incomplete forms were excluded before data entry.

Data Analysis

Data were coded, entered, and analyzed using IBM SPSS Statistics version 25.0 (IBM Corp., Armonk, NY, USA). Before analysis, data cleaning procedures were performed, including range checking, consistency verification, and assessment of missing values. Descriptive statistics were used to summarize respondent characteristics and study variables. Categorical variables (age, class, knowledge category, attitude category, and preventive practice category) were

presented as frequencies and percentages. For continuous domain scores (knowledge, attitude, and practice), means and standard deviations were calculated. Bivariate associations between independent variables (knowledge, attitude, age, and class) and the dependent variable (preventive practice) were assessed using the Chi-square test of independence. Fisher's Exact test was applied when expected cell counts were less than five. Crude odds ratios (ORs) with 95% confidence intervals (CIs) were calculated to estimate the magnitude of association. Variables with theoretical relevance and/or p -values < 0.25 in bivariate analysis were included in a multivariate model. Binary logistic regression analysis was performed to identify independent predictors of good preventive practice (dichotomous outcome: good vs. poor). Adjusted odds ratios (AORs) with 95% confidence intervals were reported. Model fitness was evaluated using the Hosmer–Lemeshow goodness-of-fit test. Multicollinearity was assessed by examining standard errors and correlation matrices. All statistical tests were two-tailed, and statistical significance was set at $\alpha = 0.05$.

Ethical Approval

This study was reviewed and approved by the Health Research Ethics Committee of Universitas Tanjungpura, Indonesia. Ethical clearance was granted under approval number 5421/UN22.9/PT.01.04/2025 before data collection. All participants were informed about the study objectives, procedures, potential risks, and benefits before participation. Written informed consent was obtained from each student. Participation was voluntary, and respondents were assured of confidentiality and anonymity. No personal identifiers were collected, and participants were informed of their right to withdraw from the study at any stage without academic or personal consequences.

RESULT

Table 1. Characteristics of Respondents (n = 84)

Variable	Category	n	%
Age (years)	16	19	22.6
	17	61	72.6
	18	4	4.8
Class	F1	34	40.5
	F4	26	31.0
	F9	24	28.6

The sample was predominantly composed of 17-year-old students, with relatively balanced representation across classes.

Table 2. Analysis of Factors Associated with Preventive Practice

Variable	Category	Good n (%)	Poor n (%)	Crude OR (95% CI)	p-value
Knowledge	Good	54 (72.0)	21 (28.0)	2.57 (0.60–10.98)	0.293
	Moderate/Poor	5 (55.6)	4 (44.4)	Ref	
Attitude	Positive	57 (74.0)	20 (26.0)	7.13 (1.29–39.29)	0.012*
	Negative	2 (28.6)	5 (71.4)	Ref	
Age	17–18	47 (72.3)	18 (27.7)	1.32 (0.45–3.87)	0.607
	16	12 (63.2)	7 (36.8)	Ref	
Class	F4–F9	35 (70.0)	15 (30.0)	1.09 (0.44–2.70)	0.454
	F1	24 (70.6)	10 (29.4)	Ref	

*Significant at $\alpha = 0.05$

Attitude showed a statistically significant association with preventive practice ($p = 0.012$). Students with positive attitudes had 7.13 times higher odds of demonstrating good

preventive behavior compared to those with negative attitudes. Knowledge, age, and class were not significantly associated with preventive practice.

Table 3. Logistic Regression Analysis of Factors Associated with Preventive Practice

Variable	Adjusted OR (95% CI)	p-value
Attitude (Positive vs. Negative)	6.624 (1.16–37.82)	0.033*
Knowledge (Good vs. Moderate/Poor)	1.17 (0.30–4.63)	0.822
Age	1.21 (0.42–3.47)	0.727
Class	1.07 (0.57–1.99)	0.838

*Significant at $\alpha = 0.05$

Model diagnostics indicated acceptable goodness-of-fit based on the Hosmer–Lemeshow test.

After adjustment for covariates, attitude remained the only independent predictor of preventive practice (AOR = 6.624; 95% CI: 1.16–37.82; $p = 0.033$). Adolescents with positive attitudes were approximately 6.6 times more likely to demonstrate good preventive behavior compared to those with negative attitudes. Knowledge, age, and class did not show independent associations.

This study provides empirical evidence that attitude is the dominant determinant of anemia preventive behavior among adolescents, whereas knowledge alone does not independently predict practice. Although the majority of respondents demonstrated good knowledge and positive attitudes, only attitude showed a statistically significant association with preventive behavior in both bivariate and multivariate analyses. Adolescents with positive attitudes were more than six times as likely to engage in appropriate preventive practices as those with negative attitudes.

These findings indicate a knowledge behavior gap: cognitive understanding does not automatically translate into sustained action. The absence of a significant association between knowledge and preventive practice suggests that awareness is necessary but insufficient to drive behavioral change. Instead, affective components such as perceived benefits, motivation, and personal disposition appear to exert a stronger influence on compliance with anemia prevention strategies, including iron supplementation. By identifying attitude as the only independent predictor after statistical adjustment, this study strengthens the argument for shifting school-based health interventions from knowledge-centered education to attitude-focused, motivational approaches. Reinforcement mechanisms and supportive environments are likely essential to achieving sustainable preventive behavior among adolescents.

DISCUSSION

This study demonstrated that attitude was independently associated with anemia-preventive behavior among adolescents, whereas knowledge was not significantly associated with preventive practice. These findings partially support the study hypothesis. The hypothesis that attitude would significantly influence preventive behavior was confirmed; however, the assumption that knowledge would independently predict preventive practice was not supported. Considering the substantial impact of anemia on adolescent growth and cognitive performance (Mithra et al., 2021), identifying determinants of preventive behavior is particularly important in this population.

The significant role of attitude is consistent with previous studies reporting that positive attitudes are strongly associated with adherence to iron supplementation among adolescent girls (Darmawan & Sulastris, 2026; Situmeang et al., 2022). Similarly, Munira and Viwattanakulvanid (2024) emphasized that motivational factors and personal perceptions influence compliance

beyond mere cognitive understanding. Intervention-based studies further support this finding (Munira & Viwattanakulvanid, 2024). Riswanto et al. (2024) reported that structured education improved awareness and engagement in anemia prevention, demonstrated that animated video-based education enhanced not only knowledge but also attitudes and compliance with iron supplementation. Also found that targeted nutrition education significantly improved adolescents' attitudes and encouraged better preventive practices Riswanto et al., 2024; Zakiah et al., 2023). These findings suggest that affective readiness and perceived benefits may function as stronger determinants of preventive behavior than factual knowledge alone. Supporting this notion, a randomized controlled trial in rural Bangladesh reported that mobile health-based nutritional education significantly improved anemia-related KAP scores and contributed to higher recovery rates among anemic adolescent girls (Rahman et al., 2025), highlighting the importance of sustained educational reinforcement beyond conventional information delivery.

In contrast, the lack of association between knowledge and preventive practice aligns with studies indicating that knowledge does not automatically translate into sustained behavioral change (Agustina et al., 2021; Naim et al., 2025). Although knowledge is often associated with improved awareness, behavioral implementation requires reinforcement mechanisms and supportive environments. Similarly, Putri and Fauziyah (2023) observed that contextual factors may exert a stronger influence than knowledge alone in determining anemia-related behaviors. These variations across contexts highlight the complex interactions among cognitive, affective, and environmental determinants in shaping adolescent health behaviors (Putri & Fauziyah, 2023).

The present findings contribute to the existing literature by identifying attitude as the dominant independent predictor, as determined through multivariate analysis. While many previous studies have examined knowledge, attitudes, and practices descriptively, fewer have clarified which determinant remains significant after statistical adjustment. Wisnuwardhani et al. (2023) reported that although school-based education programs improved knowledge, behavioral consistency required ongoing reinforcement. Nisrina & Sinaga (2025) also emphasized the importance of environmental and social support in sustaining preventive practices. This distinction is important because interventions that focus primarily on knowledge dissemination may overlook the motivational and perceptual components necessary for sustainable behavioral change (Nisrina & Sinaga, 2025; Wisnuwardani et al., 2023).

From a nursing perspective, these results underscore the importance of designing attitude-centered health promotion strategies in school settings. Evidence suggests that structured supervision, peer involvement, and continuous reinforcement significantly improve adherence to iron supplementation programs (Silitonga et al., 2024). Large school-based supplementation trials have also demonstrated that weekly iron-folic acid supplementation can improve hemoglobin levels among adolescents, although complementary behavioral strategies remain essential for sustained effectiveness (Cliffer et al., 2023). Moreover, family engagement has been shown to strengthen preventive nutritional behaviors among adolescents (Ningrum et al., 2026). Optimizing iron intake and addressing dietary factors that influence bioavailability are also essential components of comprehensive prevention strategies (Cohen & Powers, 2024; Litaqia & Cahya Mulat, 2025). Integrative approaches that combine education with motivational reinforcement may therefore produce more sustainable outcomes than knowledge-based interventions alone.

Despite its contributions, this study has several limitations. The cross-sectional design precludes causal inference, and the sample was limited to a single school, potentially limiting generalizability. In addition, self-reported measures may introduce reporting bias. Future research

using longitudinal or intervention-based designs is recommended to further explore causal pathways and long-term behavioral sustainability.

CONCLUSION

This study aimed to identify factors associated with anemia preventive behavior among adolescents and to determine which behavioral determinant independently predicts preventive practice. The findings demonstrate that attitude was the only variable independently associated with anemia-preventive behavior. In contrast, knowledge, age, and class did not remain significant predictors after statistical adjustment. These results indicate that cognitive awareness alone is insufficient to ensure sustained preventive behavior. A knowledge–behavior gap persists, emphasizing the critical role of affective and motivational components in shaping adolescent health practices. Therefore, anemia prevention policies should move beyond information-based education toward attitude-centered and reinforcement-driven strategies. Evidence-based recommendations include strengthening school-based nursing interventions, integrating peer-support systems, implementing structured supervision of adherence to iron supplementation, and involving families in health promotion activities. Multilevel behavioral reinforcement approaches are essential to enhance long-term compliance and improve adolescent anemia prevention outcomes.

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Conflict of Interest

The authors declare that there are no conflicts of interest related to this study.

Authors' Contributions

Ledy Ervita contributed to conceptualization, study design, supervision, data interpretation, manuscript drafting, and final approval of the manuscript. Wulida Litaqia contributed to study design, data collection, data analysis, and manuscript revision. Devi Harmita contributed to data collection, data management, and literature review. Yusriani Saleh Baso contributed to methodological review, statistical validation, and critical revision of the manuscript. Hanafi contributed to supervision, critical appraisal of the manuscript, and final approval of the version to be published. All authors approved the final manuscript and agree to be accountable for all aspects of the work.

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