

School-Based Interventions for the Prevention of Iron Deficiency Anemia in Adolescent Girls: A Scoping Review

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ABSTRACT

Background: Iron Deficiency Anemia (IDA) is a critical global public health challenge among adolescent girls, driven by increased physiological iron requirements during growth spurts, menstrual blood loss, inadequate dietary intake, as well as lifestyle and environmental factors. Schools serve as a strategic platform for delivering broad and sustainable IDA prevention interventions. This study aims to summarize and analyze various school-based intervention models for preventing IDA among adolescent girls.

Methods: A scoping review comprehensive literature search was performed across PubMed, Google Scholar, and Cochrane Library databases using BOOLEAN operators based on the PICOS framework. After screening and data extraction, 12 qualified articles were included in the final synthesis.

Results: Synthesis of the included studies demonstrated that school-based interventions effectively reduced anemia prevalence, increased hemoglobin (Hb) levels, optimized serum folate status, and improved nutrition-related Knowledge, Attitude, and Practice (KAP) among adolescent girls. Four main

pillars of successful school-based interventions were identified regular Weekly Iron and Folic Acid Supplementation (WIFAS), interactive nutrition education utilizing visual media, fixed-day supplementation accompanied by peer educator empowerment, and comprehensive risk factor control by restricting iron-inhibiting beverages and integrating deworming programs alongside school sanitation (WASH).

Conclusion: Integrated and sustainable school-based interventions, supported by multi-sectoral collaboration among primary health centers (Puskesmas), school authorities, peer educators, and parents, hold substantial potential to significantly reduce anemia prevalence, optimize academic performance, and improve the reproductive health status of adolescent girls.

Keywords: adolescent girls; iron deficiency anemia; iron-folic acid supplementation; school-based intervention; WIFAS.

INTRODUCTION

Iron deficiency anemia (IDA) is the most common global health problem, especially in young women.¹ According to WHO data by

2025, anemia affects approximately 1.62 billion people worldwide, of which about 191 million are adolescents.² Meanwhile, data from *Kementrian Kesehatan Republik Indonesia (Kemenkes)* shows that Indonesia is ranked eighth out of 11 Asian countries, with the number of cases reaching around 7.5 million.³ These data demonstrate that anemia remains a crucial public health issues requiring serious attention.

The disease is also often associated with increased morbidity and mortality rates among women and children. It leads to adverse birth outcomes, reduces productivity in adulst, and impaired cognitive and behavioral development in children, particularly adolescents.⁴ Adolescent girls are particularly vulnerable due to biological factors, including rapid growth spurts and periodic iron loss form menstruation.⁵ Anemia affects 33.7% of adolescent girls and women aged 15-49 years globally, compared to 11.3% of boys and men in the same age bracket.⁶ Adolescent girls (10-19 years old) are more affected than boys because they have vulnerability due to early puberty, menstruation, as well as increased iron needs and lower iron reserves.^{7,8}

Although the health issue of iron deficiency anemia in adolescent girls is considered very important, the results of various studies show that this is still a challenge because the level of awareness and attitude of adolescent girls towards IDA is still low. raise awareness, and provide knowledge and skills to stay

away from IDA. So, Scoping Review It discusses several prevention models in the form of school-based interventions in the prevention of deficiency anemia in adolescent girls.

METHODS

The methodology employed was scoping review conducted across several electronic databases including PubMed, Google Scholar, and the Cochrane Library. The studies included in this review focused on school-based interventions aimed at preventing iron deficiency anemia in adolescents. The literature search was guided by key terms framed within the PICOS (Prevention, Intervention, comparison, outcome and study design) framework, utilizing BOOLEAN operators: ("school-based intervention" OR "school intervention" OR "school program" OR "school-based program" OR "school-based promotion") AND ("iron deficiency anemia" OR "iron deficiency" OR "anemia" OR "IDA") AND ("adolescent girl" OR "teenage girl" OR "adolescent female*" OR "female adolescent" OR "young women").

The initial database search yielded 681 records from Google Scholar, 6 from PubMed, and 1 from the Cochrane Library. Following screening and data extraction, 12 scholarly articles met the eligibility criteria and were included in the final review.

RESULT AND DISCUSSION

No	Author	Variable	Sample	Method	Results
1	Zuraida et al (2022) ⁹	Nutritional knowledge, attitude, iron intake, hemoglobin (Hb) levels	72 junior high school girls (38 intervention groups, 34 control groups) in Lampung	Quasi-experimental (pre-post test with control group); 6-week Free Club Model Anemia intervention (nutrition education, parent/teacher meal monitoring, IFA supplementation)	There was a significant improvement in knowledge, attitudes, iron intake, and Hb levels in the intervention group compared to the control group.
2	Sofiyetti et al (2026) ¹⁰	Compliance with IFA consumption, Hb levels, erythrocyte count,	78 high school girls (39 interventions, 39 controls) in Jambi City.	Quasi-experimental (pre-post test with control group); intervention of the "REMANIA" model (peer cadres), weekly	The intervention group had significantly higher IFA adherence, significantly increased Hb levels, erythrocyte index, and hematocrit.

		hematocrit values.		joint IFA drinking, and body color puzzles for 3 months.	
3	Bolka et al (2025) ¹¹	Serum folate levels, Hb levels, nutritional knowledge, diversity of food consumption.	329 school girls (164 WIFAS schools, 165 non-WIFAS schools) in Ethiopia.	Comparative cross-sectional study, comparing schools that implement the Weekly Iron and Folic Acid Supplementation (WIFAS) + nutrition education program with non-WIFAS schools	Students at WIFAS schools have significantly higher average serum folate concentrations and Hb levels as well as a much lower prevalence of anemia.
4	Jalambo et al (2017) ¹²	Knowledge, attitude, practice-KAP) related to IDA.	89 young women with iron deficiency in the Gaza Strip, Palestine.	Randomized controlled trial (RCT); both groups received weekly IFA for 3 months, the intervention group received 9 interactive nutrition education sessions.	A significant increase in the nutrition education group, the level of knowledge increased, positive attitudes increased to 70.5%, and practice also increased.
5	Zuair (2025) ¹³	Knowledge, attitudes, and practices related to IDA.	153 high school students (45 students with IDA were intervened in Saudi Arabia.	Pre-post intervention study; Low-intensity nutrition education (2 sessions with a duration of 45 minutes) presented by public health nurses.	The intervention significantly improved nutrition knowledge and practice scores, but showed no change in the domain of attitudes.
6	Singh et al (2020) ¹⁴	Prevalence of anemia, Hb levels, clinical symptoms, and eating habits.	210 high school girls (106 interventions, 104 controls) in Delhi, India.	School-based intervention study (6 months), intervention group received weekly IFA (WIFS)	The decrease in the prevalence of anemia was much higher in the IFA+ education group. The average increase in Hb in the intervention group reached 2.3 g/dL compared to the control group (1.9 g/dL).
7	Duggilara et al (2026) ¹⁵	Prevalence of anemia, Hb levels, iron intake factors, tea consumption, menstrual factors.	278 young women (13-17) years old in rural Andhra Pradesh, India.	Cross-sectional study, Hb point of care measurement and structured questionnaire.	The prevalence of anemia was 66.9%. Inadequate iron intake, drinking habits at meals, and menstrual duration are the main factors in the incidence of anemia.
8	Yewodiaw et al (2025) ¹⁶	Prevalence of anemia, IFA adherence, knowledge, history of parasitic infections	345 young women (172 WIFAS schools, 173 non-WIFAS schools) in Janamora District, Ethiopia	School-based comparative cross-sectional study; structured questionnaires, anthropometric measurements, and Hb level tests.	The prevalence of anemia was significantly lower in schools of the WIFAS program. Factors strongly associated with female anemia include poor IFA adherence, low knowledge of anemia, coffee/tea drinking habits, and concerns about parasitic infections.
9	Kureishy et al (2026) ¹⁷	WIFAS coverage, compliance,	750 young women (KAP survey) &	Mixed-methods evaluation; Quantitative latitude-	School-based WIFAS programs have successfully achieved high

		anemia knowledge, eating habits, anemia rates prevented,	30,506 female students (program data) in Pakistan	cutting studies are combined with qualitative interviews.	compliance, increased knowledge of anemia, and are expected to prevent anemia cases.
10	Ibnu et al (2025) ¹⁸	Prevalence of anemia, Hb levels, knowledge, attitudes, and motivation for prevention.	65 anemic adolescent girls (37 interventions, 28 controls) in Jambi City.	Quasi-experimental study; "8000 Days Against Anemia Club" intervention for 6 weeks (interactive lectures, games, peer counseling)	The prevalence of anemia in the intervention group decreased dramatically from 100% to 7.1% (the control group remained 78.4%) accompanied by an increase in the average Hb of 2 g/dL.
11	Markusi et al (2026) ¹⁹	The level of knowledge of adolescent girls about anemia and IFA.	33 grade VII students of Dwi Jendra Junior High School, Denpasar.	Pre-experimental one-group pretest-posttest design. The intervention was carried out in the form of banner-based visual education sessions and question and answer discussions.	The average knowledge score increased significantly from (posttest). Visual media-based education (banner) has been proven to be effective in increasing nutritional literacy and awareness of IFA consumption in adolescent girls.
12	Hossain et al (2017) ²⁰	Nutritional knowledge, causes and impacts of nutritional anemia, dietary variations (sources of iron), personal hygiene, and anemia prevention strategies.	150 female students (grades 5–10, divided into 5 groups of 30 students each) in rural schools in Bangladesh,	The school-based health education program uses a combination of lecture methods, open discussions, video documentary players, demonstrations, and pre-post test evaluations.	Produce a 5-day interactive educational intervention module/framework designed to achieve the target of nutrition understanding up to 95%. School-based multidisciplinary education has proven to have the potential to increase knowledge, form positive attitudes, and encourage behavior change to prevent nutritional anemia.

Iron deficiency anemia in adolescent girls is a significant global health challenge. In adolescence, iron labor increases dramatically along with rapid growth (Growth spurt) and monthly blood loss due to menstruation so that the daily iron requirement increases drastically.²¹ If this increase in physiological needs is not balanced with micronutrient intake, adolescent girls will be very susceptible to a decrease in hemoglobin levels which leads to IDA.¹⁴ The impact of this condition is not only limited to physical problems, decreased immunity, and cognitive impairment that trigger a decline in learning achievement in school, but also has long-term consequences

for reproductive health, including the risk of giving birth to babies with low birth weight (BBLR) and perpetuating the cycle of intergenerational malnutrition.^{11,20} Based on a comprehensive synthesis of various scientific literature, the implementation of school-based interventions has proven to be a very strategic, effective, and impactful approach in improving nutritional literacy, supplementation compliance, and improving hematology indicators for adolescent girls.^{9,10,17,19}

School institutions play a crucial role as an efficient intervention platform because they are able to provide direct and sustainable access to the group of young women as the

most vulnerable age group.¹⁷ According to the intervention carried out by Hossain & Luies (2017) in rural schools to break the chain of inequality of nutritional information which is often exacerbated by economic limitations and gender-biased cultural norms in the distribution of family food.²⁰ Through school involvement, weekly iron and folic acid supplementation programs (weekly iron and folic acid supplementation/WIFAS) combined with nutrition education can be integrated into teaching and learning programs in schools.¹⁷ Evidence of the superiority of this school-based intervention is shown by Yewodiaw et al (2025) where schools implementing the WIFAS program recorded a significantly lower prevalence of anemia compared to non-WIFAS schools.¹⁶ These findings are in line with the results of research by Bolka et al (2025) which reported that female students in WIFAS schools have hemoglobin (13.30 g/dL vs 12.27 g/dL) and serum folate concentration (9.76 g/dL vs 7.38 g/dL) which was significantly higher than that of female students in schools without a program.¹¹ The success of school-based interventions is largely determined by the method of delivery of nutrition education materials and the use of appropriate learning media.^{12,19} Giving blood supplement tablets (IFA) without being accompanied by nutrition education has been approved to be not optimal in changing adolescents' daily behavior.¹⁴ The use of simple and easily accessible visual media, such as banners or educational banners in the school environment, can make a positive contribution to improving nutritional knowledge. Markusi et al (2026) recorded a drastic increase in knowledge scores from the average pretest (58,2) to posttest (96,0) after exposure to anemia material using banner media. The permanent placement of visual media in corridors or classroom facilitates repeated exposure to information (long-term cognitive retention), so that key messages regarding the prevention of anemia and the management of IFA side effects are more easily absorbed.¹⁹ In addition to single media, the incorporation

of multimotive educational methods such as interactive lectures, documentary video screenings, group discussion, flipchart, and structured modules are also effective in encouraging understanding of nutrition and building adolescents' internal motivation.^{12,18,20} Club-based interventions or interactive group activities such "8000 Days Against Anemia Club" by Ibnu et al (2025) were able to drastically reduce the prevalence of female student anemia 100% to only 7,1% within 6 weeks.¹⁸ However, Zuair (2025) provides an important note that short-duration school education interventions can quickly improve the domain of knowledge and practice, but require more consistent mentoring in order to be able to change attitudes that has taken root.¹³

Besides education, the biggest challenge of the WIFAS program in schools is compliance students in consuming IFA regularly.^{10,16} Obstacles such as nausea, the onset of side effects, fear of medical myths, and simply forgetting are the main reasons for low compliance of adolescents.^{10,17} Yewodiaw et al (2025) identified that non-compliant female student taking IFA had 3,69 time higher risk of developing anemia than non-compliant female student.¹⁰ Therefore, intervention innovations in the form of the formation of peer cadres (Peer supplementation) proved to be a very powerful solution.^{9,10} Research by Sofiyetti et al (2026) show that the involvement of anti-anemia adolescents cadres (REMANIA) supported by visual monitoring (Body Puzzle) was able to increase IFA consumption by up 4,169 times, leading to a noticeable increase in hemoglobin levels, hematocrit values, and erythrocyte index. The use of peer groups and teacher supervision in schools creates positive social norms (Peer Support), thereby reducing rejection and increasing the confidence of young women to regularly consume IFA.^{10,17} The substance of the material in the school intervention program must also be well prepared and not only focus on IFA, but also include balanced nutrition management, control of environmental risk factors, and

personal hygien.^{16,20} School nutrition education needs to emphasize the importance of consuming foods that are sources of animal iron (Heme Iron) and vegetable (Non-Heme Iron), the use of vitamin C as a drivers of iron absorption (Iron enhancer), as well as restrictions on consumption of iron-absorbing drinks (Iron Inhibitors) such as tea and coffee when eating. Duggirala et al (2026) and Yewodiaw et al (2025) confirmed that the habit drinking tea or coffee repeatedly around mealtime increase the risk of female student anemia by 2,0 to 5,9 times. In addition to diet, the control of secondary anemia based on school environment is a very important aspect.^{15,16} Yewodiaw et al. (2025) reported that a history of parasitic infection increased the risk of anemia in schoolgirls by 6,94–7,60 time due to chronic microbleeding in gastrointestinal tract.¹⁶ Therefore, the nutrition education planning framework by Hossain & Luies (2017) which combines school health promotion with periodic deworming programs and improvement of school sanitation facilities (WASH) additional intervention measures to achieve comprehensive elimination of anemia.²⁰

The long-term success of this schools-based intervention approach requires commitment and collaboration between the health office, the schools, peer cadre organizations, and the support of parents at home.^{9,17} The integration of permanent visual educational media in school health program facilities, the implementation of supervised joint IFA drinking actions, the empowerment of peer groups, and the implementation of coordinated deworming programs in a sustainable manner have great potential to reduce the prevalence of anemia, improve the quality of life, and optimize the academic and future potential of adolescent girls.^{10,18,19}

CONCLUSION

Iron Deficiency Anemia (IDA) in adolescent girls is affected by a surge in nutritional needs, menstrual bleeding, inadequate iron intake, the habit of drinking tea or coffee with meals, and parasitic infections. School-based

interventions have proven to be the most effective strategy through the management of four main pillars. First, regular weekly iron and folic acid supplementation (WIFAS) has been shown to be effective in reducing the prevalence of anemia, increasing hemoglobin levels, and optimizing serum folate. Second, the combination of providing IFA with interactive nutrition education using visual media (banners, banners, flipcharts) succeeded in improving nutrition knowledge, improving diet, and fostering motivation to prevent anemia. Third, IFA drinking together at school (fixed-day supplementation) who are accompanied by peer cadres (such as REMANIA or Anemia Free Club). Fourth, school intervention by integrating balanced nutrition education, limiting tea or coffee consumption during meals, and giving dewormers (Deworming) and sanitation improvement. The implementation of school-based programs that are integrated and supported by the collaboration of health centers, schools, peer cadres, and parents has great potential to reduce anemia rates, optimize learning achievement, and improve the quality of reproductive health of adolescent girls.

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Declaration of Generative AI and AI-Assisted Technologies in the Manuscript Preparation

Process: During the preparation of this work, the authors used Claude (Anthropic) in order to assist with language editing, sentence restructuring, and improving the clarity of academic writing in certain sections of the manuscript. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

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