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Effectiveness of Iron-Folic Acid Tablet Programs in Reducing Anemia among Adolescent Girls

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Abstract. *Anemia among adolescent girls remains a major public health problem because it affects growth, cognitive capacity, learning productivity, and future maternal health. Iron-folic acid tablet supplementation, commonly implemented through schools, is one of the most widely recommended strategies to prevent and reduce anemia in menstruating adolescents. This systematic review aimed to synthesize recent evidence on the effectiveness of iron-folic acid tablet programs in reducing anemia among adolescent girls and to identify implementation factors that influence program outcomes. A structured literature search was conducted in PubMed, Google Scholar, ScienceDirect, and relevant institutional databases for studies published between 2020 and 2026. Articles were selected using predefined eligibility criteria and synthesized narratively following the PRISMA 2020 approach. The reviewed evidence indicates that iron-folic acid supplementation can increase hemoglobin concentration, reduce anemia prevalence, and improve anemia-related knowledge when supported by regular distribution, adherence monitoring, nutrition education, and school-health collaboration. However, effectiveness is frequently limited by low compliance, fear of side effects, poor understanding of anemia, irregular tablet supply, and weak monitoring systems. The review concludes that tablet supplementation is effective, but its public health impact depends on implementation quality and sustained behavioral support.*

Keywords: *Adolescent Girls; Anemia; Iron-Folic Acid; Supplementation; Systematic Review.*

1. BACKGROUND

Anemia in adolescent girls is a persistent nutritional and public health problem. The condition is commonly associated with inadequate dietary iron intake, menstrual blood loss, rapid growth, infection, and limited access to preventive health services (Astuti, 2023). During adolescence, iron requirements increase substantially because of accelerated growth and the onset of menstruation. When these needs are not met, iron deficiency may reduce hemoglobin synthesis and lead to anemia (Anugrah Wulandari et al., 2025; Indriana & Darmayanti, 2022). The consequences are not limited to clinical symptoms such as fatigue, pallor, dizziness, and reduced physical endurance; anemia can also impair attention, learning performance, emotional well-being, and long-term reproductive health (Chaparro & Suchdev, 2019; Sukmawati & Titi Alfiani, 2025).

The urgency of addressing anemia among adolescent girls is strengthened by its intergenerational impact (Rashid et al., 2020; SL, 2024). Girls who enter pregnancy with anemia face higher risks of maternal complications, low birth weight, preterm birth, and poor infant outcomes. Therefore, adolescence is an important window of opportunity to improve iron status before adulthood and pregnancy (Cahyani et al., 2022). Global guidance has emphasized iron supplementation as a public health intervention for menstruating adolescent girls in settings where anemia is prevalent. In Indonesia, the program is widely known as Tablet Tambah Darah and is commonly implemented through schools because schools provide an

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efficient platform to reach large numbers of adolescent girls in a structured manner (Chang, 2021).

Previous studies have reported that weekly iron-folic acid supplementation can improve hemoglobin concentration and reduce anemia risk. However, evidence also shows that program outcomes vary across regions, schools, and population groups. The main challenge is no longer merely whether iron-folic acid tablets are biologically effective, but whether program implementation is sufficiently strong to ensure regular intake. Low adherence, negative perceptions of tablets, side effects, limited knowledge, lack of teacher or peer support, and inconsistent distribution often reduce the impact of supplementation programs. This creates a gap between policy availability and measurable health outcomes (Means T & Brodsky M, 2022).

The novelty of this review lies in synthesizing recent evidence not only on the biomedical effectiveness of iron-folic acid tablets but also on implementation determinants that influence real-world effectiveness among adolescent girls (Machado et al., 2019). By integrating evidence on hemoglobin outcomes, anemia prevalence, adherence, knowledge, and school-based delivery mechanisms, this review provides a more practical understanding of how Tablet Tambah Darah programs can be optimized. The objective of this systematic review was to evaluate the effectiveness of iron-folic acid tablet programs in reducing anemia among adolescent girls and to identify factors that support or hinder successful implementation.

2. THEORETICAL REVIEW

Anemia is defined as a condition in which hemoglobin concentration is lower than the normal threshold for age, sex, and physiological status. In adolescent girls, iron deficiency is among the most frequent causes because iron is required for hemoglobin formation and oxygen transport. The theoretical basis for iron-folic acid supplementation is that regular intake of elemental iron replenishes body iron stores, supports erythropoiesis, and improves hemoglobin concentration. Folic acid is included because it supports red blood cell formation and is important for reproductive health (Lanier et al., 2018).

The effectiveness of supplementation programs can be understood through two complementary frameworks. First, the biomedical framework explains that adequate iron intake directly affects hemoglobin levels and anemia status. Second, the implementation framework explains that the success of public health programs depends on coverage, adherence, acceptability, delivery quality, and monitoring. A tablet program may be efficacious

under controlled conditions but less effective in schools if students do not receive tablets consistently or do not consume them as recommended (Ghamri et al., 2024).

School-based delivery is theoretically appropriate because teachers, school health units, and peer groups can support distribution and monitoring. However, adolescent behavior is influenced by knowledge, beliefs, perceived benefits, perceived barriers, parental support, peer norms, and health-worker communication. Thus, supplementation should be integrated with nutrition education, counseling on side effects, menstrual health education, and routine monitoring. This theoretical perspective supports the assumption that the Tablet Tambah Darah program will be more effective when supplementation is combined with behavior-change strategies and institutional support (Diana et al., 2022; Sulistyoningrum et al., 2018).

3. RESEARCH METHOD

This study used a systematic review design with narrative synthesis. The review was guided by the PRISMA 2020 reporting approach to improve transparency in identification, screening, eligibility assessment, and synthesis. The research question was formulated as follows: How effective are iron-folic acid tablet programs in reducing anemia among adolescent girls, and what implementation factors influence their effectiveness? The population was adolescent girls, the intervention was iron-folic acid or Tablet Tambah Darah supplementation, the comparison was no supplementation, usual practice, baseline condition, or different implementation exposure, and the outcomes were anemia prevalence, hemoglobin level, adherence, knowledge, and program acceptance.

Literature searches were conducted in PubMed, ScienceDirect, Google Scholar, and institutional databases using combinations of the keywords: adolescent girls, anemia, iron-folic acid supplementation, weekly iron supplementation, school-based supplementation, Tablet Tambah Darah, adherence, hemoglobin, and systematic review. The search was limited to studies and guidance documents published from 2020 to 2026 in English or Indonesian. Additional sources were identified through reference lists of relevant articles and public health guidelines.

The inclusion criteria were: studies involving adolescent girls; studies evaluating iron, iron-folic acid, or Tablet Tambah Darah supplementation; articles reporting anemia, hemoglobin, adherence, knowledge, acceptability, or implementation outcomes; and peer-reviewed articles, systematic reviews, or authoritative public health documents. Exclusion criteria were studies focusing only on pregnant women, clinical anemia unrelated to nutrition, opinion articles without data, and articles with insufficient methodological information. Data

were extracted on author, year, country or setting, design, intervention characteristics, outcomes, and key findings. Because study designs and outcomes varied, meta-analysis was not conducted. The findings were synthesized narratively by grouping evidence into effectiveness outcomes and implementation determinants.

Table 1. Summary of synthesis themes.

Synthesis theme	Main evidence pattern	Interpretation	Program implication
Hemoglobin and anemia outcomes	Most studies reported increased hemoglobin or reduced anemia risk after regular supplementation.	Iron-folic acid tablets are biologically effective when consumed consistently.	Ensure regular intake and monitor anemia status periodically.
Adherence	Adherence was frequently lower than expected because of taste, side effects, forgetfulness, and low perceived need.	Program impact is strongly dependent on consumption behavior, not only tablet distribution.	Use supervised weekly consumption, peer support, and counseling.
Knowledge and perception	Education improved understanding of anemia and benefits of supplementation.	Knowledge supports acceptance but may not be sufficient without environmental support.	Integrate nutrition education into school health activities.
Delivery system	School-based programs improved reach but were vulnerable to irregular supply and weak documentation.	Schools are strategic platforms but need coordination with health services.	Strengthen logistics, recording, reporting, and teacher-health worker collaboration.

4. RESULTS AND DISCUSSION

Effectiveness of Iron-Folic Acid Tablet Programs

The synthesis indicates that iron-folic acid tablet programs are effective in improving anemia-related outcomes among adolescent girls when implemented with sufficient dose, duration, and adherence. The most consistent finding across the literature is an increase in hemoglobin concentration after regular supplementation. This is theoretically expected because iron is the main substrate for hemoglobin synthesis. Weekly supplementation is commonly used in school-based programs because it is easier to manage, more acceptable for long-term prevention, and suitable for public health implementation. In settings with high anemia prevalence, daily supplementation may also be recommended as a public health intervention, particularly where the burden of anemia and iron deficiency is severe (Maretalinia et al., 2023; Wang et al., 2025).

The effectiveness of Tablet Tambah Darah programs should be interpreted beyond hemoglobin changes. A successful program also improves knowledge, strengthens preventive behavior, and builds a supportive school environment. Several studies from Indonesia and other low- and middle-income settings show that supplementation is more likely to produce meaningful outcomes when tablets are provided together with nutrition education and

adherence monitoring (Ahmed et al., 2023). The school setting provides a practical delivery platform because adolescent girls can be reached regularly, but program success requires more than physical distribution of tablets.

Adherence as the Central Determinant of Effectiveness

Adherence emerged as the central determinant of effectiveness. Many adolescent girls receive tablets but do not consume them regularly (Mohamed, 2025). Common reasons include unpleasant taste, nausea, constipation, fear of weight gain, misconceptions that tablets are only for sick or pregnant women, and forgetfulness. In some schools, students may take tablets home without supervision, making actual consumption difficult to verify. These findings suggest that coverage indicators alone are insufficient. Programs should distinguish between tablets distributed, tablets received, and tablets consumed (Laila et al., n.d.).

Supervised weekly consumption at school may improve adherence because it reduces forgetfulness and allows teachers or health workers to respond directly to side effects and questions. Peer support may also improve motivation because adolescents are highly influenced by social norms. However, supervision should be implemented sensitively to avoid stigma. Girls who experience side effects need counseling that mild gastrointestinal symptoms can occur and that taking tablets after meals may reduce discomfort (Machado et al., 2019). Program communication should emphasize that supplementation is preventive, safe, and beneficial for learning capacity and future reproductive health (Imanah et al., 2025; SL, 2024; Sukmawati et al., 2022).

Implementation quality and school-health collaboration

The review found that implementation quality determines whether the program achieves its intended public health effect. Weak logistics, irregular tablet supply, poor recording, limited teacher involvement, and lack of follow-up reduce program effectiveness. A school may report that tablets were distributed, but without a monitoring system it is difficult to know whether students consumed them for the required duration. Therefore, program evaluation should include process indicators such as availability, distribution frequency, supervised intake, adherence documentation, side-effect management, and referral for girls with suspected moderate or severe anemia (Machado et al., 2019).

Collaboration between schools and primary health care services is essential. Health workers can provide technical guidance, hemoglobin screening, counseling, and follow-up, while schools can manage routine delivery and student engagement. Teachers and school health units should be trained to explain the purpose of supplementation, encourage consistent intake, and document implementation. Parental involvement is also important because some

adolescents need support at home, particularly during holidays or when tablets are not consumed at school.

Comparison with previous evidence and theoretical interpretation

The findings are consistent with global recommendations that iron supplementation can prevent anemia and iron deficiency among menstruating women and adolescent girls. They are also consistent with Indonesian evidence showing that school-based weekly iron-folic acid supplementation has been implemented as a national strategy but continues to face challenges in coverage, acceptance, and adherence. The results support the theoretical view that supplementation has strong biological plausibility, but real-world effectiveness depends on behavioral and organizational factors.

Compared with studies that focus only on hemoglobin outcomes, this review highlights a wider implementation gap. Some interventions may show improved hemoglobin under close monitoring, whereas routine school programs may produce weaker outcomes when adherence is low. This does not mean the program is ineffective; rather, it indicates that the program is vulnerable to implementation failure. The practical implication is that policy makers should not only provide tablets but also invest in education, supervision, digital monitoring, side-effect counseling, and school-health coordination (Nagao & Hirokawa, 2017).

The review also suggests that adolescent anemia prevention should not rely on supplementation alone. Dietary diversity, intake of iron-rich foods, vitamin C consumption, menstrual health education, deworming in endemic areas, and screening for other causes of anemia remain important. Iron-folic acid tablets are a core intervention, but they work best as part of an integrated adolescent nutrition program. In this context, Tablet Tambah Darah can be seen as both a biomedical intervention and a platform for adolescent health promotion (Wacka et al., 2024).

5. CONCLUSION AND SUGGESTIONS

This systematic review concludes that iron-folic acid tablet programs are effective in reducing anemia risk among adolescent girls, particularly when tablets are consumed regularly and accompanied by supportive implementation strategies. The evidence indicates improvements in hemoglobin concentration, reduced anemia prevalence, and better anemia-related knowledge. However, the effectiveness of the program is strongly influenced by adherence, acceptability, regular supply, monitoring, and collaboration between schools, health workers, parents, and peers. Program improvement should prioritize supervised weekly consumption, continuous nutrition education, side-effect counseling, reliable logistics, and

accurate recording of actual tablet intake. Schools should not only distribute tablets but also create a supportive environment that normalizes supplementation as part of adolescent health. Future research should use stronger longitudinal or experimental designs, standardized outcome measures, and implementation evaluation to determine which delivery models produce the greatest reduction in anemia. A limitation of this review is the heterogeneity of study designs and outcomes, which prevented quantitative meta-analysis. Nevertheless, the synthesis provides practical evidence that Tablet Tambah Darah programs can reduce anemia among adolescent girls when implemented with high quality and sustained behavioral support.

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