

Evaluation of the management of iron tablet supplementation program for adolescent girls in Indonesia: a scoping review

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Abstract

Purpose: This study aimed to analyze the evaluation of the management of iron and folic acid supplementation programs for adolescent girls in Indonesia using the input–process–output–outcome (IPOO) framework. **Methods:** This scoping review followed PRISMA-ScR guidance. Six information sources, including Google Scholar, PubMed, ScienceDirect, Semantic Scholar, Taylor & Francis Online, and Wiley Online Library, were searched for studies published up to 2025 using terms related to program management, iron supplementation, adolescent girls, and Indonesia. Eligibility criteria were structured using the JBI Population–Concept–Context (PCC) framework, with adolescent girls aged 10–19 years as the population, iron supplementation program management as the concept, and Indonesia as the context. Studies published in English or Indonesian were eligible, while reviews, editorials, and commentaries were excluded. **Results:** Of 2,692 records identified, 28 reports were sought for retrieval, 24 underwent full-text assessment, and seven studies met the eligibility criteria, comprising six qualitative studies and one mixed-methods study. The IPOO synthesis identified limited human resources and program resources as key input constraints, while weak monitoring, irregular supervision, and untimely distribution represented major process barriers. These implementation challenges contributed to inadequate program coverage, poor adherence to iron supplementation, and limited knowledge among adolescent girls. **Conclusion:** Iron supplementation programs showed inconsistent effectiveness due to persistent implementation barriers. Strengthening program management, resource capacity, supervision, health education, monitoring and reporting systems, and cross-sectoral collaboration between health services and schools is essential to improve adherence and ensure that program outputs translate into sustained behavioral and health outcomes.

Keywords: adolescent health; anemia; dietary supplements; iron-deficiency; program evaluation

INTRODUCTION

Anemia remains a major global public health problem, particularly among adolescent girls. It is characterized by a reduced number of red blood cells or low hemoglobin concentration, resulting in impaired oxygen transport throughout the body and reflecting poor nutritional and health status [1]. During adolescence, anemia may adversely affect physical growth, cognitive development, school performance, future work productivity, and overall quality of life [2]. Consequently, reducing the burden of anemia among adolescent girls has become a global public health priority.

Despite ongoing prevention efforts, anemia continues to affect a substantial proportion of adolescent girls in Indonesia. National surveys reported anemia prevalence of 22.7% among adolescents aged 13–18 years in 2013, 32.0% among women aged 15–24 years in 2018, and 15.5% in the same age group in 2023 [3–5]. However, regional studies indicate that anemia remains highly prevalent in several provinces. For example, studies conducted in Karanganyar and North Lombok in 2024 reported anemia prevalence of 49% and 76%, respectively, among adolescent girls [6,7]. These findings suggest substantial geographical disparities and indicate that anemia remains a persistent public health concern despite improvements observed in national estimates.

To address this problem, the World Health Organization (WHO) recommends weekly iron and folic acid supplementation (WIFAS) as a public health intervention for adolescent girls and menstruating women living in settings where anemia prevalence is at least 20%, while daily supplementation is recommended in settings where prevalence exceeds 40% [8,9]. Several countries, including Ghana, India, Nepal, and Indonesia, have implemented national iron supplementation programs for adolescent girls. Although these countries have adopted similar strategies, their experiences demonstrate that program effectiveness depends not only on supplement provision but also on adequate supply chains, monitoring systems, health education, stakeholder engagement, and policy support [10–12].

Indonesia has implemented a nationwide Weekly Iron and Folic Acid Supplementation (WIFAS) program since 2014, followed by revisions of the national guidelines in 2015 to align with WHO recommendations [13]. Nevertheless, implementation challenges remain evident. National survey data indicate that the

proportion of adolescent girls receiving iron tablets decreased slightly from 76.2% in the 2018 Basic Health Research (Riset Kesehatan Dasar/Riskesdas) to 73.5% in the 2023 Indonesian Health Survey (SKI) [3,4]. Furthermore, previous studies have consistently reported low adherence to tablet consumption despite relatively high program coverage, suggesting that program implementation has not yet achieved its intended impact.

Evidence from Indonesia indicates that these implementation challenges arise from multiple management-related factors. Previous studies have identified inadequate human resources, irregular tablet distribution, insufficient health education, limited monitoring and reporting systems, budget constraints, and poor cross-sectoral coordination as major barriers to effective program implementation [14–16]. These findings suggest that strengthening program management may be as important as increasing supplement availability in improving adherence and reducing anemia among adolescent girls.

Although several primary studies and previous reviews have examined iron supplementation among adolescent girls in Indonesia, the available evidence remains fragmented from a program management perspective. Previous reviews, including Helmyati et al. (2023), have focused primarily on acceptance of and adherence to iron supplementation, leaving a gap in a comprehensive synthesis of the programmatic factors that influence implementation across settings in Indonesia [14]. A scoping review is therefore appropriate because it enables systematic mapping of the breadth and characteristics of evidence from diverse study designs and settings while identifying key implementation gaps. In this review, the Input–Process–Output–Outcome (IPOO) framework provides a structured approach to examine program resources and prerequisites (Input), implementation and monitoring activities (Process), immediate program achievements (Output), and subsequent behavioral and health effects (Outcome). By integrating the scoping review approach with the IPOO framework, this study extends previous evidence beyond acceptance and adherence by comprehensively mapping programmatic management barriers and facilitating factors across Indonesia. Therefore, this scoping review aims to synthesize the existing evidence, identify implementation gaps across the IPOO domains, and provide recommendations to support future policy development and improvement of iron supplementation programs for adolescent girls in Indonesia.

METHODS

Protocol development, registration, and reporting guidelines

The protocol for this scoping review is publicly available through the Open Science Framework (OSF) at <https://osf.io/pztnng> (DOI: [10.17605/OSF.IO/VUPTF](https://doi.org/10.17605/OSF.IO/VUPTF)). The protocol was deposited retrospectively to provide a transparent and publicly accessible record of the review methodology. This scoping review was conducted and reported in accordance with the PRISMA-ScR guidelines for the overall structure and reporting [17]. Considerations of equity, based on PRISMA-Equity guidance, were incorporated to account for possible population disadvantages and equity implications. The review was reported in accordance with the PRISMA-ScR checklist.

Eligibility criteria, information sources and search strategies

Eligibility criteria were structured according to the JBI Population–Concept–Context (PCC) framework. Population: Studies involving adolescent girls were included, while studies that did not involve adolescent girls were excluded. Concept: Studies examining the management and implementation of iron supplementation programs were included, while studies that did not address iron supplementation programs were excluded. Context: Studies conducted in Indonesia in school-based or community-based settings were included, while studies conducted outside Indonesia were excluded. Additional eligibility criteria included quantitative, qualitative, and mixed-methods studies published in English or Indonesian up to 2025, with no restriction on the earliest publication year. Reviews, editorials, and commentaries were excluded.

A comprehensive literature search was conducted from 1 to 31 May 2025 using six electronic information sources: Google Scholar, PubMed, ScienceDirect, Semantic Scholar, Taylor & Francis Online, and Wiley Online Library. The search strategy combined controlled vocabulary, where applicable, and free-text terms related to iron supplementation, program management and implementation, adolescent girls, and Indonesia. For PubMed, Medical Subject Headings (MeSH) and free-text terms were used, while the search syntax was adapted to the search interface and indexing system of the other information sources. Complete source-specific search strategies are provided in Supplementary Table S1 ([see supplementary](#)).

Study selection, analytical framework, data items

Following duplicate removal, title and abstract screening was independently conducted by two reviewers based on the predefined eligibility criteria. The same two reviewers then assessed potentially eligible articles through full-text screening. Any disagreements regarding study eligibility were resolved through discussion until consensus was reached.

The Input–Process–Output–Outcome (IPOO) framework structured data extraction and analysis. Input comprised the resources and prerequisites required for program implementation, including human resources, funding, iron tablet availability, equipment and supporting materials, policy support, and program preparation. Process encompassed program implementation activities, including iron tablet distribution, health education, supervision, monitoring and reporting, and stakeholder involvement and coordination. Outputs represented immediate implementation achievements, including distribution coverage, distribution timeliness, program participation, and iron tablet consumption coverage. Outcomes represented subsequent behavioral and health-related effects, including adherence to iron tablet consumption, knowledge and preventive behaviors, hemoglobin levels, and anemia-related outcomes. Study characteristics, including author, publication year, study setting, study design, and sample characteristics, were also extracted.

Data extraction, synthesis, critical appraisal

Two reviewers independently extracted data using a standardized data-charting form. Prior to full data extraction, the form was piloted on a subset of the included studies to assess the clarity, consistency, and applicability of the predefined data items. The two reviewers resolved discrepancies through discussion until they reached consensus. Extracted data were organized using a matrix-based thematic mapping approach according to the input, process, output, and outcome domains. Evidence from qualitative, quantitative, and mixed-methods studies was narratively integrated by comparing patterns, similarities, and variations across the predefined IPOO domains. Given the heterogeneity of study designs and outcomes and the mapping purpose of this scoping review, no statistical pooling or meta-analysis was performed.

Formal critical appraisal of the included studies was intentionally omitted, as the primary purpose of this scoping review was to map the breadth and characteristics of the available evidence on the management of iron supplementation programs for adolescent girls rather than to assess methodological quality for effect estimation or statistical pooling.

RESULTS

Figure 1 shows the study selection results using the PRISMA flowchart. The search process involved various electronic databases. A total of 2,692 articles were obtained from various sources, including Google Scholar (n = 2,619), PubMed (n = 1), ScienceDirect (n = 4), Semantic Scholar (n = 4), Taylor & Francis (n = 29), and Wiley Online Library (n = 35). After checking for duplicates, 46 articles were removed, leaving 2,646 articles for further selection. Of the 2,646 articles screened by title and abstract, 2,618 did not meet the inclusion and exclusion criteria, leaving 28 articles for

full-text review. Of the remaining 28 articles, full texts were not available for four. After a full-text review of the 24 articles obtained, 17 articles were found to be irrelevant in terms of outcome (n = 13), inappropriate in terms of population (n = 3), and incorrect in terms of study design (n = 1). Following the study selection process, seven studies met the eligibility criteria and were included in this scoping review. Across diverse Indonesian regions, the seven studies predominantly use qualitative designs, with one mixed-methods study, to examine school and community health settings. These studies involve purposive samples of adolescents, healthcare workers, and policymakers (Table 1).

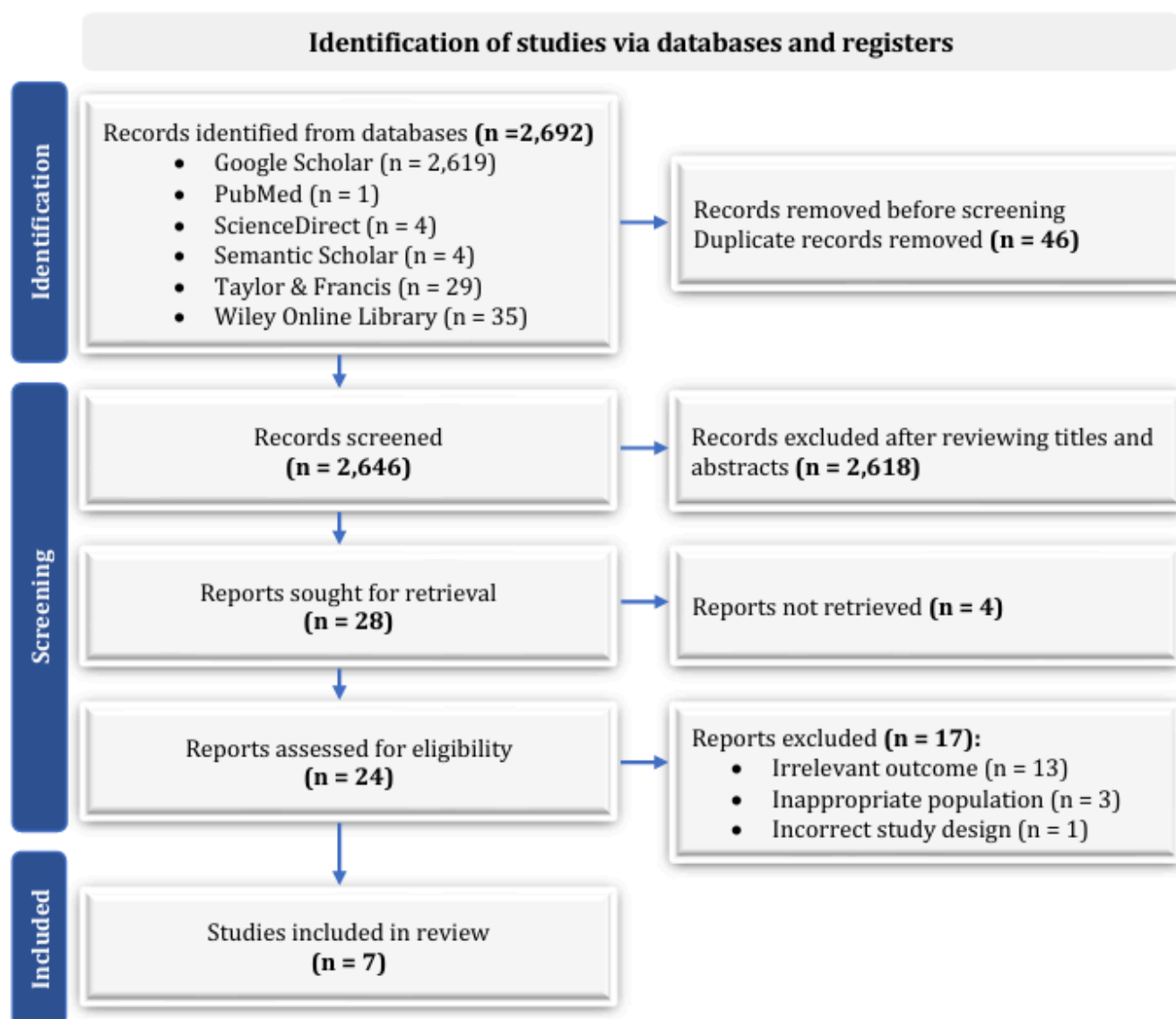


Figure 1. PRISMA flowchart

Table 1. Characteristics of included studies

Author/ Year	City/Regency	Title	Objective	Design study and method	Study setting	Sampling & sampling technique
Khomsan et al. (2025) [16]	Cianjur Regency & Depok City, West Java	Anemia: Female Youth's Knowledge and Supplementation Program Management	Analyzing adolescent girls' knowledge about anemia (quantitative); and analyzing iron and folic acid supplementation management in Cianjur and Depok Regencies.	Mixed-methods design: a) Quantitative design with a cross-sectional approach. b) Qualitative design (approach not explained).	a) Quantitative: 24 high schools. b) Qualitative: 24 high schools and 4 community health centers in the Depok and Cianjur areas.	a) Quantitative: 243 adolescent girls, sampling technique not specified. b) Qualitative: teachers and health workers, sampling technique not specified.
Yanti et al. (2023) [18]	Rokan Hulu, Riau	Evaluation of The Program for Giving Iron Supplementary Tablets to Young Girls in Schools at The Work Area of The Kunto Darussalam Public Health Center in 2022	Evaluating the program for providing iron tablets to adolescent girls in the Kunto Darussalam Community Health Center work area.	Qualitative design with a phenomenological research approach.	Schools & Health Centers	The 12 informants consisted of nutrition program managers at the Health Office, nutrition program managers at community health centers, midwives, nurses, school principals, school health center teachers, young women, and parents. Purposive sampling was used.
Susanti et al. (2021) [19]	West Pasaman, West Sumatra	Evaluation of Providing Blood-Enhancing Tablets to Adolescent Girls	To understand the input, process, and output of the evaluation of iron supplementation for adolescent girls at the Air Bangis Community Health Center in West Pasaman Regency.	Qualitative design (approach not explained).	Health Office, West Pasaman Regency Pharmacy Installation, Air Bangis Community Health Center, and Schools	29 informants, purposive sampling, with the following criteria: informants were officials and officers administering iron supplementation tablets in 2019, and adolescent girls who received iron supplementation tablets.
Ningrum (2025) [20]	Madiun, Jatim	Evaluation of the Iron Supplement Program for Adolescent Girls in the Kebonsari Community Health Center Work Area, Madiun Regency	Evaluating the iron supplementation program for adolescent girls in the Kebonsari Community Health Center, Madiun Regency.	Qualitative design (approach not explained).	Health Office, District Pharmacy Installation, Community Health Center, Junior High School & Islamic Senior High School.	16 informants, purposive sampling consisting of the Head of Nutrition Division of the Madiun District Health Office, Head of the Regional Technical Implementation Unit of the Health Office Pharmacy Installation, Nutritionist of the Kebonsari Community Health Center, School Health Program implementation team, young women.
Nurcahyanti et al. (2022) [21]	Wakatobi Regency, Southeast Sulawesi	Analysis of the Implementation of the Iron Supplement Program for Adolescent Girls in the Usuku Community Health Center, Wakatobi Regency, in 2021	To understand the implementation of the iron supplementation program for adolescent girls in the Usuku Community Health Center, Wakatobi Regency.	Qualitative design, with a case study approach.	Community Health Center & High School	The number and sampling techniques were not mentioned; it only mentions the existence of key informants and ordinary informants.
Yanti & Anwar (2022) [22]	Nagan Raya, Aceh	Cross-Sectoral Role in Supervising the Provision of Iron Supplements for Adolescent Girls in Simpang Jaya District, Nagan Raya Regency	To understand the input, process, and output of the implementation of the iron supplementation program for adolescent girls in Simpang Jaya District, Nagan Raya Regency.	Qualitative design (approach not explained).	Health Centers & Schools	An undisclosed number of participants included the Nagan Raya District Nutrition Coordinator, a Pharmacist from the Health Office, a teacher at a school in Simpang Jaya, and a young woman who received iron supplements from the Simpang Jaya Community Health Center. The study used purposive sampling.
Yudina & Fayasari (2020) [23]	East Jakarta, Jakarta Province	Evaluation of Iron Tablet Supplementation Program of Female Adolescent in East Jakarta	Evaluating the program of providing iron tablets to adolescent girls in the working area of the Pasar Rebo Community Health Center, East Jakarta.	Qualitative design (approach not explained).	Health Centers & Schools	10 informants, purposive sampling technique.

Table 2. Thematic mapping of findings across the IPOO framework

Author/ Year	Result			
	Input	Process	Output	Outcome
Khomsan et al. (2025) [16]	a) Human resources: limited number of staff. b) Budget: not specified; Facilities: anthropometric measuring instruments, questionnaires, Hb testing equipment. c) Information media: not specified; Regulations: not specified.	a) Distribution at schools: schedules are uncertain, teachers are not always available to assist with the distribution process. b) Monitoring and reporting: compliance is not monitored, monitoring is not ongoing, questionnaires are incomplete at schools, teachers are unaware of the monitoring and reporting mechanisms, and there is no monitoring budget.	a) Coverage: Most schools receive iron tablets. Compliance: Only 1.4% consume ≥ 52 tablets/year. b) Knowledge: Low (score <67.5%).	Significant differences in knowledge between high- and low-stunting areas. Diverse student perceptions regarding iron supplementation. Side effects.
Yanti et al. (2023) [18]	a) Human resources: still insufficient, officers have multiple responsibilities, doctors are not involved in the program. b) Budget: available from the BOK. c) Facilities and infrastructure: no health report books are available for female students; students are only given registration cards to take iron tablets, and the number is insufficient for all targets. Promotional media and hemoglobin testing equipment are not available. d) Regulations: refer to the Minister of Health Regulation and the 2022 Strategic Plan, but have not been fully implemented.	a) Monitoring: Neither the Health Office nor the Community Health Center monitors. b) Distribution: Not yet on time. c) Recording: Not yet running well. d) Reporting: Irregular, weak monitoring, digital education innovation initiatives, and the 'Ayo CERIA' peer group for peer-based monitoring.	a) Coverage: only 45.7%, below the Strategic Plan target. b) Compliance: low. Knowledge: minimal.	Suggestion: Young women ambassadors, village partnerships, digital innovation
Susanti et al. (2021) [19]	a) Human resources: still insufficient. b) Budget: insufficient. c) Facilities and infrastructure: promotional media are not yet available, only a few leaflets. d) Guidelines: manuals are not available in the field.	a) Preparation: Target data comes from the Data and Information Center (Pusdatin) (not up to date), is not real data, is not supported by notification letters to all junior high schools and equivalent Islamic junior high schools, and program outreach to elementary schools has not been optimal. b) Distribution: Distribution from community health centers to schools varies in frequency. Recording and reporting do not comply with guidelines. Monitoring is not running well in schools that are not monitored.	a) Coverage: 1.5% (very low). b) Targeting, Timeliness and Distribution: distribution is not yet appropriate. c) Compliance: low due to lack of monitoring. d) Knowledge: not explained. e) Distribution accuracy: not timely.	Low compliance, weak cross-sector coordination.
Ningrum (2025) [20]	a) Budget: No specific funds are allocated to support program implementation. b) Facilities and Infrastructure: Incomplete blood Hb measurement tools, brochures/leaflets/booklets, recording and reporting forms, nutritional supplementation cards, and temporary storage facilities. c) Regulations: Refer to the 2016 Rheumatoid Anemia Guidelines. d) Inadequate aspects include facilities and infrastructure, monitoring, and timeliness.	a) Consumption monitoring: not yet effective enough. b) Program monitoring and evaluation: not yet implemented effectively, with no follow-up on evaluation results. c) Recording and reporting: conducted manually by Community Health Center staff who administer the signatures; no teachers record or report.	a) Coverage: 65.3% of adolescents consume iron tablets. b) Compliance: Fairly high (846 out of 1,294 students). c) Knowledge: Still lacking (62% do not understand anemia). d) Timeliness of distribution: Not yet appropriate.	62% of teenagers do not understand anemia.
Nurcahyanti et al. (2022) [21]	a) Facilities and infrastructure: inadequate storage space for signatures; limited media. b) Regulations: not specified.	a) Distribution: Not conducted weekly throughout the year. b) Monitoring: No field visits. c) Recording and reporting: Inadequate.	a) Knowledge: not explained. b) Accuracy of distribution: not simultaneous distribution/ consumption at school.	No schedule for drinking together.

Author/ Year	Result			
	Input	Process	Output	Outcome
Yanti & Anwar (2022) [22]	a) Human resources: inadequate (limited). b) Budget: insufficient. c) Facilities and infrastructure: posters and leaflets never distributed, no nutritional supplementation cards. d) Media: unavailable. e) Regulations: not in accordance with guidelines.	a) Distribution: not appropriate. b) Monitoring: Ineffective. c) Recording and reporting: Young women do not complete their own questionnaires.	a) Coverage: Not all adolescents receive iron tablets, around 80%. b) Compliance: Low due to fear of side effects. c) Knowledge: Low, many myths. d) Targeting, timing, and distribution accuracy: Given once a month, not evenly distributed, only given to those who are menstruating.	a) Prevalence: 27.6% and 29%. b) Side effects: 80% of adolescents are afraid of taking iron supplements due to myths about side effects.
Yudina & Fayasari (2020) [23]	a) Facilities: no posters or leaflets, no Nutritional Supplement Card. b) Regulations: not yet explained in detail.	a) Monitoring: Officers rely solely on chat groups. b) Recording and reporting: Teachers do not record and report, and students do not record. c) Mismatches in time and targets.	a) Compliance: not explained. b) Knowledge: not explained. c) Accuracy of distribution: not timely. d) Recording and reporting: not implemented. e) Accuracy of targeting, timing, and distribution: given all at once, not once a week, not evenly distributed, only given to those who are menstruating.	Side effects: nausea, dizziness.

Input

Across the seven included studies, several input-related constraints emerged consistently. Multiple settings reported limited human resources, often accompanied by multiple responsibilities among program staff. Insufficient or unavailable dedicated funding was also identified in several studies. Facilities and supporting resources varied across settings but were frequently inadequate, including limited educational media, hemoglobin testing equipment, recording and reporting materials, supplementation cards, and appropriate storage facilities. In addition, studies reported inconsistent availability and implementation of program guidelines (Table 2).

Process

Process-related findings showed recurring weaknesses in program implementation. Iron tablet distribution was frequently irregular, untimely, or inconsistent with the recommended schedule. Monitoring and supervision were also commonly reported as inadequate, including limited field visits and insufficient monitoring of tablet consumption. Recording and reporting practices were inconsistent and, in some settings, were not implemented according to program guidelines. Several studies also indicated weaknesses in coordination between health services and schools, which affected the continuity of program implementation (Table 2).

Output

Program outputs varied considerably across the included studies. Reported coverage ranged from very

low levels in some settings to relatively high distribution or consumption coverage in others. However, higher availability or distribution of iron tablets did not consistently indicate appropriate program implementation. Several studies reported problems with the timeliness, targeting, and regularity of distribution. These findings demonstrate substantial variation in program delivery across different settings in Indonesia (Table 2).

Outcome

Outcome findings focused primarily on adherence, knowledge, perceptions, and anemia-related indicators. Several studies reported low adherence to iron tablet consumption, even where tablets were available or distributed. Studies also frequently identified limited knowledge of anemia and iron supplementation, while concerns about side effects and misconceptions contributed to poor adherence in some settings. Evidence on biological outcomes, including hemoglobin levels and anemia prevalence, was comparatively limited. Overall, the findings indicate that program distribution did not consistently translate into sustained adherence or improved health outcomes (Table 2).

DISCUSSION

This scoping review indicates that the major constraints in iron supplementation programs for adolescent girls in Indonesia occur across interconnected input and process components. At the input level, limited human resources, insufficient

funding and supporting facilities, inadequate educational materials, and inconsistent availability and dissemination of technical guidelines were recurrent barriers across the included studies [16,19–22]. These limitations were compounded at the process level by irregular tablet distribution, inconsistent health education and counseling, weak supervision, incomplete recording and reporting, and insufficient coordination between schools and health services [16,18–20,23]. Taken together, these findings suggest that program limitations are not attributable to a single component, but rather to weaknesses across the implementation system that affect the continuity and fidelity of program delivery.

These findings are consistent with broader international evidence. The WHO comprehensive framework for accelerating anemia reduction emphasizes that effective anemia prevention requires coordinated action across sectors, strengthened leadership and governance, appropriate allocation of human and financial resources, effective intervention delivery, and robust monitoring systems [24]. Similar implementation barriers have been documented in India's Weekly Iron and Folic Acid Supplementation (WIFS) program. A mixed-methods evaluation in Rishikesh identified prolonged iron-folic acid stock-outs, irregular reporting, and weak program supervision as major implementation barriers. It proposed strengthening supply, supervision, training, program ownership, and stakeholder meetings as key solutions [25]. India's national WIFS framework likewise incorporates supervised weekly counseling, capacity building, monitoring, and convergence between health, education, and other relevant sectors, illustrating that effective supplementation requires an implementation approach that extends beyond tablet provision alone. These international experiences reinforce the interpretation of the Indonesian evidence: strengthening workforce capacity, supply continuity, health education, monitoring and reporting, and health-education sector coordination is essential for improving program implementation. This interpretation is also consistent with implementation research principles, which emphasize understanding how implementation processes and contextual factors influence the delivery and effectiveness of health interventions in real-world settings [26].

A second principal finding is the apparent gap between program outputs and the intended behavioral and health outcomes. Across the included Indonesian studies, distributing iron tablets did not consistently translate into regular consumption or sustained adherence. Even where tablets were available or distributed through schools, adherence remained

constrained by inadequate knowledge, negative perceptions, side effects, insufficient supervision, and limited reinforcement of health education [16,18–20, 23]. Similarly, improvements in knowledge and awareness were not consistently accompanied by sustained supplementation behavior, and evidence on longer-term biological outcomes, particularly hemoglobin concentration and anemia prevalence, remained limited across the included studies. This distinction matters because distribution coverage is an immediate program output, whereas regular consumption, improved hemoglobin status, and reduced anemia are progressively more meaningful program outcomes. Therefore, assessing program performance primarily through the number of tablets distributed or adolescents reached may overestimate actual program effectiveness.

Evidence from other settings supports this output–outcome distinction. In rural West Bengal, India, effective WIFS coverage was low because both provision and adherence were inadequate; only 9.4% of in-school girls reported consuming four tablets during the preceding month as intended by the national program [27]. Conversely, a school-based program in Ghana demonstrated that sustained exposure to weekly iron and folic acid supplementation was associated with reductions in anemia among adolescent girls, indicating that consistent program participation can translate supplementation delivery into measurable health benefits [28]. Evidence from India also indicates that combining supplementation with health education can improve program outcomes. A comparative school-based study in Delhi found that anemia prevalence decreased in both groups receiving WIFS, but the reduction was greater among adolescent girls who received WIFS combined with monthly health education than among those who received WIFS alone [29]. Collectively, these findings suggest that program success should be assessed not only by distribution coverage but also by whether tablets are actually consumed as intended and whether sustained adherence produces measurable improvements in hemoglobin and anemia status. Strengthening adherence support, regular counseling and health education, supervision of consumption, and outcome-oriented monitoring may therefore help bridge the gap between program delivery and its intended public health impact.

The findings of this review highlight the need to strengthen the implementation of iron supplementation programs for adolescent girls beyond tablet distribution alone. Health authorities should ensure a continuous supply of iron tablets, strengthen the capacity of health workers and program managers,

standardize monitoring and reporting systems, and reinforce coordination between the health and education sectors. At the school level, program implementation should include regular health education, supervised tablet consumption, systematic recording of distribution and adherence, and active teacher involvement in monitoring and reinforcing supplementation practices. Program evaluation should also move beyond distribution coverage by incorporating adherence indicators and, where feasible, hemoglobin and anemia outcomes. These actions may help improve implementation quality and ensure that program outputs translate into sustained behavioral and health outcomes among adolescent girls.

This scoping review has several limitations to consider when interpreting the findings. First, the review included studies conducted in Indonesia and published in English or Indonesian; therefore, it may not have captured relevant evidence outside these eligibility criteria. Second, the relatively small number of included studies and their concentration in particular settings indicate that evidence on implementing iron supplementation programs remains uneven across Indonesia. Third, variations in study designs, settings, and reported outcomes limited direct comparison across studies; accordingly, the evidence was synthesized narratively rather than statistically pooled. Formal critical appraisal was intentionally not conducted because the primary purpose of this scoping review was to map the breadth, characteristics, and gaps of the available evidence rather than to determine intervention effectiveness. Finally, evidence on longer-term health outcomes, particularly hemoglobin levels and anemia prevalence, was limited, highlighting an important area for future research.

CONCLUSION

This scoping review highlights that the effectiveness of iron supplementation programs for adolescent girls in Indonesia remains constrained by interconnected challenges across program inputs, processes, outputs, and outcomes. Although some evidence suggests improvements in knowledge and awareness of anemia, tablet distribution alone has not consistently led to sustained adherence or meaningful health outcomes. Strengthening program management, supervision, health education, monitoring and reporting systems, and collaboration between health services and schools is therefore essential to improve implementation and ensure that program outputs translate into sustained behavioral and health outcomes.

Future research should address the identified evidence gaps by examining program implementation

across diverse settings in Indonesia using robust quantitative, mixed-methods, longitudinal, and implementation research designs. Particular attention should be given to evaluating factors influencing adherence and the effectiveness of specific implementation strategies, such as supervised tablet consumption, structured health education, strengthened monitoring, and intersectoral collaboration, as well as their effects on hemoglobin levels and anemia prevalence.

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Authors' contribution

N.N: Conceptualization, Data Curation, Formal Analysis, Methodology, Writing-Original Draft; R.R: Data Curation, Formal Analysis, Methodology, Writing-Review & Editing; N.A.R: Visualization, Writing-Review & Editing; E.A: Supervision, Writing-Review & Editing; A.M.: Validation, Writing-Review & Editing. The final version of the manuscript was reviewed and approved by all authors.

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Data availability

All data relevant to this study are accessible from the corresponding author upon request.

Ethics statement

This scoping review did not require ethical approval.

Conflicts of interest

The authors declare no conflict of interest regarding the publication of this article.

Use of artificial intelligence (AI)

Parts of this manuscript were refined using ChatGPT-4 to enhance grammatical accuracy and clarity. All content generated with AI assistance was carefully reviewed and approved by the authors, who assume full responsibility for the final manuscript.

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SUPPLEMENTARY

Supplementary Table S1. Complete source-specific search strategies

Information source	Search period	Exact search string	Field restrictions	Filters/ limits	Language restriction	Publication-year restriction	Records retrieved
Google Scholar	1–31 May 2025	("iron supplementation" OR "iron tablet" OR "iron and folic acid supplementation" OR "WIFAS") AND ("program management" OR "program implementation" OR "program evaluation") AND ("adolescent girls" OR adolescents) AND Indonesia	No specific field restriction applied	None	None applied during search	Up to May 2025; no minimum date limit	2,619
PubMed	1–31 May 2025	("Program Evaluation"[Mesh] OR "program evaluation" OR "program management" OR "process evaluation") AND ("Dietary Supplements"[Mesh] OR "Iron"[Mesh] OR "Folic Acid"[Mesh] OR "iron supplementation" OR "folic acid" OR "iron") AND ("Adolescent"[Mesh] AND "Female"[Mesh] OR "adolescent girls" OR "adolescent female" OR "teen girls") AND ("Indonesia"[Mesh] OR "Indonesia" OR "Indonesian")	MeSH Terms for controlled vocabulary; no specific field restriction was applied to free-text terms	Publication type: Article	None applied during search	Up to May 2025; no minimum date limit	1
ScienceDirect	1–31 May 2025	("iron supplementation" OR "iron tablet" OR "iron and folic acid supplementation" OR "WIFAS") AND ("program management" OR "program implementation" OR "program evaluation") AND ("adolescent girls" OR adolescents) AND Indonesia	No specific field restriction applied	Publication type: Research Article	None applied during search	Up to May 2025; no minimum date limit	4
Semantic Scholar	1–31 May 2025	("iron supplementation" OR "iron tablet" OR "iron and folic acid supplementation" OR "WIFAS") AND ("program management" OR "program implementation" OR "program evaluation") AND ("adolescent girls" OR adolescents) AND Indonesia	No specific field restriction applied	None	None applied during search	Up to May 2025; no minimum date limit	4
Taylor & Francis Online	1–31 May 2025	("iron supplementation" OR "iron tablet" OR "iron and folic acid supplementation" OR "WIFAS") AND ("program management" OR "program implementation" OR "program evaluation") AND ("adolescent girls" OR adolescents) AND Indonesia	No specific field restriction applied	None	None applied during search	Up to May 2025; no minimum date limit	29
Wiley Online Library	1–31 May 2025	("iron supplementation" OR "iron tablet" OR "iron and folic acid supplementation" OR "WIFAS") AND ("program management" OR "program implementation" OR "program evaluation") AND ("adolescent girls" OR adolescents) AND Indonesia	No specific field restriction applied	None	None applied during search	Up to May 2025; no minimum date limit	35
Total							2,692