



## Nutrition Patterns and Iron Supplementation in the Prevention of Anaemia in Adolescent Girls

Heldalia Faiza Putri Helda<sup>1\*</sup>, Cesa Septiana Pratiwi<sup>2</sup>, Ismarwati<sup>3</sup>

<sup>1,2,3</sup> Universitas 'Aisyiyah Yogyakarta

heldaliaputri@gmail.com<sup>1\*</sup>  
cesaseptianapратиwi@unisayogya.ac.id<sup>2</sup>  
ismarwati@unisayogya.ac.id<sup>3</sup>

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### ABSTRACT

**Background:** Anaemia among adolescent girls remains a major public health problem in developing countries and is associated with inadequate dietary intake and low adherence to iron supplementation. Despite numerous studies examining dietary patterns and iron supplementation, evidence regarding the nutritional, behavioural, and environmental factors influencing anaemia prevention has not been comprehensively synthesised. This study aimed to map the available scientific evidence on nutrition patterns and iron supplementation in the prevention of anaemia among adolescent girls.

**Method:** A scoping review was conducted following the Arksey and O'Malley framework. Literature searches were performed in PubMed, ScienceDirect, Wiley Online Library, and Google Scholar databases for studies published between 2020 and 2025. Articles were screened according to predefined inclusion and exclusion criteria. Data were extracted, charted, and synthesised thematically. Of the 317 articles identified, 11 studies met the eligibility criteria and were included in the review.

**Result:** The review identified four major themes: behavioural and psychosocial factors, nutritional patterns and nutrient intake, adherence to iron supplementation, and educational interventions. Low intake of iron, protein, and vitamin C, unhealthy dietary habits, and poor adherence to iron-folic acid supplementation were consistently associated with a higher risk of anaemia. Knowledge, motivation, attitudes, self-efficacy, and support from schools and families influenced preventive behaviours and supplementation adherence. Educational interventions improved knowledge and adherence; however, their impact on haemoglobin levels was inconsistent across studies.

**Conclusion:** Anaemia prevention among adolescent girls requires an integrated approach combining dietary improvement, iron supplementation, behavioural interventions, and supportive environments. Strengthening nutrition education, promoting adherence to supplementation programmes, and implementing school-based health promotion strategies are recommended to reduce the burden of anaemia among adolescent girls.

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## INTRODUCTION

Anaemia among adolescent girls remains a significant public health challenge, particularly in developing countries where access to nutritious foods, socioeconomic conditions, and the implementation of health programmes remain suboptimal Handayani et al. (2025) . Adolescent girls are especially vulnerable to anaemia due to increased iron requirements during growth, menstrual blood loss, inadequate dietary intake, and dietary practices that may restrict the consumption of iron-rich foods . Iron deficiency continues to be the leading cause of anaemia in this population and may adversely affect physical growth, cognitive performance, academic achievement, and future reproductive health. (Us & Safitri, 2023; WHO,2025) .

The burden of anaemia among adolescent girls remains substantial worldwide. The prevalence has been reported at approximately 32% in Indonesia Asmanidar et al. (2024) . 35.8% in Egypt Khalil, (2025) , 21.4% in Iran Azizi et al. (2025) , and around 30% across Ghana and several sub-Saharan African countries Dagnaw et al. (2025) . Despite differences in prevalence across settings, evidence consistently indicates that inadequate iron intake, poor dietary quality, limited consumption of micronutrient-rich foods, and dietary habits that inhibit iron absorption contribute significantly to the occurrence of anaemia among adolescent girls.

To address this issue, many countries have implemented strategies such as iron supplementation programmes, school-based nutrition interventions, free nutritious meal programmes, and health education initiatives. However, the effectiveness of these interventions varies considerably across populations and contexts. Previous studies have suggested that adherence to iron supplementation, nutritional knowledge, dietary behaviour, family and community support, and broader environmental factors may influence the success of anaemia prevention efforts. Tabita et al. (2023). These findings indicate that anaemia prevention is a multifactorial issue that cannot be explained solely by iron supplementation or dietary intake. (WHO, 2023).

Although numerous studies have investigated dietary patterns, iron supplementation, and anaemia prevention among adolescent girls, the available evidence remains dispersed across disciplines and research contexts. Previous reviews have predominantly focused on evaluating the effectiveness of specific interventions notably iron supplementation programmes, nutrition education, or dietary improvement strategies. While such reviews have yielded valuable insights, they have generally examined individual components of anaemia prevention in isolation, without adequately addressing the broader range of determinants that influence prevention outcomes.

Emerging evidence indicates that anaemia prevention among adolescent girls is shaped not only by nutritional factors such as iron intake and dietary quality but also by behavioural factors, including adherence to supplementation, dietary practices, and health literacy, as well as environmental influences, such as family support, school environments, socioeconomic conditions, and access to health services. Nevertheless, these determinants have largely been investigated in isolation, resulting in a fragmented understanding of how they collectively contribute to anaemia prevention. Consequently, significant knowledge gaps persist regarding the interaction and relative contributions of nutritional, behavioural, and environmental factors in supporting effective anaemia prevention among adolescent girls, particularly in low and middle-income countries where the burden of anaemia remains disproportionately high.

Given the diversity of study designs, populations, and determinants represented in the literature, a scoping review was deemed the most appropriate methodological approach to comprehensively map the available evidence. Unlike conventional systematic reviews, which focus primarily on intervention effectiveness, a scoping review enables the exploration and synthesis of a broader range of evidence and facilitates the identification of research gaps across heterogeneous studies. To the best of our knowledge, no prior scoping review has comprehensively synthesised evidence on anaemia prevention among adolescent girls by integrating nutritional, behavioural,

and environmental perspectives within a unified framework. Accordingly, this review aims to map the existing evidence concerning the role of dietary patterns and iron supplementation together with associated behavioural and environmental factors in the prevention of anaemia among adolescent girls in low and middle-income countries, while identifying areas that warrant further research and policy attention.

The research questions were formulated based on the PCC (Population, Concept, Context) framework as follows:

**Table 1. PCC Framework**

Population	Concept	Context
Adolescent Girls	Nutritional Patterns and <i>Iron Supplementation</i> in the Prevention of Anaemia	In Developing Countries

## Review Questions

“What is the role of dietary patterns, sources of iron and vitamin C, protein intake, dietary behaviour, and iron tablet supplementation in the prevention of anaemia in adolescent girls, including the level of adherence to iron tablet consumption and the factors influencing it in developing countries?”.

## METHOD

This literature review employs a scoping review methodology as it aims to map the available scientific evidence regarding dietary patterns and iron-supplement tablets in the prevention of anaemia among adolescent girls. This scoping review protocol has been registered on the Open Science Framework (OSF) and is accessible via DOI: 10.17605/OSF.IO/XHKYC. The method used is based on the Arksey and O'Malley framework, which consists of five stages: identifying the research question, identifying relevant studies through a systematic search of scientific databases, selecting articles based on predefined inclusion and exclusion criteria, charting the data to extract and organise key information from each article, and grouping, summarising, and reporting the results to provide a comprehensive overview of the research evidence.

### 1. Eligibility Criteria

The inclusion and exclusion criteria in this study were determined based on the PCC (Population, Concept, Context) framework as follows:

**Table 2. Inclusion Criteria and Exclusion Criteria**

Inclusion Criteria	Exclusion Criteria
School-aged adolescent girls in communities or the general population in developing countries.	Populations of non-adolescent girls (workers, housewives, students) without specific analysis of adolescents.
Original articles based on quantitative research.	Editorials, opinion pieces, news reports, conference summaries, <i>grey literature</i> .
Published within the last 5 years (2020–2025).	Published before 2020.
English or Indonesian.	Languages other than Indonesian and English.
Focus on the prevention of anaemia through dietary patterns and iron supplementation.	Discusses only the occurrence or treatment of anaemia without addressing prevention.

### 2. Information Sources

The literature search was conducted using four electronic databases: PubMed, ScienceDirect, Wiley Online Library, and Google Scholar. PubMed was selected because it provides extensive coverage of biomedical and public health literature relevant to anaemia prevention among adolescent girls. ScienceDirect and Wiley Online Library were included due to their broad collection of peer-reviewed international journals encompassing observational and intervention studies. Google Scholar was used as a supplementary source to identify potentially relevant studies that may not have been indexed in the selected databases. Additional manual searches were conducted through the reference lists of eligible articles to minimise the risk of overlooking relevant evidence. No correspondence was made with study authors to retrieve additional data or unpublished findings. Searches were limited to articles published between 2020 and 2025 in English or Indonesian, with the final search completed on 20 December 2025. The selected databases were considered appropriate for capturing multidisciplinary evidence related to adolescent health, nutrition, and public health. Furthermore, the inclusion of Google Scholar and manual reference-list screening was intended to enhance the comprehensiveness of the search process and minimise the likelihood of missing relevant studies.

### 3. Search Strategy

The literature search was conducted systematically following the Population–Concept–Context (PCC) framework. The population consisted of adolescent girls, the concepts included dietary patterns and iron supplementation for anaemia prevention, and the context focused on developing countries. Search terms were developed using a combination of Medical Subject Headings (MeSH), free-text keywords, synonyms, truncation techniques, and Boolean operators (AND, OR) to maximise the sensitivity and comprehensiveness of the search strategy.

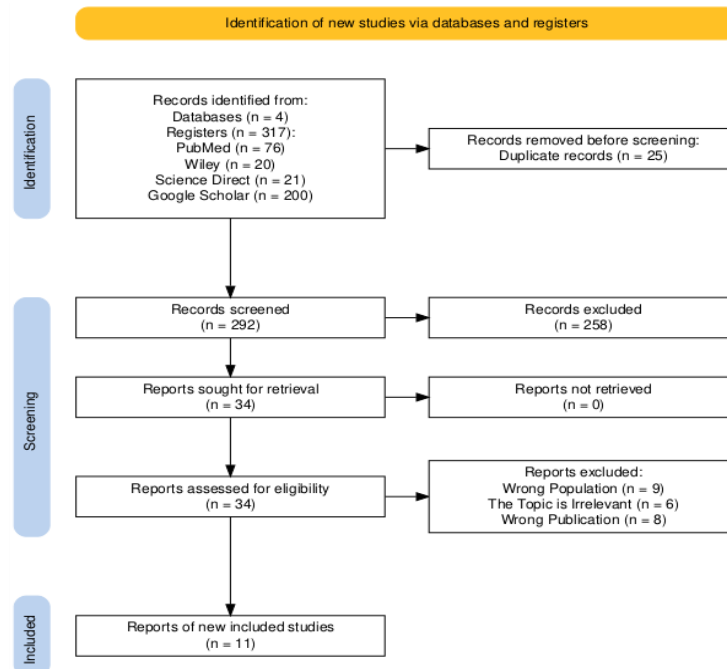
Keywords included adolescent girl, adolescent female, teenage girl, school-aged girl, dietary pattern, nutritional intake, lifestyle, health behaviour, iron supplementation, iron folic acid, anaemia prevention, and iron deficiency anaemia. Relevant MeSH terms included “Adolescent”, “Lifestyle”, “Health Behavior”, “Anemia”, and “Iron-Deficiency Anemia”. Truncation symbols were used where appropriate (e.g., adolescen\*, habit\*) to capture variations of relevant terms.

The core search strategy was developed in PubMed as follows: ("Anemia"[Mesh] OR "Iron-Deficiency Anemia"[Mesh] OR anaemia OR anemia OR "anaemia prevention") AND ("Adolescent"[Mesh] OR adolescen\* OR "adolescent girl\*" OR "adolescent female\*" OR "teenage girl\*" OR "school-aged girl\*") AND ("Dietary Pattern\*" OR "Nutritional Intake" OR lifestyle OR "Health Behavior"[Mesh] OR "health behaviour\*") AND ("Iron Supplementation" OR "iron tablet\*" OR "iron folic acid" OR IFA).

The search strategy was subsequently adapted according to the indexing systems and search functionalities of each database. For PubMed, MeSH terms and field tags were used where applicable. For ScienceDirect and Wiley Online Library, equivalent keyword combinations were applied within titles, abstracts, and keywords. Google Scholar searches employed simplified keyword combinations due to platform-specific search limitations. The core concepts and Boolean operators were maintained across all databases to ensure consistency of the search process.

Additional manual searches through the reference lists of eligible articles and supplementary searches using Google Scholar were conducted to identify potentially relevant studies that were not captured through the primary database search. These procedures were undertaken to enhance the transparency, comprehensiveness, and reproducibility of the review process.

## 4. Article Screening



**Figure 2. PRISMA Flow Diagram**

Article selection was conducted in a phased and systematic manner following the PRISMA guidelines. Article screening and eligibility assessment were independently conducted by two reviewers using predefined inclusion and exclusion criteria. Titles and abstracts were screened initially, followed by full-text assessment of potentially eligible studies. Any disagreements between reviewers were resolved through discussion and consensus. When consensus could not be reached, a third reviewer was consulted to make the final decision. Formal inter-rater reliability statistics were not calculated because the review primarily aimed to map evidence rather than quantitatively synthesise findings. This process was implemented to improve the reliability and consistency of study selection. All articles were exported to Mendeley Desktop to remove duplicates and were subsequently screened based on titles and abstracts. Relevant articles were then assessed through full-text review according to the predefined inclusion and exclusion criteria.

During the identification stage, 317 articles were retrieved from searches across four databases, of which 25 duplicate articles were removed, leaving 292 articles for further screening. These articles were subsequently screened based on titles and abstracts, at which stage 258 articles were excluded on the grounds that they were irrelevant to the research topic, did not pertain to the adolescent female population, or did not address nutritional patterns or iron supplementation in relation to anaemia prevention.

The remaining 34 articles were eligible for full-text review, all of which were successfully retrieved. During the eligibility assessment stage, 23 articles were excluded for the following reasons: inappropriate population ( $n = 9$ ), irrelevant research topic ( $n = 6$ ), and publication type not meeting the inclusion criteria ( $n = 8$ ). Finally, 11 articles met all inclusion criteria and were included in this scoping review.

**Table 3. Summary of articles included in the review**

No.	Title	Authors and Year	Country	Objective	Research Design	Data Collection Methods and Instruments	Sampling Technique and Number of Respondents	Data Analysis Method	Research Findings
<b>A1</b>	Anemia Prevention Behaviour in Female Adolescents and Related Factors Based on the Theory of Planned Behaviour: A Cross-Sectional Study	Halfie Z, et al. (2022)	Indonesia	To identify risk factors associated with anaemia among adolescent girls and interventions used to prevent or manage anaemia.	Descriptive correlational study with a cross-sectional approach	Questionnaire administered through Google Forms.	Purposive sampling; 105 adolescent girls	Descriptive and bivariate analysis	Significant relationships were found between attitude, subjective norms, perceived behavioural control, intention, and anaemia prevention behaviour.
<b>A2</b>	Diet Behaviour and Consumption of Iron Inhibitors: Incidence of Anaemia in Adolescent Girls	Erna K, et al. (2023)	Indonesia	To analyse the influence of dietary behaviour and iron absorption inhibitors on anaemia incidence among adolescent girls.	Cross-sectional study	Haemoglobin examination, dietary assessment, and questionnaires.	Simple random sampling; 100 respondents	Univariate, multivariate, and bivariate analysis	Poor dietary behaviour and consumption of iron inhibitors significantly increased the risk of anaemia among adolescent girls.
<b>A3</b>	The Relationship between Iron and Vitamin C Intake, Risk Beverage Consumption Frequency, and Dietary Behaviour with Anaemia among Adolescent Girls in Depok City	Fitripancari A, et al. (2023)	Indonesia	To determine the relationship between nutrient intake, risky beverage consumption, and dietary behaviour with iron deficiency anaemia.	Cross-sectional study	Haemoglobin examination and questionnaire-based dietary assessment.	Stratified random sampling; 123 adolescent girls	Univariate and bivariate analysis	Iron intake, vitamin C intake, and unhealthy dietary behaviour were significantly associated with iron deficiency anaemia.
<b>A4</b>	Effect of Dietary Pattern on the Presence of Iron Deficiency Anaemia among Adolescent Girls	Amina S, et al. (2022)	Egypt	To determine how dietary habits and patterns influence iron deficiency anaemia among adolescent girls.	Case-control study	Anthropometric measurements, physical examinations, blood sampling, and questionnaires.	Purposive and convenience sampling; 100 adolescent girls	Descriptive analysis	Iron deficiency anaemia was associated with low socio-economic status, unhealthy dietary habits, inadequate nutrient intake, and parasitic infections.

<b>A5</b>	The Relationship between Compliance with Iron Supplement Consumption, Nutritional Intake, and Nutritional Status on the Incidence of Anaemia among Adolescent Girls at SMPN 1 Gunungsari	Sekarmirah O, et al. (2023)	Indonesia	To determine the relationship between compliance with iron supplementation, nutritional intake, and nutritional status with anaemia incidence.	Analytical observational study with a cross-sectional approach	Haemoglobin examination, anthropometric measurements, and questionnaires.	Stratified random sampling; 61 adolescent girls	Univariate and bivariate analysis	Compliance with iron supplementation, protein intake, and iron intake were significantly associated with anaemia incidence.
<b>A6</b>	Determinants of High School Adolescent Girls' Adherence to Iron and Folic Acid Supplementation in Depok City	Apriningsih, et al. (2020)	Indonesia	To explore factors influencing adherence to iron and folic acid supplementation among adolescent girls.	Cross-sectional study	Structured questionnaire interviews.	Purposive sampling; 274 adolescent girls	Descriptive, multivariate, and bivariate analysis	Adherence was significantly associated with school-based tablet consumption, student motivation, and teacher education.
<b>A7</b>	Health Belief Model Application: Knowledge and Patterns of Iron Source Food Consumption as Preventive Efforts against Anaemia	Stefani V, et al. (2021)	Indonesia	To analyse the relationship between knowledge, Health Belief Model constructs, dietary consumption patterns, and anaemia status.	Cross-sectional study	Questionnaires and haemoglobin examination.	Cluster random sampling; 46 adolescent girls	Descriptive statistical analysis	Knowledge level was significantly associated with anaemia incidence, whereas most Health Belief Model constructs were not significantly associated.
<b>A8</b>	The Effectiveness of Iron-Folic Acid Supplementation and Educational Intervention on Haemoglobin Levels, Knowledge, and Compliance among Adolescent Girls in Islamic Boarding Schools	Aras U, et al. (2022)	Indonesia	To assess the effectiveness of combined iron-folic acid supplementation and educational intervention compared with supplementation alone.	Quasi-experimental pre-test and post-test control group design	Haemoglobin examination and questionnaire-based assessment of knowledge and compliance.	Simple random sampling; 135 adolescent girls	Univariate and bivariate analysis	Educational intervention significantly improved knowledge regarding anaemia and nutrition, although haemoglobin levels did not significantly improve.
<b>A9</b>	Iron and Folic Acid Supplementation Compliance among	Adadow Y, et al. (2020)	Ghana	To assess compliance with iron and folic acid	Cross-sectional study	Questionnaires and haemoglobin assessment using	Cluster and simple random	Univariate and	Most respondents continued taking iron and folic acid tablets,

	Adolescent Girls in Karaga District, Ghana			supplementation and iron status among adolescent girls.		HemoCue Hb 301.	sampling; 404 adolescent girls	bivariate analysis	and adherence was significantly associated with socio-economic status and educational level.
<b>A10</b>	The Effect of Educational Intervention Based on the Theory of Planned Behaviour to Prevent Iron Deficiency Anaemia in Female High School Students	Tayebeh R, et al. (2025)	Iran	To determine the effectiveness of Theory of Planned Behaviour-based education in preventing iron deficiency anaemia.	Quasi-experimental study	Lectures, discussions, question-and-answer sessions, and questionnaires.	Random sampling; 160 adolescent girls	Univariate and bivariate analysis	Educational intervention significantly improved attitudes, subjective norms, perceived behavioural control, intentions, and nutritional behaviour.
<b>A11</b>	Impact of Mobile Health-Based Nutritional Education on Haemoglobin Levels in Anaemic Adolescent Girls in Rural Bangladesh: A Randomised Controlled Trial	Jiaur Rahman, et al. (2025)	Bangladesh	To evaluate the impact of mobile health-based nutritional education on haemoglobin levels among anaemic adolescent girls.	Randomised controlled trial	Anthropometric measurements, blood sampling, and questionnaires.	Simple random sampling; 138 respondents	Descriptive analysis	Mobile health-based nutritional education significantly improved knowledge, attitudes, practices, and anthropometric indices, although haemoglobin improvement was not statistically significant.

## 5. Data Extraction and Critical Appraisal

Data extraction was performed systematically using a standardised data extraction form developed prior to the review process. The extracted information included author and year of publication, country of study, study design, participant characteristics, sample size, data collection methods, nutritional exposures, iron supplementation practices, methods of anaemia assessment, and key findings related to anaemia prevention among adolescent girls. Data extraction was conducted independently by two reviewers, and any discrepancies were resolved through discussion and mutual consensus.

The methodological quality of the included studies was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Tools according to the respective study designs. Each appraisal item was evaluated and converted into a percentage score. Study quality was subsequently categorized into three grades: Grade A ( $\geq 80\%$  of appraisal criteria fulfilled), Grade B (60–79% fulfilled), and Grade C ( $< 60\%$  fulfilled). This grading system was used to facilitate interpretation of methodological quality and evidence strength. Consistent with scoping review methodology, no studies were excluded based on critical appraisal results as long as they met the predefined inclusion criteria.

**Table 4. Critical Appraisal Tools**

Article Code	Critical Appraisal Tools	Results
A1	JBI Tools for <i>Cross-sectional</i> Studies	<b>B</b>
A2	JBI Tools for <i>Cross-sectional</i> Studies	<b>C</b>
A3	JBI Tools for <i>Cross-sectional</i> Studies	<b>B</b>
A4	JBI Tools for <i>Cross-sectional</i> Studies	<b>A</b>
A5	JBI Tools for <i>Cross-sectional</i> Studies	<b>A</b>
A6	JBI Tools for <i>Cross-sectional</i> Studies	<b>A</b>
A7	JBI Tools for <i>Cross-sectional</i> Studies	<b>B</b>
A8	JBI Tools for Quasi-Experimental Studies	<b>B</b>
A9	JBI Tools for <i>Cross-sectional</i> Studies	<b>B</b>
A10	JBI Tools for Quasi-Experimental Studies	<b>A</b>
A11	JBI Tools for Randomised Controlled Trials	<b>B</b>

Overall, the evidence base was dominated by observational studies, particularly cross-sectional designs, which are useful for identifying associations between dietary factors, iron supplementation, and anaemia prevention, but are inherently limited in their ability to establish causal relationships. Several studies employed stronger methodological designs, including quasi-experimental studies and one randomised controlled trial (RCT), which provided more robust evidence regarding the effectiveness of educational and nutritional interventions.

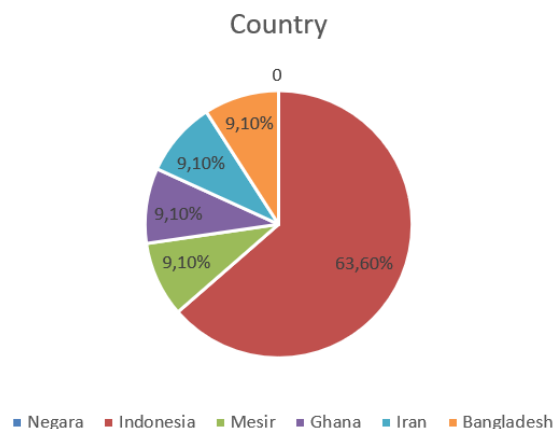
Among the included studies, the RCT (A11) demonstrated the strongest level of evidence because participants were randomly allocated and outcomes were assessed using objective measurements of haemoglobin levels. Quasi-experimental studies also provided valuable evidence regarding behavioural and educational interventions, although the absence of full randomisation may have introduced potential bias. Therefore, findings related to nutrition education, behavioural interventions, and iron supplementation adherence derived from intervention studies may be interpreted with greater confidence than those derived from observational studies.

Despite the generally acceptable methodological quality of the included studies, several limitations were consistently reported, including relatively small sample sizes, reliance on self-reported questionnaire data, short intervention periods, and insufficient control of potential confounding variables. These limitations should be taken into account when interpreting the findings of this scoping review.

## RESULTS AND DISCUSSION

## Characteristics by Country

**Figure 1. Characteristics by Country of Origin**



Based on the results of the mapping of countries of origin for the 11 articles analysed in this scoping review, the majority of studies originated from Indonesia (63.6%). Furthermore, one article each originated from Egypt, Ghana, Iran and Bangladesh, with an identical percentage of 9.1%. Based on the mapping of countries of origin, seven studies were conducted in Indonesia (63.6%), while one study each was conducted in Egypt, Ghana, Iran, and Bangladesh (9.1% each).

Prior to presenting the thematic findings, a data charting process was conducted to extract the main characteristics of each article, including study design, research context, respondent characteristics, variables and instruments used, as well as findings relevant to the objectives of the scoping review. This process ensured that all included evidence sources aligned with the focus and research questions.

Across the included studies, inadequate dietary intake, adherence to iron supplementation, and health-related behaviours were frequently reported as factors associated with anaemia among adolescent girls. Fitripancari et al. (2023) indicate that low iron and vitamin C intake, as well as unhealthy dietary behaviours, are more frequently found in adolescent girls with anaemia, whilst Soliman et al. (2022) report that irregular eating habits and consumption of foods that inhibit iron absorption are commonly found in the anaemia group.

Regarding supplementation Apriningsih et al. (2020) and Yidana et al. (2020) report that adherence to the consumption of iron or iron–folic acid tablets is influenced by knowledge, motivation, and support from the school environment. Abby et al. (2023), Utami et al. (2022) and Rahman et al. (2025) reported improvements in knowledge and adherence following educational interventions, while changes in haemoglobin levels were not consistently observed. Furthermore, research based on behavioural theory indicates that attitudes, subjective norms, perceived behavioural control, and behavioural intentions are associated with anaemia prevention behaviour among adolescent girls Puspitasari et al. (2022), Andani et al. (2021) and Rakhshani et al. (2025).

These articles utilised a structured questionnaire, the Food Frequency Questionnaire (FFQ), as well as haemoglobin level measurements using HemoCue or standard laboratory methods.

## Synthesis of Results

The synthesis of results in this scoping review was conducted using a thematic analysis approach to the data obtained from the data charting process. The synthesised data included the

research focus, main variables, research context, and key findings relevant to the prevention of anaemia in adolescent girls. This process aimed to identify patterns and commonalities in the findings across the included articles.

During the data charting stage, emphasis was placed on behavioural and psychosocial factors, nutritional patterns and nutrient intake, adherence to iron-folic acid tablet (IFA) consumption, as well as educational interventions and contextual health factors. Although study designs and methods varied across the included articles, behavioural factors, nutritional intake, and adherence to supplementation were commonly reported variables.

Based on the results of the mapping and synthesis of the reviewed articles, four major themes were identified that describe the factors playing a role in the prevention of anaemia in adolescent girls, as follows:

**Table 5. Synthesis of Main Findings**

Theme	Main Findings	Supporting Articles
Behavioural & psychosocial factors in the prevention anaemia	Knowledge, motivation, attitudes, self-efficacy influence prevention behaviour	A1, A6, A7, A8, A10
Nutritional patterns and nutrient intake related to anaemia	Low iron, protein, vitamin C intake associated with anaemia	A2, A3, A4, A5
Adherence to iron supplementation	School support and motivation affect adherence	A4, A5, A6, A8, A9
Educational interventions and contextual health factors	Education improves awareness but Hb impact inconsistent	A4, A8, A11

### **Theme 1. Behavioural and Psychosocial Factors in the Prevention of Anaemia**

This theme covers attitudes, intentions, subjective norms, perceived behavioural control, knowledge, motivation, and self-efficacy among adolescent girls. Several articles indicate that positive attitudes, supportive social norms, and perceived behavioural control are associated with anaemia prevention behaviours and adherence to iron tablet consumption. Higher levels of knowledge and motivation also contribute to better prevention behaviours.

Behavioural theories such as the Theory of Planned Behaviour (TPB) and the Health Belief Model (HBM) provide useful frameworks for understanding anaemia prevention behaviours among adolescent girls. Studies included in this review suggest that positive perceptions, stronger intentions, and greater self-efficacy are associated with improved dietary practices and adherence to iron supplementation. The TPB approach has been reported to effectively improve anaemia prevention behaviour, while HBM-based constructs such as perceived susceptibility, perceived benefits, and self-efficacy may contribute to improved preventive behaviours among adolescent girls (A1, A6, A7, A8, A10).

### **Theme 2. Nutritional Patterns and Nutrient Intake Related to Anaemia**

This theme covers the intake of iron, protein and vitamin C, as well as the quality and balance of dietary patterns. Several articles report that inadequate intake of iron and protein increases the risk of anaemia in adolescent girls. Vitamin C plays a role in enhancing iron absorption, although its direct link to the incidence of anaemia is not always significant. Furthermore, unbalanced dietary patterns, such as skipping meals and consuming nutrient-poor foods, contribute to high rates of anaemia (A2, A3, A4, A5).

### **Theme 3. Adherence to Iron Supplementation (TTD/IFA)**

This theme highlights the low adherence to iron supplement tablets among adolescent girls. Low adherence is reported as one of the main causes of high rates of anaemia. School support and school-based supplementation programmes have been shown to play a role in improving compliance with TTD/IFA consumption. Furthermore, socio-economic factors and family educational levels also influence adolescents' compliance with iron supplementation (A4, A5, A6, A8, A9).

#### Theme 4. Educational Interventions and Contextual Health Factors

This theme covers nutritional education interventions, technology-based education (mHealth), as well as health and environmental factors. Nutritional education has been reported to improve adolescent girls' knowledge and attitudes, although its impact on increasing haemoglobin levels remains inconsistent. Technology-based interventions show potential in improving knowledge, attitudes, and nutritional practices, but their effectiveness regarding anaemia status remains limited. Health factors such as parasitic infections and environmental conditions also play a role in the occurrence of anaemia in adolescent girls (A4, A8, A11).

Overall, the findings of this scoping review demonstrate that anaemia prevention among adolescent girls is influenced by interconnected nutritional, behavioural, psychosocial, and environmental factors. Nutrient intake directly affects iron status, while adherence to iron supplementation helps address inadequate dietary intake. Behavioural factors such as knowledge, attitudes, motivation, and self-efficacy influence both dietary practices and supplementation adherence, whereas educational and environmental support strengthen these preventive behaviours. Structured health education has also been shown to improve awareness and preventive behaviours regarding anaemia, particularly adherence to iron supplementation (Soetrisno et al. 2021). Therefore, effective anaemia prevention requires a comprehensive and integrated approach involving nutritional improvement, iron supplementation programmes, behavioural interventions, and supportive social environments.

Most studies reported a significant relationship between inadequate nutrient intake and anaemia incidence (A2, A3, A4, A5). A meta-analysis by Pasricha et al. (2021) demonstrated that low intake of iron, protein, and vitamin C consistently increases the risk of anaemia among adolescent girls, particularly in South Asia and Sub-Saharan Africa. Adolescent girls with low iron intake were reported to have a risk of anaemia up to nearly eight times higher than those with adequate intake (A3). Furthermore, irregular eating habits, skipping breakfast, and the consumption of foods and beverages that inhibit iron absorption are more frequently observed in adolescent girls with anaemia, although there is inconsistency in the findings regarding tea and coffee consumption (A2, A3, A4).

Adherence to iron supplement tablets plays a crucial role in preventing anaemia in adolescent girls, but remains variable. Weekly iron supplementation is only effective in increasing haemoglobin levels if adherence is  $\geq 70\%$ , whilst non-adherence increases the risk of anaemia (Choy et al. 2020). These findings suggest that adherence to iron supplementation is not solely determined by the availability of supplements but is strongly influenced by behavioural and psychosocial factors. Knowledge, motivation, self-efficacy, and social support appear to facilitate adherence, indicating that educational and behavioural interventions are essential complements to supplementation programmes. (A1, A6, A7, A9, A10). Behavioural theory-based interventions are more effective than conventional education (Lassi et al. 2021). However, increased knowledge and adherence do not always have a significant impact on haemoglobin levels, particularly in short-term interventions (A8, A11).

The frequent use of questionnaires and FFQs across studies highlights the importance of behavioural and dietary assessment in understanding anaemia risk. However, reliance on self-reported measures may introduce reporting bias and should be considered when interpreting the findings. Among the reviewed articles, (A11) was rated as the strongest because it employed an intervention design, measured haemoglobin levels directly, and assessed changes in knowledge and behaviour before and after the intervention.

The predominance of cross-sectional designs limits the ability to establish causal relationships between nutritional factors, supplementation adherence, and anaemia outcomes. In addition, reliance on self-reported questionnaires may introduce measurement and reporting bias. These methodological limitations should be considered when interpreting the strength of the available evidence.

A principal strength of this scoping review lies in its comprehensive mapping of evidence pertaining to nutritional patterns and iron supplementation among adolescent girls, employing a systematic and transparent approach in accordance with the PRISMA-ScR guidelines. Notwithstanding, the findings must be interpreted in light of several methodological limitations. First, the relatively limited number of included studies may constrain the breadth of evidence available for synthesis. Second, the geographic concentration of studies within Indonesia may restrict the generalisability of findings to other developing-country contexts characterised by distinct sociocultural, economic, and health-system configurations. Third, the predominance of cross-sectional study designs inherently limits the capacity to establish causal relationships among nutritional factors, supplementation adherence, and anaemia outcomes. Additionally, the reliance of many studies on self-reported questionnaires introduces the risk of measurement and recall bias. Finally, the restriction of the literature search to four databases and publications in English or Indonesian may have resulted in the exclusion of relevant evidence indexed in other repositories. These limitations should be carefully considered when evaluating the strength, comparability, and transferability of the synthesised evidence.

## CONCLUSION

This study showed that most lecturers at the Faculty of Nursing, Universitas Padjadjaran had positive perceived health status. Among the factors analyzed, behavioral and genetic factors were found to be significantly associated with perceived health status, whereas health care service and environmental factors did not show significant associations. These findings indicate that, among nursing lecturers, perceptions of health status were more strongly influenced by internal factors, particularly daily health behaviors and family history of disease, than by relatively homogeneous external factors such as access to health care services and the work environment.

Overall, the findings of this study emphasize the importance of promotive and preventive approaches in maintaining the health of nursing lecturers. In the field of nursing, lecturers' health is particularly important because lecturers do not only serve as educators, but also as clinical supervisors and role models for healthy behavior among students. Therefore, nursing faculties and higher education institutions are encouraged to develop workplace health promotion programs that focus on behavioral change, such as regular physical activity, nutrition education, work-related stress management, periodic health examinations, and screening for risk factors of non-communicable diseases, particularly among lecturers with a family history of disease. Future studies are recommended to use longitudinal designs or mixed methods and to include objective health indicators so that the findings can provide a stronger basis for developing occupational health policies for lecturers in the field of nursing.

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