

BMJ Open Facilitators and barriers to implementing national iron and folic acid supplementation programmes for adolescents in India: a protocol for systematic review

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To cite: Shah R, Shinde S, Akagwu O, *et al.* Facilitators and barriers to implementing national iron and folic acid supplementation programmes for adolescents in India: a protocol for systematic review. *BMJ Open* 2026;**16**:e115187. doi:10.1136/bmjopen-2025-115187

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (<https://doi.org/10.1136/bmjopen-2025-115187>).

Received 10 December 2025
Accepted 06 May 2026



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ABSTRACT

Introduction Anaemia remains a major public health concern among Indian adolescents, particularly girls. National-level and state-level initiatives led by the Government of India, such as the Weekly Iron and Folic Acid Supplementation, *Anaemia Mukh Bharat* and the Intensified National Iron Plus Initiative, aim to control iron-deficiency anaemia through systematic supplementation and behaviour change communication strategies. However, implementation challenges persist. Given the limited evidence on barriers, facilitators and interventions implemented to improve the outlined national schemes, we have designed a systematic review to inform future research and programmes. This review aims to systematically identify and synthesise evidence on barriers and facilitators influencing the implementation of national iron and folic acid supplementation programmes targeting adolescents aged 10–19 years in India.

Methods and analysis A comprehensive search will be conducted using five databases, namely PubMed, EMBASE, Web of Science, CINAHL and Scopus, from inception to 30 September 2025. To capture grey literature, we will also search government portals, international agency repositories, clinical trial registries and the Google platform. Eligible studies include experimental, observational, qualitative and implementation research conducted in school-based, community-based or combined delivery settings. Screening, data extraction and quality appraisal will be performed independently by two reviewers using the Covidence platform. The Joanna Briggs Institute tool will be used to assess methodological quality of included studies. Quantitative data will be synthesised descriptively following the Synthesis Without Meta-analysis guidelines, and qualitative data will be analysed using thematic synthesis.

Ethics and dissemination Ethical approval is not required as there is no human participation. The results will be published in a peer-reviewed journal and presented at scientific conferences.

PROSPERO registration number CRD420251153248.

INTRODUCTION

Anaemia, particularly iron deficiency anaemia, remains a major global public

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ A comprehensive, high-sensitivity search across multiple databases and grey literature sources will maximise identification of relevant studies.
- ⇒ Inclusion of quantitative, qualitative and mixed-methods evidence will enable a comprehensive assessment of implementation barriers and facilitators of adolescent iron and folic acid supplementation programmes in India.
- ⇒ Independent screening, data extraction and quality appraisal by two reviewers using standardised tools (Joanna Briggs Institute) will enhance methodological rigour and minimise bias.
- ⇒ Substantial heterogeneity in study designs, settings and outcomes may limit comparability and preclude meta-analysis, requiring narrative and thematic synthesis.
- ⇒ Restriction to published and accessible grey literature may lead to omission of relevant unpublished studies.

health challenge, affecting an estimated 2 billion people worldwide.¹ According to the WHO, 40.0% of children aged 6–59 months, 37.0% of pregnant women and 30.0% of women aged 15–49 years are anaemic. Anaemia accounted for a substantial burden of disease, with an estimated 50 million years of healthy life lost due to disability in 2019, largely driven by dietary iron deficiency.² Iron and folic acid deficiencies, which are major contributors to anaemia, constitute a significant portion of this burden and are among the leading causes of years lived with disability among adolescent girls and women of reproductive age.^{3–5} It has remained a subject of the World Health Assembly (WHA) since 1959. In response, the WHA adopted six global nutrition targets to reduce anaemia in women of reproductive age (15–49) by 50.0%

between 2012 and 2025.⁶ However, according to the latest WHO Global Health Observatory data (2023), the global prevalence in this group remains around 30.7% (30.5% in non-pregnant women and 35.5% in pregnant women), reflecting only marginal progress over the past decade.³ This indicates that the progress is not on track to meet the set targets, and it is particularly slow in low- and middle-income countries.^{3 7}

In India, anaemia continues to be a major public health concern, particularly among adolescents. The National Family Health Survey 5 (2019–2021) reported anaemia prevalence rates of 59.0% among adolescent girls and 31.0% among adolescent boys.⁸ More than half of adolescent girls are anaemic, placing them at increased risk of impaired growth, reduced physical and cognitive capacity and adverse maternal outcomes later in life. Global comparative data across 195 countries show that India has the second-highest burden of adolescent anaemia, with a prevalence of 54.1%.⁹ The burden is disproportionately higher in rural areas and among low-income households.⁸

Adolescence is a critical period for physical and cognitive development, during which anaemia can hinder growth, reduce physical capacity, impair neurocognitive functions and increase susceptibility to infections.¹⁰ The increased physiological demand for iron during puberty, exacerbated by menstrual blood loss in females, further elevates anaemia risk.¹ To address this persistent challenge, the Government of India launched the Anaemia Mukh Bharat (AMB) initiative in 2018 as a comprehensive and unified strategy. AMB builds on earlier efforts, including the Intensified National Iron Plus Initiative and the Weekly Iron and Folic Acid Supplementation programme. These initiatives target six population groups, including both school-going and out-of-school adolescents, through six evidence-based interventions implemented via multisectoral mechanisms.^{11–13} Iron and Folic Acid (IFA) supplementation remains a cornerstone of these programmes, with distribution to adolescent girls initiated in 2013 and to pregnant women for over two decades.¹⁴ Despite these longstanding national programmes, challenges persist in achieving adequate coverage, compliance and effectiveness, resulting in suboptimal IFA uptake.^{15–19}

While several studies have evaluated anaemia interventions in India, synthesised evidence on the factors influencing the implementation of national IFA supplementation programmes remains limited. These factors operate at multiple levels. At the individual level, barriers include poor adherence, gender norms, stigma, cultural beliefs and misinformation that may influence adolescents' willingness or ability to regularly consume IFA.²⁰ System-level barriers include uneven programme coverage across rural and urban areas, limited outreach to out-of-school adolescents and insufficient focus on marginalised populations, such as tribal and socioeconomically disadvantaged groups.²¹ Additional challenges include supply chain disruptions, weak service delivery mechanisms and inadequate integration with other adolescent health programmes. Conversely, facilitators

include strong policy commitment, multisectoral collaboration, effective delivery platforms, trained personnel, community engagement, reliable supply chains and tailored approaches for hard-to-reach populations.^{22 23}

Given these multilayered challenges, a comprehensive synthesis of existing evidence is needed. This systematic review aims to identify key facilitators and barriers to the implementation of national IFA supplementation programmes for adolescents in India. The findings will help inform future interventions, strengthen implementation strategies, and support policymakers in improving programme outcomes.

REVIEW QUESTIONS

Primary research questions

1. What are the key facilitators and barriers influencing the implementation of national IFA supplementation programmes targeted at adolescents in India?
2. What interventions have been implemented to strengthen or improve the existing national IFA supplementation programmes or schemes for adolescents in India?

Sub research questions

1. What factors influence the uptake of IFA supplementation among adolescents in India, considering individual, system, contextual and interest-holder-related dimensions?
2. What IFA supplementation interventions have been implemented within or alongside national programmes to reduce anaemia among adolescents in India, and what has been their impact?
3. What evidence gaps remain regarding the implementation of adolescent IFA supplementation programmes in India, and how can these inform future research, policy, and practice?

METHODS AND ANALYSIS

The protocol follows the Preferred Reporting Items for Systematic Reviews and Meta-analyses Protocols (PRISMA-P) 2015 statement for reporting.²⁴ The review is registered with the PROSPERO database (registration ID: CRD420251153248). No amendments have been made to the protocol since registration. Any future changes will be documented in PROSPERO with the date, description and rationale, and reported in the final review.

Eligibility criteria

The inclusion and exclusion criteria are structured using the PICO framework and summarised in [table 1](#).

Search terms and strategy development

Information sources

Five electronic databases will be searched: PubMed (via MEDLINE), Embase, Web of Science, Scopus and CINAHL (via EBSCOhost), covering all records from inception to 30 September 2025 without language

Table 1 Inclusion and exclusion criteria

Item	Inclusion criteria	Exclusion criteria
Population	Adolescents aged 10–19 years, both school-going and out-of-school, who are beneficiaries of national IFA supplementation programmes in India (WIFS, AMB, I-NIPI). Studies with overlapping age groups will be included if data for adolescents (10–19 years) are reported separately or if $\geq 75\%$ of participants fall within this range.	Studies focusing exclusively on non-adolescent groups (infants, adults, pregnant women) or conducted outside India. Studies not related to national supplementation programmes or focusing solely on pregnant adolescents (who receive distinct antenatal care) will be excluded.
Intervention	National or large-scale government-supported IFA supplementation programmes defined as programmes implemented at national, state or multidistrict level with standardised delivery mechanisms, such as WIFS, AMB and I-NIPI.	Interventions not related to IFA supplementation (such as but not limited to school feeding programmes that do not include an explicit IFA supplementation component, WASH-only interventions or education-only activities), or those targeting treatment of specific medical conditions (anaemia due to haemoglobinopathies).
Comparator	No intervention, usual care, alternative delivery models (such as but not limited to school-based vs community-based delivery of IFA supplementation, including delivery integrated within school platforms such as feeding programmes where IFA supplementation is provided) or variations in programme components (IFA-only vs IFA plus deworming).	Not applicable.
Outcomes	Studies reporting implementation-related outcomes such as coverage, adherence, uptake, compliance, acceptability, feasibility, fidelity, reach, community engagement, interest-holder perspectives, sustainability, cost-effectiveness, integration or equity will be included. Studies must also report at least one barrier or facilitator, either explicitly or inferentially (e.g. 'low adherence due to side effects' as a barrier or 'high coverage due to school-based delivery' as a facilitator). Equity-related variables, where reported, will be extracted to support subgroup and equity-focused analyses.	Studies that do not report barriers or facilitators to programme implementation, uptake, delivery or effectiveness, or that are limited to biomedical outcomes without an implementation context.
Study Design	RCTs, quasi-experimental studies, implementation research, mixed-methods studies, qualitative research or observational studies examining implementation processes. Studies published in English, Hindi and/or regional Indian languages will be included, with translations arranged as needed.	Editorials, commentaries, reviews or purely descriptive cross-sectional studies not exploring barriers or facilitators. Studies with no full text after reasonable retrieval attempts will be excluded.

AMB, Anaemia Mukht Bharat; IFA, iron and folic acid; I-NIPI, Intensified National Iron Plus Initiative; RCTs, randomised controlled trials; WASH, Water, Sanitation, and Hygiene; WIFS, Weekly Iron and Folic Acid Supplementation.

restrictions. To identify unpublished and non-indexed studies, a grey literature search will be conducted using predefined keywords aligned with the main PubMed search strategy concepts. Grey literature sources will include: government portals (Ministry of Health and Family Welfare, Ministry of Education, NITI Aayog), international agency repositories (UNICEF India, WHO SEARO, World Bank, India), programme-specific portals (Anaemia Mukht Bharat Dashboard), clinical trial registries (CTRI, WHO ICTRP), Google Scholar (using advanced search features) and reference lists of included studies (first-generation hand searching).

Search terms and strategy development

The search strategy will combine Medical Subject Headings, controlled vocabulary (Emtree) and free-text keywords for five core concepts: (1) anaemia; (2)

adolescents; (3) iron and folic acid supplementation or anaemia programmes; (4) implementation outcomes, including barriers, facilitators and delivery strategies; and (5) geographical location (India). Boolean operators (AND/OR) and truncation (adolescen*) will be used for precision and coverage.

Search sensitivity and adaptation

A high-sensitivity search approach will be employed to ensure comprehensive inclusion of relevant studies, particularly qualitative and implementation research that may not be well indexed. By 'high-sensitivity', we refer to an author-designed strategy that deliberately uses broad sets of keywords, synonyms and truncations across databases to maximise recall. Specificity will be maintained through careful screening and duplicate removal. This approach is informed by the Peer Review of Electronic

Search Strategies 2015 guidelines for electronic search strategies.²⁵ The complete search strategy is attached (online supplemental file 1).

The number of records retrieved, screened and included will be documented using a PRISMA flow diagram in line with PRISMA 2020 guidance,²⁶ to ensure transparency and reproducibility.

Search validation process

The sensitivity of the search strategy will be assessed by confirming that several sentinel articles are successfully retrieved.

Procedures to contact authors

When data are missing or inconsistent across reports, corresponding author(s) will be contacted via email (up to two attempts). All communication will be documented (contact date, method, response status and decision made). If no response is received or discrepancies remain unresolved, we will proceed with the available data and note potential implications for the discussion.

Screening procedure

All search results will be imported into Covidence (Veritas Health Innovation, Melbourne, Australia), an internet-based platform for systematic review management. Duplicates will be removed automatically in Covidence, followed by manual checks.²⁷ Two independent reviewers will independently screen titles and abstracts and assess full texts according to the PICO-based eligibility criteria. Discrepancies will be resolved by discussion or, if required, a third reviewer. Screening results will be illustrated in a PRISMA 2020 flowchart. The final list of included articles will then be used for the data extraction.

Handling of non-English sources

Studies and/or reports published in Hindi or other regional Indian languages will be included where relevant. Initial screening and translation will be conducted by one of the coauthors, proficient in respective language(s). For data extraction, translated content will be cross-verified by a second bilingual to ensure accuracy and consistency. If required, an independent translation agency and/or software will be used if members of the research team are unable to translate papers into English.

Extraction procedure and reliability

Data extraction will be conducted using a standardised extraction form developed based on objectives of this review and established systematic review practices. The standardised extraction form will capture study characteristics, participant demographics, intervention features, implementation outcomes (barriers, facilitators, delivery mechanisms) and findings. Two reviewers will independently extract data from all included studies. To ensure consistency and reliability, a pilot extraction will be conducted on a sample of 10 studies, selected to reflect variation in study design and source type (eg, peer-reviewed articles and grey literature).

Inter-rater agreement will be assessed, and discrepancies will be discussed and resolved. Where agreement is below a predefined threshold ($\geq 90\%$), the extraction form and coding approach will be refined before proceeding with full data extraction.

Data validation, risk of bias and quality assessment

The methodological quality of included studies will be appraised using the Joanna Briggs Institute critical appraisal tools, selected for their applicability across diverse study designs, including qualitative, observational and mixed-methods research anticipated in this review. This approach allows for a consistent and structured assessment of methods quality and risk of bias across heterogeneous study designs.²⁸ Quality appraisal will focus on assessing risk of bias within individual studies, including selection bias, measurement bias and reporting bias, as appropriate to study design. Two reviewers will assess all included studies independently, with discordance resolved by discussion or adjudication. Low-quality studies will not be excluded but will be interpreted cautiously in the synthesis. Confidence in findings will be interpreted based on methodological quality, consistency and strength of evidence across included studies, taking into account the heterogeneity in study designs and the inclusion of qualitative and implementation research.

Quantitative data transformations

Quantitative data on compliance, adherence, coverage, accessibility and reduction in anaemia prevalence will be extracted wherever available. Data on interventions implemented to strengthen or improve the existing national IFA supplementation programmes/schemes will be recorded using intervention-related domains. Given anticipated heterogeneity, meta-analysis may not be feasible; therefore, synthesis will follow the Synthesis Without Meta-analysis guidelines.²⁹ Descriptive statistics (proportions, ranges) will summarise outcomes, and effect estimates such as relative risk (RR), OR or risk difference (RD) will be calculated where possible. Sensitivity analyses will assess the robustness of findings.

Qualitative data synthesis

Qualitative data will be analysed using thematic synthesis to identify recurrent barriers, facilitators and interventions. The Consolidated Framework for Implementation Research (CFIR) will guide coding and categorisation across individual, system and contextual levels. Relevant constructs from the RE-AIM framework (Reach, Effectiveness, Adoption, Implementation and Maintenance) will be incorporated to highlight programme reach and sustainability. Intervention-related data will be recorded using components listed below: intervention design characteristics (type, components and frequency), delivery mechanisms and settings, followed by fidelity and effectiveness of interventions delivered. Team consensus will determine final analytical domains. Reporting of qualitative synthesis will be guided by the ENTREQ (Enhancing

Transparency in Reporting the Synthesis of Qualitative Research) statement to ensure clarity and transparency in the presentation of methods and findings.³⁰

Where data permit, findings will be stratified and analysed by interest-holder groups (such as but not limited to adolescents, parents or caregivers, frontline health workers, teachers, programme implementers and policy-makers). This will allow identification of similarities and/or differences in perceived barriers, facilitators and implementation experiences across groups. Diverse perspectives will be explicitly reported to enhance contextual interpretation of findings.

Integrated data synthesis

Findings will be synthesised narratively, integrating qualitative and quantitative results. Data will be grouped by main themes relating to barriers and facilitators of programme implementation including systematic, societal, cultural, programmatic, environmental and health-related factors. Facilitators will include government policies and frameworks, infrastructure and delivery platforms, awareness and advocacy initiatives, monitoring and feedback mechanisms, supply chain management, community engagement and a holistic programmatic approach. Where feasible, quantitative data will be summarised using descriptive statistics, such as compliance rates, adherence rates, programme coverage, accessibility, anaemia prevalence and improvements in haemoglobin concentration. If sufficient data are available, a meta-analysis may be conducted to estimate pooled effect sizes for programme outcomes, using appropriate measures (RR, OR, RD) with 95% CIs. Qualitative results will be coded and mapped to an implementation framework, such as CFIR, where appropriate, to facilitate integration with thematic findings. Where feasible, results will also be presented by interest-holder group to highlight variation(s) in implementation experiences and outcomes. An equity-focused analysis will be incorporated using the PROGRESS-Plus framework (Place of residence, Race/ethnicity, Occupation, Gender/sex, Religion, Education, Socioeconomic status, Social capital, plus additional context-specific factors such as age, disability and programme access).³¹ Where data permit, findings will be stratified across these dimensions to explore variations in barriers, facilitators and implementation outcomes. This will support identification of underserved populations and inform more equitable programme design and delivery.

Potential meta-biases, including publication bias and selective reporting, will be considered during data synthesis and interpretation. The inclusion of grey literature aims to minimise publication bias; however, formal statistical assessment (using funnel plots) may not be feasible due to expected heterogeneity in study designs and outcomes.

Criteria for conclusions

Conclusions about the facilitators and barriers to implementing national iron and folic acid supplementation

programmes will be derived primarily from the thematic analysis of qualitative data and descriptive and analytical synthesis of quantitative findings. Themes will be identified based on recurrence and the strength of supporting evidence across studies. For studies reporting quantitative outcomes (adherence rates, coverage, programme reach), findings will be summarised narratively or using descriptive statistics. Where feasible, effect size estimates will be used to interpret magnitude and direction of impact. A similar approach will be used to report interventions implemented to improve the national iron supplementation scheme in line with the outlined qualitative synthesis components. Robustness will be determined by methodological quality, risk of bias and the magnitude of reported effects. The findings of this review will help identify practical barriers and facilitators relevant to improving national IFA programmes in India. The results will inform programme implementers and policymakers regarding delivery gaps, supply chain issues and context-specific strategies that may strengthen programme performance. The review will also highlight priority evidence gaps and guide future implementation research focused on adolescent nutrition and anaemia reduction.

Researcher positionality

The review team comprises researchers with backgrounds in public health, clinical medicine, nutrition and implementation science, with experience working in adolescent health and national nutrition programmes in India and similar settings. We acknowledge that these perspectives may influence interpretation of findings. To minimise potential bias, data extraction and synthesis will be conducted independently by multiple authors/researchers involved in this work, supported by team discussions to ensure reflexivity, transparency and consistency in interpretation.

Justification for synthesis approach

Given expected heterogeneity in study designs and contexts, a mixed-methods narrative synthesis is the most appropriate approach. Quantitative results will be summarised using descriptive or inferential statistics, while qualitative findings will be synthesised following the approach described by Thomas and Harden to identify recurring patterns and contextual factors.³² Quantitative data (adherence or coverage) will be summarised using descriptive statistics where possible. Where sufficient data exist, effect measures (RR or OR) will be estimated in line with the Cochrane Handbook³³; however, meta-analysis will not be primary synthesis method due to anticipated heterogeneity. This approach is pragmatic to achieve the review's scope, aims and objectives. Data integrity will be ensured through independent data extraction by at least two reviewers, with discrepancies resolved through discussion or a third reviewer. Transparency and reliability will be supported by adherence to recognised reporting guidelines, including PRISMA 2020, as well as established

methodological guidance for systematic reviews.^{26 34} The narrative synthesis will follow the procedure described by Popay and colleagues,³⁵ which involves developing a preliminary synthesis and tabulating data by major themes such as facilitators, barriers, compliance and intervention related outcomes.

Strengths and limitations of the review

This review has several strengths, including the use of a comprehensive, high-sensitivity search strategy across multiple databases and grey literature sources and the inclusion of diverse study designs to capture real-world implementation evidence. While this review has been designed to ensure methodological rigour and comprehensive coverage, several potential limitations should be acknowledged. First, differences in study design, methodological rigour and the reporting quality may complicate the synthesis and interpretations of findings. The inclusion of diverse study types, though necessary to capture real-world implementation evidence, may introduce heterogeneity that affects confidence in pooled conclusions. Second, variation(s) in implementation models, target populations, geographical settings and outcome measurement approaches are anticipated. This diversity may limit the comparability and generalisability of results across contexts.

Finally, this review may have the following limitations:

- ▶ Variability in study quality: Differences in study design, conduct and reporting may complicate data synthesis and interpretation.
- ▶ Heterogeneity: Variation in implementation models, populations and study settings may limit comparability and generalisability of findings.
- ▶ Scope limitation within AMB: The review focuses specifically on the IFA supplementation component of AMB strategy and other national programmes implemented in India. It does not assess other components such as periodic deworming, food fortification, behaviour change communication or diagnostic tools (digital haemoglobinometers and point-of-care testing). While the clinical validity and reliability of those diagnostic tools may impact the outcomes, their evaluation is beyond the scope of this review. Similarly, interventions addressing non-nutritional causes of anaemia (malaria, haemoglobinopathies) will be excluded.
- ▶ This review may also be limited by potential constraints in the review process, including reliance on published data, the possibility of missing grey literature despite comprehensive searching and subjective judgement during screening and thematic synthesis. Independent dual screening and extraction will help reduce these risks, but they cannot be eliminated entirely.

Plan for updating the review

The review will be updated if substantial new evidence emerges that could significantly alter its conclusions. A formal updating will be planned within 3 years of

publication or sooner if major policy revisions occur in India's national iron supplementation programmes. The timing of the update will depend on the new data, evolving policy priorities and research feasibility.

Ethics and dissemination

As this study involves analysis and synthesis of previously published data, formal ethical approval is not required. The review will adhere to the highest standards of research integrity, transparency and ethical reporting as recommended by the Cochrane Handbook and PRISMA 2020 guidelines.

Findings will be disseminated through publication in a peer-reviewed journal and shared with policymakers, programme implementers and public health practitioners via research networks, conferences and national dissemination workshops.

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Acknowledgements The authors thank the Harvard T.H. Chan School of Public Health India Research Center, an office of the Harvard Global Research Support Centre India, and the Narotam Sekhsaria Foundation for supporting this work through the India Research Fellowship. The team also acknowledges the contributions of institutional collaborators and colleagues who provided inputs and administrative support during the preparation of this protocol. The authors thank Manchester Metropolitan University, UK, for supporting the open access publication of this article.

Contributors RS and AA conceptualised the study and developed the protocol. RS designed the search strategy, conducted the methodological planning and drafted the manuscript. AA, SS, OA, SJ and WF provided critical input on study design, methodology and interpretation. RS and the research team refined the eligibility criteria, data extraction framework and synthesis approach. All authors reviewed, revised and approved the final manuscript. RS is the guarantor of the review.

Funding RS has been funded by the Harvard T.H. Chan School of Public Health India Research Centre, an office of Harvard Global Research Support Centre India, and the Narotam Sekhsaria Foundation. The funders had no role in the study design, analysis or preparation of this protocol or subsequent publications.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

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