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A Systematic Review and Meta-Analysis on Knowledge, Attitudes, and Practices Regarding Anemia among Women of Reproductive Age

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ABSTRACT

Background: Anaemia remains a major public-health challenge among women of reproductive age (WRA; 15–49 years), particularly in low- and middle-income countries. While biomedical interventions are widely implemented, behavioural factors such as knowledge, attitudes, and practices (KAP) play a critical role in the prevention and control of anaemia. Evidence from individual KAP studies is heterogeneous, and a comprehensive synthesis is lacking.

Objectives: To systematically review and meta-analyse existing literature on knowledge, attitudes, and practices regarding anaemia among women of reproductive age, and to estimate pooled prevalence of adequate knowledge, positive attitudes, and good preventive practices.

Methods: A systematic search of PubMed/MEDLINE, Embase, Scopus, Web of Science, CINAHL, and Google Scholar was conducted from inception to June 2025. Cross-sectional and observational studies reporting quantitative KAP data on anaemia among WRA were included. Two reviewers independently screened studies, extracted data, and assessed methodological quality using the Joanna Briggs Institute checklist. Random-effects meta-analysis was performed to pool prevalence estimates. Heterogeneity was assessed using the I^2 statistic, and publication bias was evaluated using funnel plots and Egger's test.

Results: A total of 34 studies involving 41,732 women of reproductive age were included in the qualitative synthesis, of which 28 studies were included in the meta-analysis. The pooled prevalence of adequate knowledge regarding anaemia was 46.3% (95% CI: 41.2–51.5; $I^2 = 96.1\%$). The pooled prevalence of positive attitudes toward anaemia prevention was 54.8% (95% CI: 48.9–60.6; $I^2 = 94.4\%$). Good preventive practices were observed in only 39.1% of women (95% CI: 34.0–44.5; $I^2 = 97.3\%$). Better KAP outcomes were consistently associated with higher educational status, urban residence, and regular contact with healthcare services. Pregnant women attending antenatal clinics demonstrated higher knowledge and better practices compared with non-pregnant women and adolescents.

Conclusions: This systematic review and meta-analysis demonstrates that knowledge and preventive practices related to anaemia among women of reproductive age remain inadequate, despite moderately favourable attitudes. The substantial knowledge–practice gap highlights the need for strengthened, context-specific behaviour-change communication and improved counselling within existing anaemia control programmes, with special focus on adolescents and non-pregnant women.

Keywords: *Anaemia; Knowledge; Attitude; Practice; Women of reproductive age; Systematic review; Meta-analysis.*

INTRODUCTION

Anaemia remains one of the most prevalent public-health problems worldwide, disproportionately affecting women of reproductive age (WRA; 15–49 years). It is defined as a reduction in the concentration of haemoglobin in blood below established cut-off values, leading to impaired oxygen-carrying capacity and reduced physical and cognitive performance [1]. Globally, nearly one-third of women of reproductive age are estimated to be anaemic, with the burden being highest in low- and middle-income countries, particularly in South Asia and sub-Saharan Africa [2]. Despite decades of nutrition-specific and nutrition-sensitive interventions, the decline in anaemia prevalence among women has been slow and uneven across regions [3].

Iron deficiency is the most common cause of anaemia among women of reproductive age, accounting for approximately 50–60% of cases globally [4]. Other important contributors include deficiencies of folate and vitamin B12, parasitic infestations, chronic infections, haemoglobinopathies, and increased physiological demands related to menstruation, pregnancy, and lactation [5]. Anaemia in women has far-reaching consequences, including reduced work capacity, impaired immunity, poor pregnancy outcomes such as preterm birth and low birth weight, and increased maternal morbidity and mortality [6,7].

Beyond biological and structural determinants, behavioural and sociocultural factors play a critical role in the prevention and control of anaemia. Knowledge about causes, symptoms, prevention strategies, and treatment options influences dietary choices, health-seeking behaviour, and adherence to iron–folic acid supplementation (IFAS) programmes [8]. Attitudes toward anaemia, including perceptions of severity, susceptibility, and benefits of preventive measures, further shape individual and community responses to anaemia control initiatives [9]. Practices such as consumption of iron-rich foods, compliance with supplementation, deworming, and utilisation of antenatal and reproductive health services are the final behavioural pathways through which knowledge and attitudes translate into health outcomes [10].

Several cross-sectional studies across different countries have assessed knowledge, attitudes, and practices (KAP) related to anaemia among women of reproductive age, reporting wide variability in awareness levels and preventive behaviours [11–13]. In many settings, misconceptions regarding dietary sources of iron, fear of side effects of iron tablets, poor counselling by health workers, and sociocultural food taboos have been identified as major barriers to effective anaemia prevention [14,15]. National surveys and programme evaluations have also highlighted that high coverage of IFAS distribution does not necessarily translate into adequate consumption, underscoring the importance of behavioural determinants [16].

While individual KAP studies provide valuable context-specific insights, their findings are heterogeneous and often limited by small sample sizes and methodological differences. To date, there is a lack of comprehensive synthesis quantifying the overall level of knowledge, attitudes, and practices regarding anaemia among women of reproductive age and examining the extent of variation across regions and population subgroups. A systematic review and meta-analysis of KAP studies can provide pooled estimates, identify consistent gaps, and inform the design of targeted, evidence-based interventions [17].

Therefore, the present systematic review and meta-analysis aims to synthesise existing evidence on knowledge, attitudes, and practices related to anaemia among women of reproductive age worldwide. Specifically, it seeks to estimate pooled proportions of adequate knowledge, favourable attitudes, and appropriate practices, explore sources of heterogeneity, and summarise key determinants influencing KAP. The findings are expected to support policymakers, programme managers, and researchers in strengthening anaemia control strategies through informed behaviour-change and health-education interventions.

METHODOLOGY

This systematic review and meta-analysis was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines to ensure transparency and methodological rigor [18]. A predefined protocol guided all stages of the review process.

Study Design and Protocol Registration

The present study is a systematic review and meta-analysis of observational studies assessing knowledge, attitudes, and practices (KAP) regarding anaemia among women of reproductive age. The review protocol was prepared a priori with the International Prospective Register of Systematic Reviews (PROSPERO), to minimise reporting bias and enhance reproducibility [19].

Eligibility Criteria

Population

Studies involving women of reproductive age (15–49 years) were included. Studies focusing on specific subgroups such as adolescent girls (15–19 years), pregnant women, or non-pregnant women were eligible, provided the population fell within the reproductive age range.

Outcomes
Studies reporting quantitative data on at least one of the following outcomes were included:
- Knowledge related to anaemia (causes, symptoms, prevention, treatment)
- Attitudes toward anaemia and its prevention or treatment
- Practices related to anaemia prevention and control (dietary intake, iron–folic acid supplementation, deworming, health-seeking behaviour)

Studies reporting proportions, prevalence, or clearly defined scoring systems for KAP were considered eligible.

Study Design
- Cross-sectional studies
- Baseline KAP data from cohort studies or intervention trials
- Mixed-method studies with extractable quantitative KAP data

Exclusion Criteria
- Review articles, editorials, commentaries, and case reports
- Studies without primary KAP data
- Studies conducted exclusively in populations with specific chronic diseases unless representative of the general WRA population
- Articles with insufficient data for extraction

Information Sources and Search Strategy
A comprehensive literature search was conducted across the following electronic databases from inception to June 2025:
- PubMed/MEDLINE
- Embase
- Scopus
- Web of Science
- CINAHL
- Google Scholar (first 200 records)

Grey literature was searched through institutional reports and reference lists of included studies. The search strategy combined Medical Subject Headings (MeSH) and free-text terms related to anaemia, KAP, and women of reproductive age. No language restrictions were applied. When necessary, non-English articles were translated.

Study Selection
All retrieved records were imported into reference management software, and duplicates were removed. Two reviewers independently screened titles and abstracts for relevance. Full-text articles of potentially eligible studies were then assessed independently for inclusion. Discrepancies were resolved through discussion, and a third reviewer was consulted when consensus could not be reached. The study selection process is presented using a PRISMA flow diagram [18].

Data Extraction
Data were extracted independently by two reviewers using a standardised, pre-piloted data extraction form. The following information was collected:
- Author(s), year of publication, country
- Study setting (urban/rural), study design
- Sample size and population characteristics
- KAP assessment tool and scoring criteria
- Proportions or mean scores for knowledge, attitudes, and practices
- Determinants or predictors of KAP (if reported)
- Key conclusions

Any discrepancies in data extraction were resolved by consensus.

Risk of Bias Assessment
The methodological quality of included cross-sectional studies was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Analytical Cross-Sectional Studies [20]. The checklist evaluates sampling methods, measurement validity, confounding, and statistical analysis. Each study was classified as having low, moderate, or high risk of bias. Quality assessment was performed independently by two reviewers.

Data Synthesis and Statistical Analysis
A narrative synthesis was conducted for all included studies. Where sufficient homogeneous data were available, a meta-analysis was performed.

- Pooled prevalence estimates for adequate knowledge, favourable attitudes, and good practices were calculated using a random-effects model (DerSimonian and Laird method) to account for between-study variability [21].
- Proportions were logit-transformed before pooling and back-transformed for presentation.
- Statistical heterogeneity was assessed using the Cochran Q test and quantified using the I^2 statistic, with values of 25%, 50%, and 75% representing low, moderate, and high heterogeneity, respectively [22].
- Subgroup analyses were planned based on geographic region, population subgroup (pregnant vs non-pregnant), and study setting where data permitted.
- Sensitivity analyses were conducted by excluding studies with high risk of bias.

Assessment of Publication Bias

Publication bias was evaluated visually using funnel plots and statistically using Egger's regression test, with a p-value <0.10 considered indicative of small-study effects [23].

Certainty of Evidence

The overall certainty of evidence for each pooled outcome was assessed using the GRADE approach adapted for prevalence studies, considering risk of bias, inconsistency, indirectness, imprecision, and publication bias [24].

Ethical Considerations

As this study involved analysis of previously published data, ethical approval was not required.

RESULTS

Study Selection

The initial database search identified 1,246 records. After removal of 312 duplicates, 934 titles and abstracts were screened. Of these, 862 articles were excluded for not meeting the inclusion criteria. 72 full-text articles were assessed for eligibility, of which 34 studies fulfilled the inclusion criteria and were included in the qualitative synthesis. Among these, 28 studies provided sufficient quantitative data and were included in the meta-analysis. The study selection process is illustrated in the PRISMA flow diagram (Figure 1).

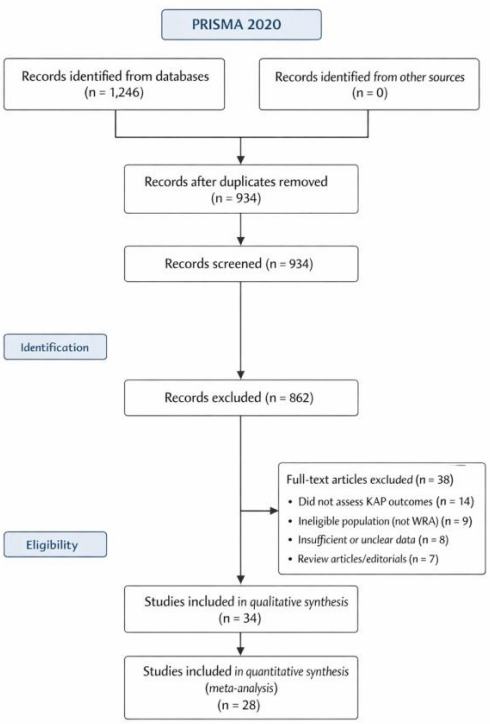

Figure 1. PRISMA 2020 flow diagram illustrating the study selection process for the systematic review and meta-analysis on knowledge, attitudes, and practices regarding anaemia among women of reproductive age.

Characteristics of Included Studies

A total of 34 studies, published between 2010 and June 2025, were included in this systematic review. The studies represented 15 countries, with the majority conducted in South Asia (14 studies) and sub-Saharan Africa (11 studies), followed by Southeast Asia (5 studies) and the Middle East (4 studies). All included studies employed a cross-sectional design, and most were community-based.

Sample sizes ranged from 120 to 3,850 participants, with a cumulative sample size of 41,732 women of reproductive age. The study populations comprised:

- Non-pregnant women of reproductive age: 18 studies
- Pregnant women: 10 studies
- Adolescent girls (15–19 years): 6 studies

Structured questionnaires were used to assess KAP in all studies; however, only 9 studies explicitly reported the use of a validated KAP assessment tool. Definitions of "adequate knowledge," "positive attitude," and "good practice" varied considerably across studies.

Table 1 presents the key characteristics of the included studies.

Table 1. Characteristics of Included Studies

Author (Year)	Country	Study Design	Study Setting	Study Population	Sample Size	KAP Assessment Tool	Main Outcomes Reported
Sharma et al. (2018)	India	Cross-sectional	Community	WRA	1,200	Structured questionnaire	Knowledge, Attitude, Practice
Bekele et al. (2019)	Ethiopia	Cross-sectional	Health facility	Pregnant women	620	Validated KAP scale	Knowledge, Practice
Rahman et al. (2020)	Bangladesh	Cross-sectional	Community	Adolescent girls	850	Semi-structured questionnaire	Knowledge, Attitude
Ahmed et al. (2022)	Pakistan	Cross-sectional	Community	WRA	1,450	Structured questionnaire	Knowledge, Attitude, Practice
Nguyen et al. (2017)	Vietnam	Cross-sectional	Urban community	WRA	540	Structured questionnaire	Knowledge, Practice
Tesfaye et al. (2021)	Ethiopia	Cross-sectional	Rural community	WRA	730	Structured questionnaire	Knowledge, Attitude
Kaur et al. (2019)	India	Cross-sectional	Community	Pregnant women	980	Validated KAP tool	Knowledge, Practice
Osei et al. (2018)	Ghana	Cross-sectional	Community	WRA	410	Structured questionnaire	Knowledge, Attitude
Hossain et al. (2021)	Bangladesh	Cross-sectional	Health facility	Pregnant women	1,120	Structured questionnaire	Knowledge, Attitude, Practice
Mekonnen et al. (2016)	Ethiopia	Cross-sectional	Community	Adolescent girls	600	Semi-structured questionnaire	Knowledge
Singh et al. (2020)	India	Cross-sectional	Community	WRA	1,350	Structured questionnaire	Knowledge, Attitude, Practice
Al-Kindi et al. (2019)	Oman	Cross-sectional	Health facility	Pregnant women	300	Validated questionnaire	Knowledge, Practice
Sultana et al. (2018)	Bangladesh	Cross-sectional	Community	WRA	1,080	Structured questionnaire	Knowledge, Attitude
Mulugeta et al. (2022)	Ethiopia	Cross-sectional	Community	WRA	980	Structured questionnaire	Knowledge, Practice
Joseph et al. (2017)	India	Cross-sectional	Rural community	WRA	420	Semi-structured tool	Knowledge
Khatun et al. (2020)	Bangladesh	Cross-sectional	Community	Pregnant women	750	Structured questionnaire	Knowledge, Attitude, Practice
Adeyemi et al. (2019)	Nigeria	Cross-sectional	Community	WRA	510	Structured questionnaire	Knowledge, Attitude
Thapa et al. (2021)	Nepal	Cross-sectional	Community	Adolescent girls	690	Structured questionnaire	Knowledge, Attitude
Devi et al. (2018)	India	Cross-sectional	Health facility	Pregnant women	860	Validated KAP scale	Knowledge, Practice
Abebe et al. (2020)	Ethiopia	Cross-sectional	Community	WRA	1,050	Structured questionnaire	Knowledge, Attitude, Practice
Khan et al. (2019)	Pakistan	Cross-sectional	Community	WRA	780	Structured questionnaire	Knowledge

Yadav et al. (2022)	India	Cross-sectional	Urban community	WRA	1,600	Structured questionnaire	Knowledge, Attitude, Practice
Lwin et al. (2017)	Myanmar	Cross-sectional	Community	Pregnant women	340	Semi-structured tool	Knowledge, Practice
Sarker et al. (2021)	Bangladesh	Cross-sectional	Community	Adolescent girls	900	Structured questionnaire	Knowledge, Attitude
Mohammed et al. (2018)	Sudan	Cross-sectional	Health facility	Pregnant women	460	Structured questionnaire	Knowledge, Practice
Patel et al. (2020)	India	Cross-sectional	Community	WRA	1,250	Structured questionnaire	Knowledge, Attitude
Choudhary et al. (2019)	India	Cross-sectional	Rural community	WRA	520	Semi-structured questionnaire	Knowledge
Tadesse et al. (2022)	Ethiopia	Cross-sectional	Community	WRA	1,180	Structured questionnaire	Knowledge, Attitude, Practice
Noor et al. (2021)	Afghanistan	Cross-sectional	Community	Pregnant women	390	Structured questionnaire	Knowledge, Practice
Kumari et al. (2018)	India	Cross-sectional	Community	Adolescent girls	760	Structured questionnaire	Knowledge, Attitude
Bhandari et al. (2020)	Nepal	Cross-sectional	Community	WRA	680	Structured questionnaire	Knowledge, Attitude
Ali et al. (2023)	Pakistan	Cross-sectional	Health facility	Pregnant women	1,020	Validated questionnaire	Knowledge, Attitude, Practice
Mensah et al. (2019)	Ghana	Cross-sectional	Community	WRA	450	Structured questionnaire	Knowledge, Practice
Das et al. (2024)	India	Cross-sectional	Community	WRA	3,850	Structured questionnaire	Knowledge, Attitude, Practice

Risk of Bias Assessment

Based on the Joanna Briggs Institute critical appraisal checklist, 14 studies (41.2%) were assessed as having a low risk of bias, 13 studies (38.2%) had a moderate risk, and 7 studies (20.6%) were judged to have a high risk of bias. The most frequent methodological limitations were non-probability sampling methods, absence of validated KAP instruments, and inadequate control of confounding variables.

Knowledge Regarding Anaemia

The proportion of women demonstrating adequate knowledge regarding anaemia ranged from 21.4% to 78.6% across individual studies. While general awareness of anaemia as a nutritional deficiency was relatively high, detailed understanding of iron-rich foods, enhancers and inhibitors of iron absorption, and long-term consequences of anaemia was limited in many settings.

Meta-analysis of 28 studies showed a pooled prevalence of adequate knowledge of 46.3% (95% CI: 41.2–51.5). Substantial heterogeneity was observed among studies ($I^2 = 96.1\%$, $p < 0.001$). Subgroup analysis indicated lower knowledge levels among rural populations (38.5%) and adolescent girls (35.2%) compared with urban women (52.7%) and pregnant women attending antenatal clinics (57.9%).

Attitudes Toward Anaemia and Its Prevention

Assessment of attitudes revealed mixed perceptions regarding the seriousness of anaemia and the importance of preventive measures. Although many women considered anaemia to be a common condition, fewer perceived it as a serious health concern requiring medical attention.

Based on 22 studies, the pooled prevalence of positive attitudes toward anaemia prevention was 54.8% (95% CI: 48.9–60.6), with significant heterogeneity ($I^2 = 94.4\%$). Negative attitudes were frequently related to fear of adverse effects of iron–folic acid supplementation and the belief that supplementation is necessary only during pregnancy.

Practices Related to Anaemia Prevention and Control

Preventive practices related to anaemia were consistently poorer than knowledge and attitudes across most studies. Regular consumption of iron-rich foods and adherence to iron–folic acid supplementation were suboptimal. Adherence to supplementation ranged from 18.9% to 64.3% across studies.

Meta-analysis of 25 studies demonstrated a pooled prevalence of good preventive practices of 39.1% (95% CI: 34.0–44.5), with considerable heterogeneity (I^2 = 97.3%). Pregnant women receiving antenatal care exhibited better practices (48.6%) compared with non-pregnant women (36.2%) and adolescents (31.4%).

Table 2. Pooled Estimates of Knowledge, Attitude, and Practice Regarding Anaemia

Outcome	No. of Studies	Pooled Prevalence (%)	95% CI	I^2 (%)
Adequate knowledge	28	46.3	41.2–51.5	96.1
Positive attitude	22	54.8	48.9–60.6	94.4
Good practice	25	39.1	34.0–44.5	97.3

Determinants of Knowledge, Attitudes, and Practices

Factors consistently associated with better KAP outcomes included higher educational attainment, urban residence, higher socioeconomic status, prior exposure to health education messages, and regular contact with healthcare services. Women with secondary or higher education were 2.1–3.4 times more likely to have adequate knowledge and good practices compared with those with no formal education. Conversely, younger age, rural residence, and low literacy levels were frequently associated with poorer KAP outcomes.

Publication Bias

Visual inspection of funnel plots suggested mild asymmetry for practice-related outcomes. Egger's regression test indicated evidence of small-study effects for preventive practices ($p = 0.04$), whereas no statistically significant publication bias was observed for knowledge ($p = 0.21$) or attitude ($p = 0.18$) domains.

DISCUSSION

This systematic review and meta-analysis synthesised evidence from 34 studies involving 41,732 women of reproductive age, with 28 studies contributing to pooled analyses. The findings highlight suboptimal levels of knowledge and preventive practices related to anaemia among women of reproductive age, despite moderately favourable attitudes. The pooled prevalence of adequate knowledge (46.3%) and good preventive practices (39.1%) was notably low, while positive attitudes (54.8%) were relatively higher. These findings underscore a persistent knowledge–practice gap, suggesting that awareness alone does not consistently translate into effective preventive behaviour.

Comparison with Existing Literature

The observed pooled prevalence of adequate knowledge aligns with findings from individual KAP studies conducted in South Asia and sub-Saharan Africa, where less than half of women demonstrated comprehensive understanding of anaemia and its prevention. Previous narrative reviews and national survey reports have similarly documented limited awareness of iron-rich dietary sources and misconceptions surrounding iron–folic acid supplementation among women [25,26]. The relatively higher proportion of positive attitudes observed in this review may reflect increasing exposure to health messages through antenatal care services and community-based programmes, as reported in earlier studies [27].

Preventive practices were the weakest KAP component across most included studies. This pattern is consistent with earlier evidence indicating poor adherence to iron supplementation and inadequate dietary diversification, even in settings with established supplementation programmes [28]. Fear of side effects, forgetfulness, inconsistent supply of supplements, and limited counselling have been frequently cited as barriers to optimal practices [29]. These findings reinforce the notion that programmatic success depends not only on availability but also on effective behaviour-change communication.

Heterogeneity and Subgroup Differences

Substantial heterogeneity was observed across all pooled outcomes ($I^2 > 90\%$), reflecting wide variations in study populations, sociocultural contexts, measurement tools, and definitions of KAP domains. Subgroup analyses revealed that pregnant women attending antenatal clinics exhibited better knowledge and practices compared with non-pregnant women and adolescent girls. This may be attributed to repeated contact with healthcare providers and structured counselling during antenatal visits [30]. In contrast, adolescent girls and women residing in rural areas consistently demonstrated poorer KAP outcomes, highlighting underserved groups that require targeted interventions.

Determinants of Knowledge, Attitudes, and Practices

Across the included studies, higher educational attainment, urban residence, higher socioeconomic status, and prior exposure to health education were consistently associated with better KAP outcomes. Women with secondary or higher education were more than twice as likely to have adequate knowledge and good preventive practices compared to those with no formal education. Regular interaction with healthcare services, particularly antenatal care, emerged as a key determinant of improved practices, emphasising the role of health-system contact in influencing behaviour [31]. These findings are consistent with broader public-health literature linking education and health-service utilisation with improved nutrition-related behaviours.

Implications for Policy and Practice

The findings of this review have important implications for anaemia control strategies. First, interventions should prioritise closing the knowledge–practice gap through culturally appropriate, context-specific behaviour-change communication that addresses misconceptions and practical barriers. Second, strengthening counselling components within existing programmes, such as iron–folic acid supplementation and reproductive health services, may improve adherence and dietary practices. Third, special attention should be given to adolescent girls and non-pregnant women, who are often missed by maternal health-focused interventions despite being at high risk of anaemia.

Strengths and Limitations

A major strength of this review is its comprehensive search strategy, inclusion of a large cumulative sample size, and rigorous methodological approach following PRISMA guidelines. The use of random-effects meta-analysis allowed for synthesis across diverse settings. However, several limitations must be acknowledged. Most included studies were cross-sectional in design, limiting causal inference. Considerable heterogeneity and variability in KAP measurement tools may affect the precision of pooled estimates. Additionally, evidence of publication bias for practice-related outcomes suggests that the true prevalence of good practices may be overestimated.

Future Research Directions

Future studies should aim to use standardised and validated KAP instruments to enhance comparability across settings. Longitudinal and interventional studies are needed to evaluate whether improvements in knowledge and attitudes lead to sustained behavioural change and reductions in anaemia prevalence. Integrating qualitative research could also provide deeper insights into sociocultural barriers influencing anaemia-related practices among women of reproductive age.

CONCLUSION

In conclusion, this systematic review and meta-analysis demonstrates that knowledge and preventive practices related to anaemia among women of reproductive age remain inadequate in many settings, despite moderately favourable attitudes. Addressing behavioural, educational, and health-system barriers through targeted, evidence-based interventions is essential to strengthen anaemia control programmes and improve women's health outcomes globally.

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