

TITLE: Impact of behavior change communication and social marketing strategies to improve compliance to iron-folic acid supplementation in low- and middle-income countries (LMICs): A mixed-method rapid review

AUTHORS

Neha Gupta¹, Bhumika TV¹, Rasmi Avula², Samuel Scott², Binita Sharma¹, Soyra Gune², Monisha Lakshminarayanan¹, Sylvia Musinzi¹, Kashish Vohra³, Kapil Yadav³, Howard White¹

Affiliations:

1 Campbell South Asia, New Delhi, India

2 IFPRI, New Delhi, India

3 NCEAR A, AIIMS, New Delhi

ABSTRACT

Anemia exists at high levels and in multiple population groups in India. This paper reviews the evidence on the impact of behavior change communication (BCC) and social marketing interventions on reducing anemia and on improving compliance to iron folic acid supplements in LMICs. The review used the adapt, agree, and act framework based on the transtheoretical model for examining the causal process. The review followed a systematic search, screening, coding, and critical appraisal process. A PubMed search and a hand search of relevant websites and journals was followed by screening of 15,744 titles, abstracts, and full text based on the criteria outlined in a population, intervention, comparison, outcome, and study design (PICOS) framework. A total of 29 articles met the criteria for inclusion.

The BCC messages in the included studies focused on the following: the preparation of food mixed with MNPs, food preparation demonstrations, and the MNP/IFAS dosing schedule. Different modes were used to impart BCC to the target population including reminder/adherence cards, radios, billboards/banners, community-based activities such as games and contests, attractive branding and names for supplements/communication programs, public broadcast system, key messages printed on t-shirts, videos, and modification of packaging of iron tablets, and text messaging via mobile phones.

The review adopted meta-analysis and thematic synthesis approach to analyze the quantitative and qualitative data. The review identified that the causal process through which the interventions have an impact on the outcome is by making the individuals or target population aware or agree about the topic/issue/concern. The change in awareness level after intervention has been studied as knowledge outcomes. This is followed by the **act** mechanism wherein, the target population who have received the intervention adopts a particular behavior (improved adherence/compliance to IFA/MNP regime) (pooled effect d-1.18; 95% CI- 0.61, 1.76). This had an impact on reducing the levels of anemia and improving hemoglobin levels (pooled effect d- 0.76; 95% CI: 0.38, 1.14). The themes identified from the thematic synthesis is as follows: availability, accessibility and adherence to supplements; knowledge, communication and engagement; and programmatic and implementation challenges. Overall, it shows that there is a positive impact of the BCC or social marketing strategies in improving the compliance of IFAS or MMN supplements.

KEYWORDS

Anemia, behavior change communication, rapid review, compliance, IFA supplement

BACKGROUND

Anemia continues to be a major global public health issue, currently affecting more than 40% of children and women of reproductive age worldwide (World Health Organization [WHO], 2023). The burden is particularly severe in low- and middle-income countries (LMICs), where 57% of children under the age of five and 40% of women of reproductive age are anemic (WHO, 2023). In these settings, anemia significantly contributes to maternal and child mortality and is closely associated with adverse outcomes such as low birth weight, cognitive impairment, delayed mental and physical development, and increased vulnerability to infections (Balarajan et al., 2011; Stoltzfus, 2001). The causes of anemia are multifactorial, ranging from inadequate dietary intake of essential micronutrients (e.g., iron, folate, vitamins A and B12) to the presence of infectious diseases and chronic health conditions (Kassebaum et al., 2014). Additional contributing factors include menstrual history, gastrointestinal symptoms, medication use, and blood donation. Social determinants such as poverty, gender inequality, poor access to healthcare and education, and the broader impacts of climate change further compound the issue (McLean et al., 2009; Osendarp et al., 2021). These interconnected factors underscore the need for integrated, multisectoral strategies to effectively address anemia.

Despite the well-documented benefits of iron and folic acid (IFA) supplementation in reducing anemia, adherence to supplementation remains low in many high-coverage settings. For instance, research by Sununtnasuk et al. (2016) found that although 81% of pregnant women received IFA supplements, only 8% adhered to the recommended dosage. Adherence—defined as the degree to which a patient's behavior aligns with healthcare provider recommendations—is influenced by multiple barriers. These include limited awareness of the health benefits of IFA, concerns about side effects, issues of availability due to stockouts or affordability, inconsistent consumption caused by the unpleasant taste or odor of supplements, cultural beliefs, stigma, and logistical and psychosocial challenges (Taye et al., 2015; Gebreamlak et al., 2017). Addressing these barriers requires targeted and context-specific strategies such as community engagement, healthcare worker training, and comprehensive educational campaigns.

The transtheoretical model (TTM) elucidates the theory of behavior change by delineating stages such as pre-contemplation, contemplation, preparation, action, and maintenance (Prochaska and Velicer, 1997). The "Aware, Agree, Act" framework (Figure 1), rooted in the transtheoretical model, delineates the causal pathway through which behavior change strategies operate to enhance initial behavior improvement, ultimately leading to the mitigation of adverse outcomes (Storey et al., 2011). Behavior Change Communication (BCC) involves an interactive process with communities, integrating various communication channels to deliver tailored messages and approaches that promote positive behavior by enhancing motivation at the individual and community levels, stimulate societal and community dialogues, foster essential attitude changes, mitigate disparities, and address demand-side barriers [Figure 1].

There are systematic reviews to understand the effects of traditional fortification and supplementation programs, deworming, and antimalarial interventions to address anemia. However, there is a gap in the understanding of different behavior change communication strategies and their role in addressing anemia. Thus, the present rapid mixed-method review was conducted to understand the impact of BCC and social marketing in improving adherence to IFA and multi-micronutrient supplements and reducing anemia prevalence.

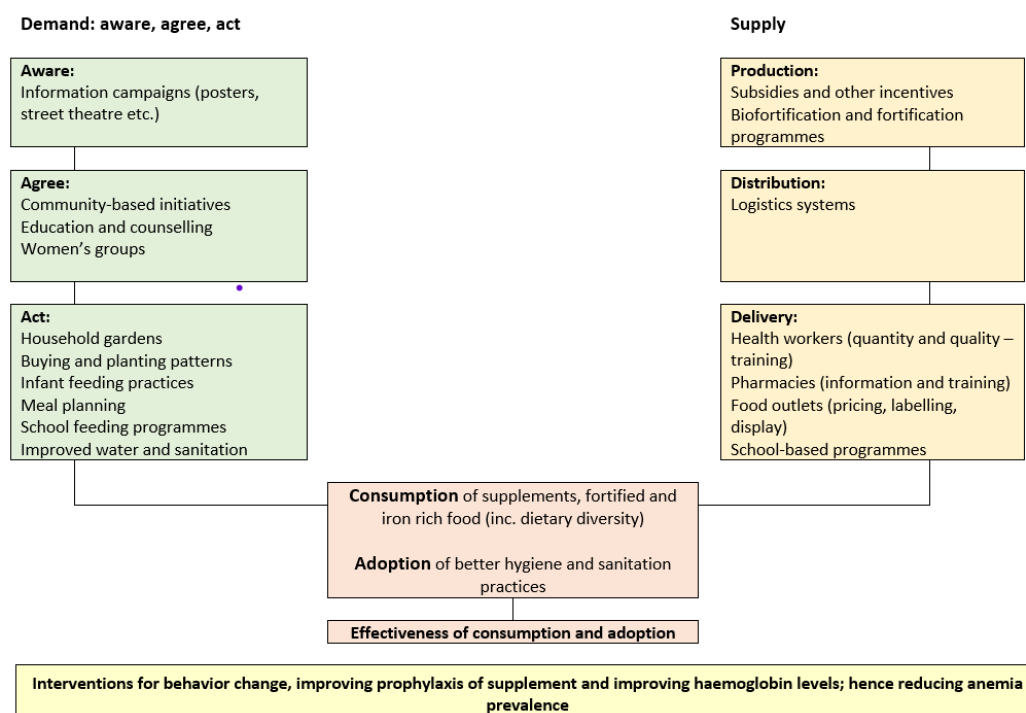


Figure 1: Conceptual framework based on the transtheoretical model describing the aware, agree and act principle

METHODOLOGY

This study employed a mixed-method systematic review approach to comprehensively assess interventions aimed at enhancing adherence to micronutrient supplements, with a specific focus on those containing iron and folic acid (IFA) multi-micronutrient supplements. The quantitative methodology utilized a combination of quantitative and qualitative approaches to offer a nuanced understanding of the factors influencing adherence across diverse population groups.

Inclusion Criteria

The Population, Intervention, Comparison, Outcomes, and Study Design (PICOS) framework guided the establishment of eligibility criteria.

Population encompassed various groups, including adolescent girls, adolescent boys, women of reproductive age, pregnant and lactating women, children (6 months-9 years), frontline workers/health workers, and other program-level staff. Studies involving individuals older than 49 years were excluded. This age group was not part of the national anemia program and hence were not included in the review. The studies were restricted to low and middle-income countries.

Interventions targeted behavior change communication, counseling, and social marketing strategies to enhance compliance with micronutrient supplements containing IFA. Food fortification interventions, excluding point-of-use micronutrient power, and interventions

addressing non-nutritional causes of anemia were beyond the scope of this review. For impact evaluations, studies with a valid comparison group were chosen, excluding pre-post intervention studies with no control groups. For the process evaluations, the presence of the comparison group was not the only criterion.

Intervention domains
Education counseling using any predefined education model (example PRECEDE education model), video-based education, text messaging via mobile phones, counselling sessions, training sessions
Social marketing strategies – improved packaging of iron tablets, create an attractive name, image, organization of games and contests in the community
Distribution of supplements combined with behavior change counselling approaches

Outcome included improved levels of hemoglobin, reduced levels of anemia, and increased adherence to supplements. Intermediate outcomes included improved knowledge levels regarding different aspects of anemia, and increased number of antenatal care (ANC) visits.

Outcome domain	Sub-domain
Consumption and adherence to MMP and iron supplement	Availability of supplement at Health Centre, supplement received during ANC visits, Type of supplement consumed - as syrup or tablets, frequency of consumption - ever consumed or past 7 days, number of doses
Maternal knowledge	Ever heard about supplements, identify reasons for iron deficiency, knowledge/ attitudes/ intentions regarding supplements and causes of iron deficiency anemia, identify clinical signs & symptoms of anemia, subjective norms, behavioral intention, and performance; knowledge about supplementation
Improved biochemical levels	Hemoglobin, hematocrit, ferritin, number of individuals with anemia
Service utilization	Timing of first ANC visit, total number of ANC visits during pregnancy

Study Designs, Language, and Timeline: Eligible studies were impact evaluations with any evaluative component, experimental studies (RCTs, quasi-experimental studies, PSM, RDD), difference-in-difference studies, interrupted time series, and completed process evaluations, whether qualitative, quantitative, or both. Additionally, observational studies with qualitative components were considered. Studies published in English from 2000 to the present were reviewed.

Exclusion criteria comprised impact evaluations lacking implementation outcomes of interest and a valid comparison group. Descriptive studies without measurement or implementation outcomes were also excluded.

Search Methods: A search strategy based on PICOS was developed and executed on the PubMed database in April and May 2023. Articles published between January 2000 and April 2023 were examined. Additional hand searches were conducted in the archives of relevant journals from 2017 to 2023, including Lancet Global Health, WHO Bulletin, BMJ Global Health, American Journal of Clinical Nutrition, Advances in Nutrition, BMC Public Health, Journal of Nutrition, PLOS One, Maternal and Child Nutrition, Public Health Nutrition, and Health Policy and Planning. Websites such as WHO, BMGF, Open Grey, Google Scholar, IFPRI, Nutrition International, Micronutrient Forum, and UNICEF were also explored. Table S1 lists the detailed search strategy used for the review.

Screening of Studies: The Eppi Reviewer software facilitated the screening, data extraction, and critical appraisal processes. The articles were screened based on title and abstract, followed by full-text screening for those meeting the criteria. The screening was guided by a screening tool [Table S2]. Two independent reviewers screened each article, with any discrepancies reconciled. If there were any disagreements, then they were reviewed and resolved by the third-party reviewer. The PRISMA diagram [Figure 2] illustrates the number of articles at each screening stage.

Data Extraction: The data was extracted from the studies based on PICOS by two independent reviewers. The data extraction was guided by a data extraction tool. The tool was designed and pilot tested to extract the following information: study design, geography, study characteristics, intervention details, and outcome characteristics, including stakeholder quotes. Table S3 details the data coding tool being used for the review.

Critical Appraisal: Quality assessment tools specific to process evaluations and effectiveness studies were employed (Ref-Keenan and White) to assess the confidence in the study findings. Two reviewers independently assessed each study's quality, followed by reconciliation of any differences. Process evaluations were assessed for appropriateness of methodology, recruitment and sampling strategy, ethical considerations, rigor of data analysis, relevancy of recommendations, and availability of information on intervention. Effectiveness studies were evaluated for intervention description, baseline balance, study design, validation and definition of outcomes, and blinding of participants. The tools follow the 'weakest link principle' whereby if a study scores low in any one of the items on the checklist, the overall study confidence for that study is marked as low. Overall, studies were rated as high, medium, or low quality [Table S4 & S5].

Data Analysis

Quantitative Studies: The primary unit of analysis for the quantitative data within the studies of interest is the individual. Multiple papers or reports based on the same study or data were treated as a single case for purposes of this review, which fits with our proposed approach to mixed methods analysis, described below, in which the unit of analysis was the case, not the paper. The study was only considered a separate case if the research sample did not include participants in any other coded study. A meta-analysis was conducted using the standardized mean difference for continuous variables. Effect size calculations were performed using the Campbell online effect size calculator (Wilson, no date). We used the random effects model to conduct meta-analysis and any subgroup analysis. The heterogeneity between effect sizes studies was assessed by reporting the I^2 . Forest plots were generated for a visual representation of pooled effect size. A total of 12 impact evaluations were included in the

review. These effect sizes were derived from a total of 11 studies. Two studies used the same sample for the analysis and hence only one was considered for extracting effect sizes.

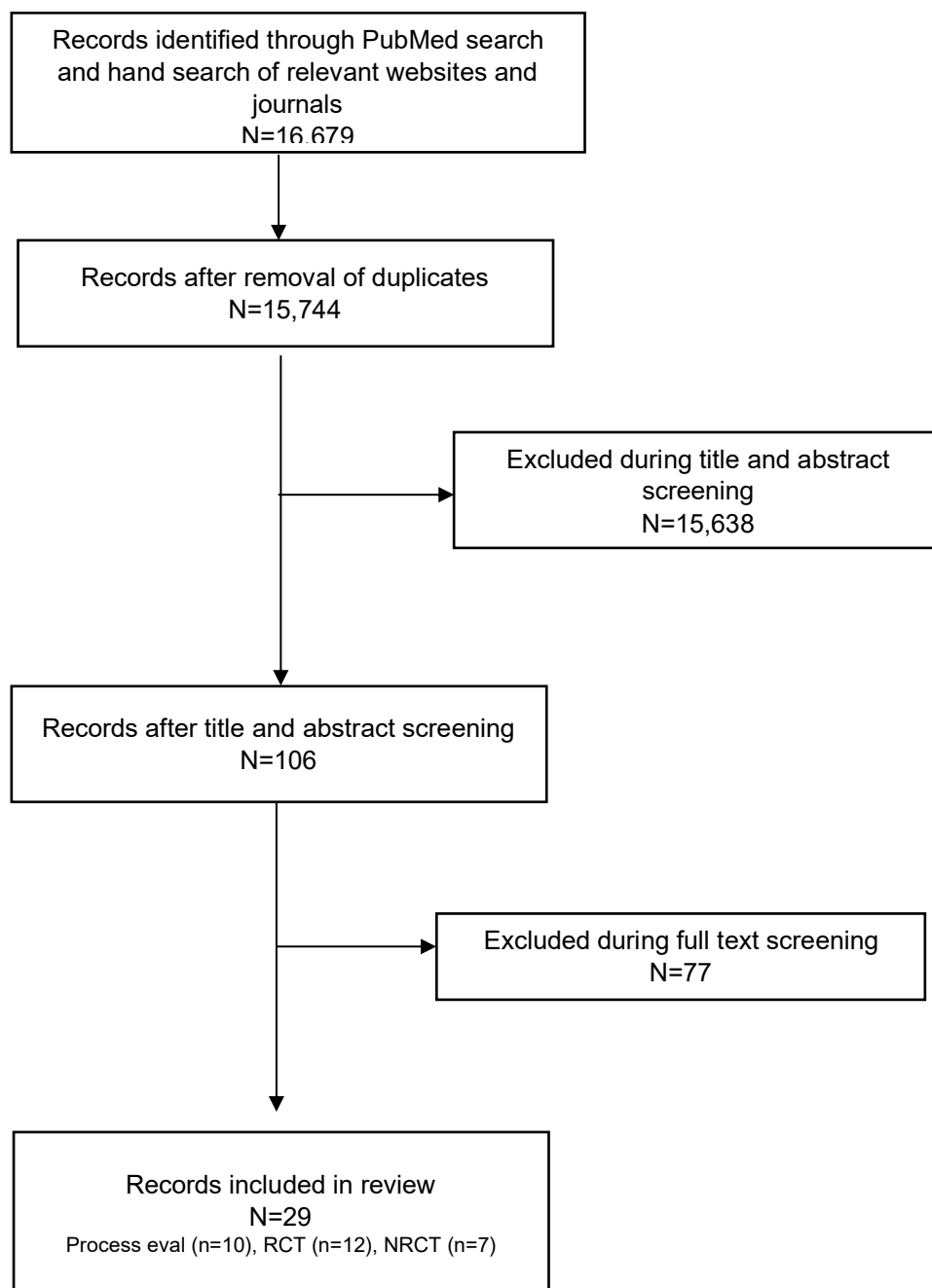


Figure 2: PRISMA Flowchart

Qualitative studies: We used thematic synthesis to analyze the data. All process and Impact evaluations that were included in the studies were manually coded by two independent reviewers. The authors conducted line-by-line coding of each study and identified concepts about the impact of behavior change communication interventions on adherence to supplements. Two authors reviewed the included papers and discussed and revised the preliminary synthesis until all the authors agreed that an extensive depth of data was included in the analysis. All the discrepancies were resolved through discussion and the involvement of a third reviewer. The Participants/stakeholders' quotations and texts under the results/findings or discussions sections from the included studies were extracted, and the patterns/concepts across the studies were observed. The identified concepts were then grouped into codes and sub-codes and once the codes were finalized, the cluster of selective codes was further sorted into potential themes and subthemes based on review and discussions.

RESULTS

In this mixed-methods review, we included a total of 29 studies [Table S6]. Of these 12 were impact evaluations (Hoddinott, Khani, Kone, Kurzawa, Senanayake, Sharifirad, Sharma, Singh, Thaver, Kamau, Kamau, Madestria); process evaluations (n=10) (Kanal, Khan, Martin, Martin b, Omotayo, Phuc, Roche, Shet, Srivastava, Garcia), observational designs (n=7) (Ford, Gunnala, Lutsey, Lyoba, Shah, Ugwu, Gross). Descriptions of PICOS and critical appraisals for the included studies are provided in Table 1, 2, 3 & S7.

Geographical Distribution and Settings:

The 30 studies were distributed across different regions: South Asia (n=15), Sub-Saharan Africa (n=6), East Asia and Pacific (n=4), Middle East and North Africa (n=4), and South America (n=1). The countries where the highest number of studies have been conducted include Kenya (n=4), India (n=3), and Nepal (n=3). More than half of the studies were conducted in rural settings (n=17), while the rest were carried out in both rural and urban areas (n=9) [Table 1].

Population, Interventions, Outcomes, and Study Designs (PICOS):

The majority of the studies focused on pregnant women (n=16), with other target groups including adolescents (n=7), children under five years (n=4), women of reproductive age (n=7), and frontline workers (n=4). Approximately 10 studies included multiple population groups [Table 1].

The most studied interventions were Behavior Change Communication (BCC) (n=24) and Iron and Folic Acid (IFA) supplementation (n=23). In terms of behavior change communication, the program broadly focused on capacity building of the frontline workers, which includes nurses, community health volunteers, lay health workers, and community nutrition workers. It enabled them to deliver effective counseling measures and health education activities in the community. They were also provided with reading materials such as counseling guides and booklets. Skill-building training programs were also organized for District Health staff in forecasting, procuring, and supplying IFA supplements in the community. Further, the Health workers organized numerous preventive & promotive programs through the utilization of monthly mother meetings, ANC clinics, and home visits, and generated awareness on the prevention of anemia and the importance of IFA supplement consumption and adherence, focusing on the target beneficiaries. MNP brochures and reminder cards were distributed to

the target group. Also, Social marketing strategies and community mobilization approaches were adopted, wherein mini-Olympics, games, and contests were organized in the community. Innovative activities were developed, such as creating an attractive name, image and packaging for the supplement. In one of the studies, a facilitator's house was marked with a blue flag to indicate to the beneficiaries the location from where they could collect the IFA supplement and communication materials, T-shirts were distributed to the facilitators to identify them as resource persons. IEC materials such as leaflets, flipcharts, posters, newsletters, and streamers were opted for dissemination of messages, even loudspeakers cars, and billboards were utilized. Advertising media such as TV, radio, Print, and other information advertorials were also been taken advantage of. Furthermore, mHealth was implemented to aware pregnant women on MCH service utilization and dietary habits. Regarding, IFA supplement intervention, the programs were centered on the distribution of IFA supplements free of cost and the behavior change communication strategies as discussed above. The details of the PICOS are shared in Table 1.

Critical Appraisal of Included Studies:

For process evaluations (n=10), most were rated as low quality (n=7) due to omissions of information on researchers' positions, assumptions, and biases. Among the 12 effectiveness studies, ratings were either low (n=6) or medium (n=6), with many studies ranked low due to attrition (Table 2-3).

Table 1: Description of the Population, Intervention, Comparator, Outcome and study design (PICO) of the included studies (n=30)

Author (Year)	Population	Intervention	Comparator	Outcome	Study design	Location
Ford (2020)	U5CH, WRA	Distribution of MNP at facilities, counselling of caregivers on preparation of food mixed with MNP, food preparation demonstration, MNP dosing schedule and education on IYCF practices.	NA	MNP sachet coverage, MNP consumption, Prevalence of anemia, Prevalence of Iron deficiency anemia	Population based cross sectional surveys	Uganda
Garcia (2005)	WRA, PW	Organization of Social marketing Program which includes community activities such as games, Mini Olympics , Ms. Femina contest and School activities to generate awareness among adolescent girls. Utilisation of advertising media and IEC materials.	NA	Awareness of Iron and folic acid supplement , Doctors and consumers perception and feedback on the supplements.	Non-experimental impact evaluation	Philippines
Gross (2006)	U5CH, Adol girls, WRA	Distribution of MNP accompanied by a communication programme.	NA	Acceptability of the supplements and compliance. Knowledge Of micronutrients.	Formative research	Peru
Gunnala (2017)	U5CH	Distribution of MNP brochure and reminder card for each MNP distribution. Media such as radios, billboards/banners were utilized for education purpose. MNP and IYCF counselling were delivered.	NA	MNP acceptability and pricing attitude, Perceived barriers and facilitators to MNP intake	Cross sectional household survey	Nepal
Hoddinott (2018)	U5CH, WRA	Cash transfer services and behavior change activities were conducted.	Multiple arms-Cash transfer alone, food distribution, cash transfer and food distribution and no treatment	Knowledge and awareness regarding consumption of micronutrient supplement, child consumption of micronutrient supplement and other iron supplements.	Experimental Impact Evaluation (RCT)	Bangladesh
Kamau (2019)	PW	Training of Community Health Volunteers on IFAS programmes, IFAS health education and distribution of supplements.	Refresher training on IFAS to	Knowledge and attitude towards IFAS, proportion of women	A pre test post test quasi	Kenya

Author (Year)	Population	Intervention	Comparator	Outcome	Study design	Location
			health care workers	counselled on various IFAS aspects.	experimental design	
Kamau (2020)	PW	Training of Health care providers and distribution of IFAS supplements along with counselling sessions.	Only distribution of IFA supplements at ANC clinics	Compliance with IFA supplement	Pre test- post test quasi experimental study	Kenya
Kanal (2005)	Adol, WRA	Social marketing , community mobilization approaches, school based activities for awareness generation and peer educator training were conducted followed by establishment of WIFAS committee in schools.	NA	Knowledge about anemia and IFA supplements. IFA consumption and compliance.	Process evaluation	Cambodia
Khan (2005)	WRA, PW	Distribution of IFA supplement, Social mobilization activities, Training to Commune health workers, medical doctors and members of the district steering committee.	NA	Knowledge, attitude, and practices about anemia. Perception on IFA supplements after consumption. Reported buying and using IFA supplements.	Process evaluation	Vietnam
Khani (2021)	PW	Training program (6 sessions) on anemia in pregnancy , involvement of Spouses. Distribution of educational CDs and booklets.	Received routine training from health care providers and educational booklet	Knowledge, attitude, perceived behavioral control and nutritional performance	Quasi experimental design	Iran
Koné (2023)	PW	Organization of three days workshop for training purpose. Distribution of supplements.	No training and supplements delivery	Prevalence of anemia, IFA compliance, ANC coverage, changes in Hb level.	Experimental Impact Evaluation (RCT)	Cote d'Ivoire

Author (Year)	Population	Intervention	Comparator	Outcome	Study design	Location
Kurzawa (2021)	PW, FLW	Training of frontline workers on IFA supplementation and BCC strategies, IPC , counselling methods. Supply chain management training for District Supervisory level staff, ongoing supportive supervision.	Consumption of IFA supplement, provision of IFA supplement and assumed month of pregnancy to initiate IFA supplement	IFA supplement consumption, provision of IFA supplements, ANC visits in last pregnancy, IFA compliance	Quasi-experimental impact evaluation	Bangladesh
Lutsey (2008)	PW	Training, distribution of IFA supplements and nutritional counselling.	NA	Difference in Hb concentration IFA consumption and compliance	Cross sectional interviews	Philippines
Lyoba (2020)	PW	Interviews were conducted with the target population to assess factors associated with IFAS adherence among pregnant women.	NA	Adherence to IFAS, Knowledge of anemia, Knowledge of IFA supplementation Perception of the quality of services	Cross sectional design	Tanzania
Madestria (2021)	Adol girls	Educational media was developed and delivered which includes video and Modification of iron Tablet Packaging.	Only video	Knowledge and attitude towards iron tablet consumption	Quasi experimental pre test post test control design.	Indonesia
Martin (2017)	PW, lactating, FLW	Behavior change communication strategies involved development of semi-structured interview guides which included broadly on ANC services and perception of micronutrient supplements.	NA	Barriers to IFA consumption and its adherence. Knowledge of FLWs on IFA supplements Provision of IFA supplements at health facilities	Process evaluation	Kenya

Author (Year)	Population	Intervention	Comparator	Outcome	Study design	Location
Martin (2017)	PW	Home visits, distribution of calcium and IFA supplements, counselling and provision of regimen calendars.	NA	Role of adherence partner on improving IFA adherence. Acceptance of participants to try an adherence partner.	Process evaluation	Ethiopia
Omotayo (2018)	PW	Training , counselling and continuous mobilization to attend ANC clinic. Distribution of IFA supplements and BCC materials.	NA	Availability of supplements and counselling aids at facility level. Provision of IFA supplements to PW during ANC visits. IFA compliance	Process evaluation	Kenya
Phuc (2009)	WRA, PW	Training of trainers sessions for nurses and VHWs. Free monthly supply of iron tablets and albendazole tablet, provision of IEC materials, reminder calendars to participants, improved packaging, incentives.	NA	IFA compliance Anemia and hookworm prevalence	Process evaluation	Vietnam
Roche (2018)	Adol girls	Increasing awareness on WIFAS, supply of IFA supplements, supportive supervision and providing resources through joint advocacy meetings.	NA	Anemia prevalence IFA supply chain management Knowledge and skills of manpower involved. Effects of multisectoral involvement in the programme	Process evaluation	Indonesia
Senanayake (2010)	PW	Education session that focused on IFA supplementation and improving bioavailability.	Control group received routine ANC care.	Mean Hb, serum ferritin level Number of anemic and low serum ferritin	Quasi experimental design	Srilanka
Shah (2016)	Adol girls	Awareness sessions , distribution of IEC materials. Peer educators training and incentives.	NA	Prevalence of anemia IFA compliance	(Cross sectional study)	India

Author (Year)	Population	Intervention	Comparator	Outcome	Study design	Location
Sharifirad (2011)	Adol girls	Organization of 4 training sessions based on PRECEDE model and pamphlets, booklets were provided.	No training	Knowledge, attitude and practice on iron deficiency anemia. Hemoglobin level, Hematocrit level, serum ferritin level	Quasi experimental design	Iran
Sharma (2016)	PW, lactating	An evidence based maternal health promotion was designed. A participatory activities and health promotion activities were conducted.	NA	IFA consumption during pregnancy. Utilization of ANC services Health seeking behaviour	Quasi-experimental impact evaluation	Nepal
Shet (2017)	FLW	Training of Lay health workers on anemia, nutrition, IFA supplementation and distribution of IFA supplements. Observational assessment, counselling and education sessions were conducted.	NA	Perception on anemia control interventions Barriers and facilitators to IFA supplementation	Process evaluation	India
Singh (2020)	PW	Capacity building of Female Community Health Volunteers (FCHV), text messaging via mobile phone on MCH service utilization and dietary intake.	Regular ANC services	Difference in Hb level before and after intervention in both groups. Knowledge regarding anemia and other health issues.	Experimental Impact Evaluation (RCT)	Nepal
Srivastava (2015)	PW	Social mobilization activities were carried out for demand generation of IFA tablets ,orientation meeting of registered medical practitioners (RMPs), sensitization meeting for opinion leaders, etc. organization of School based awareness activities.	NA	Knowledge attitude towards IFA supplement. Prevalence of anemia Difference in mean Hb level before and after intervention.	Process evaluation	India
Thaver (2020)	Adol girls, WRA, PW	Training of LHWs ,distribution of MMN Supplements, deworming, health and nutrition education-individual counselling and monthly follow up visits.	Nutrition education	Change in mean Hb level 1 st /2 nd /3 rd visit	Quasi experimental study	Pakistan

Author (Year)	Population	Intervention	Comparator	Outcome	Study design	Location
Ugwu (2014)	PW	NA	NA	IFA compliance Reported Side effects of IFA supplements Knowledge regarding IFA supplementation Factors that facilitate compliance to IFA supplementation	Cross sectional survey	Nigeria

PW- Pregnant women; FLW- Frontline workers; WRA- Women of Reproductive age; U5CH- Under 5 children; Adol-Adolescent; IFA- Iron and folic acid; BCC- Behaviour Change Communication; Hb- Hemoglobin

Table 2: Critical appraisal of the effectiveness studies included in the review

Author Name	1*	2*	3*	4*	5*	6*	7*	8*	Overall*
Hoddinott (2018)	High	Medium	High	High	Medium	High	Medium	Medium	Medium
Kamau (2019)	High	High	High	High	Medium	High	Medium	Medium	Medium
Kamau (2020)	High	High	High	High	Medium	High	Medium	Medium	Medium
Khani (2021)	Medium	Low	Low	High	Medium	Low	Low	Medium	Low
Koné (2023)	Medium	Medium	Medium	High	Medium	High	Medium	Medium	Medium
Kurzawa (2021)	High	Medium	High	Medium	Medium	High	Medium	Medium	Medium
Madestria (2021)	Medium	Low	Medium	High	Medium	Low	Low	Medium	Low
Senanayake (2010)	High	High	High	High	Medium	Low	Low	Medium	Low
Sharifirad (2011)	High	Low	High	High	Medium	Low	Low	Medium	Low
Sharma (2016)	High	High	High	Low	High	High	Low	Medium	Low
Singh (2020)	High	Medium	High	High	Medium	High	High	Medium	Medium
Thaver (2020)	High	High	High	High	Medium	Low	Low	Medium	Low

***1. Intervention-**Is the intervention clearly named and described, including all relevant components
2. Baseline balance
3. Evaluation: Are the evaluation questions clearly stated?
4. Study design- Use the study design coding
5. Outcomes-Are the outcomes clearly defined? Where appropriate do they use an existing, validated measurement tool?
6. Sample size (power calculation)-Do the authors report a power calculation as the basis for sample size?
7. Attrition- Reported for endline and longest follow up. Calculate overall attrition and differential attrition It is often necessary to calculate from table of results. If sample size varies by outcome calculate for highest attrition.
8. Blinding Overall (including questions for all studies)-The overall score uses the weakest link in the chain principle i.e., is the lowest score on any item

Table 3: Critical appraisal of the process evaluations included in the review

Author Name	Q1*	Q2*	Q3*	Q4*	Q5*	Q6*	Q7*	Q8*	Q9*	Q10*	Q11*	Overall *
Kanal (2005)	Medium	No	No	No	No	No	No	Low	Medium	Low	Medium	Low
Khan (2005)	Medium	Medium	Medium	Medium	No	Medium	No	Medium	Medium	Medium	Medium	Low
Martin (2017)	Medium	Medium	Medium	Medium	No	Medium	Medium	Medium	High	Medium	Medium	Low
Martin (2017)	Medium	High	High	Medium	No	Medium	Medium	High	High	High	Medium	Low
Omotayo (2018)	High	High	High	High	No	High	Medium	High	High	High	High	Low
Phuc (2009)	Medium	High	High	Medium	Medium	Medium	Medium	Medium	Medium	Medium	High	Medium
Roche (2018)	High	High	High	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Shet (2017)	High	High	High	High	Medium	High	High	High	High	High	High	Medium
Srivastava (2015)	High	Medium	No	No	No	No	No	Medium	High	Medium	High	Low
Garcia												

*1. Are the evaluation questions clearly stated? 2. Is the evaluation design described? 3. Is the methodology appropriate to address the evaluation questions? 4. Is the recruitment or sampling strategy described? 5. Are the researcher's own position, assumptions and possible biases outlined? 6. Is the recruitment or sampling strategy appropriate to address the evaluation questions? 7. Have ethical considerations been sufficiently considered? 8. Is the data analysis approach adequately described? 9. Is the data analysis sufficiently rigorous? 10. Are the implications or recommendations clearly based on the evidence from the study? 11. Is the intervention clearly named and described, including all relevant components? 12. Overall (including questions for all studies- The overall score uses the weakest link in the chain principle i.e., is the lowest score on any item)

Meta-analysis

The effect sizes were extracted from a total of 11 impact evaluations (Hoddinott, Thaver, Singh, Sharma, Sharifirad, Senanyake, Madestria, Khani, Kurzawa, Kone, Kamau). These evaluations have studied the impact of different interventions including the use of cash transfer services or behavior change communication on the consumption of supplements; individual counseling regarding MMN supplementation, deworming, health and nutrition education; text messaging via mobile phone to educate about maternal and child health service utilization and dietary intake/improving bioavailability, antenatal care (ANC), skilled birth attendance (SBA) and institutional delivery. Different outcome domains that were studied across these studies include maternal knowledge, antenatal care service utilization, consumption of supplements, and improved biochemical levels. Forest plots were generated for the above-listed outcome domains.

Figure 3 illustrates the forest plot for adherence to micronutrient supplements (IFA/MMN), involving six impact evaluation studies (Hoddinott et al 2018, Kamau et al, 2020, Khani et al, 2021, Kone et al, 2023, Kurzawa et al, 2021, Sharma et al 2016). Five studies reported a positive impact of the BCC/social marketing strategy on supplement consumption or compliance. The interventions studied in the studies include behavior change communication, distribution of IFA supplements with counseling or training, use of interpersonal communication, use of health promotional materials like educational booklets and CDs, and capacity building of health care workers. The adherence was studied as consumption of supplements such as tablets, and syrups at different frequencies (ever consumed, consumed in the past 7 days, more than 3 doses of the supplement). Adherence was also defined as the consumption of all doses of the supplement and the consumption of 70% of the supplement. Overall, there was a significant positive impact of the intervention strategy on this outcome (I²=97.9%; p value=0.000).

The forest plot for hemoglobin levels or the prevalence of anemia, studied by four experimental studies (Senanayake et al 2010, Sharifirad et al 2011, Singh et al 2020, Thaver et al 2020). The studies used the PRECEDE education model, text messaging via mobile phone, and education as intervention strategies. PRECEDE education model is a planning model for health promotion that systematically guides the health promotion process through administrative and policy, education and organizational, behavioral and environmental, epidemiological, and social levels of diagnosis of a health concern. These counseling or education sessions were coupled with training and capacity building of health workers, especially females, free distribution of supplements, and weekly/fortnightly home visits for assessing the supplement consumption. The hemoglobin levels and prevalence of anemia were studied as biochemical levels of hemoglobin. All four studies reported a positive impact of BCC/social marketing strategies on improving hemoglobin levels or reducing anemia prevalence (I²=90.9%; p value= 0.000).

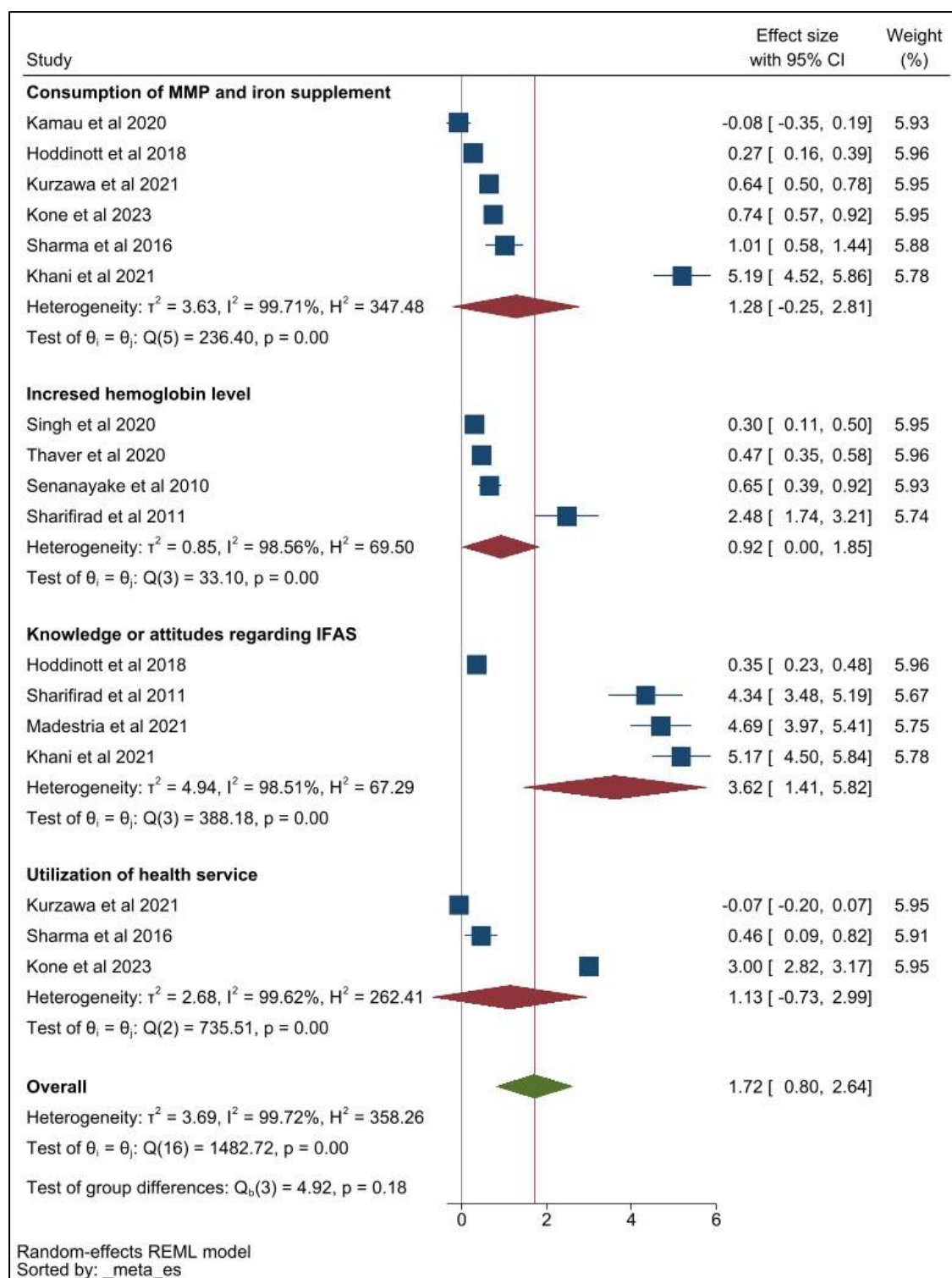


Figure 3: Forest plot depicting the impact of behavior change communication interventions on various outcomes

Qualitative synthesis

A total of three major descriptive themes were identified with the thematic synthesis, which was conducted for the present review. These three major themes had twenty-two sub-themes based on the perception of the target population and various other stakeholders on the effectiveness of intervention strategies on anemia reduction and adherence to IFA supplements. These three major themes are as follows: 1. Availability, acceptability, and adherence; 2. Knowledge, communication, and engagement; 3. Programmatic implementation and challenges [Table 4]. The excerpts from the studies are detailed in the synthesis table S8.

Availability, Accessibility, and Adherence

Six sub-themes were identified that contributed to the availability, accessibility, and adherence to iron and folic acid (IFA) supplementation. High adherence to IFA not only improved hemoglobin levels, thereby reducing anemia, but was also associated with more frequent prenatal visits, improved awareness of health programs, and perceived positive health benefits of IFA supplementation. Education and social class played a significant role in enhancing adherence. Furthermore, the availability of supplements and the involvement of adherence partners were found to be directly associated with improved compliance.

Adherence to Supplements

Factors contributing to adherence among women included the “desire to get well,” storing pills in a visible location, taking them first thing in the morning, and reminders from husbands or female family members.

“I cannot forget. That is the first thing grandmother would ask me. If I have forgotten she will tell me to go and take them.” — 22-year-old primigravida (Martin, 2016)

“I had been cautioned that my haemoglobin level was very low. It was a must that I should take it... It was not easy for me to forget; every morning, I had to take it.” — 28-year-old post-partum woman, four children (Martin, 2016)

The most commonly cited reasons for non-consumption included forgetfulness, gastrointestinal side effects, unpleasant taste, inconvenience, non-affordability of iron supplements, and the perception of having an adequate diet that did not require additional supplementation (Lutsey, 2007; Ugwu, 2014; Martin, 2016). Women with tertiary-level education and higher social class demonstrated better knowledge of iron supplementation during pregnancy and were more likely to comply compared to those with limited knowledge (Ugwu, 2014).

Key motivators for IFA consumption included fear of anemia-related risks to the mother and child, perceived positive effects of IFA on maternal and child health, regular follow-up, consistent availability of supplements, and the involvement of family members in counseling (Srivastava, 2015). Compliance with IFA supplementation was reported to be higher among girls compared to boys.

Weekly IFA supplementation under the supervision of trained peer educators was associated with improved compliance and reduced anemia (Shah, 2016). Teachers sought support from health staff to counsel girls who refused Weekly Iron and Folic Acid Supplementation (WIFAS); however, non-adherence was largely attributed to school absenteeism. The involvement of

parents through school committees in the WIFAS programme improved both coverage and adherence to IFA consumption (Roche, 2018).

Table 4: Qualitative thematic analysis – domains and sub-domains

Codes	Description	Sub-codes
Availability, accessibility and adherence	The six sub themes contributed towards availability, accessibility and adherence to supplement. High adherence to IFA supplements not only contributed to improvement in hemoglobin level leading to anemia reduction but it also led to more frequent prenatal visits, better knowledge of the health programs and perceived positive health benefits towards IFA supplements. Education and social class played a vital role in improving adherence. Also, availability of supplements, adoption of adherence partner were found to be directly interlinked with adherence to IFA supplements.	Adherence to supplements
		Adoption of adherence partner
		Supplement consumption
		Availability of equipment to measure Hb
		Availability of supplements
		Inadequate access to food
Knowledge, communication and engagement	Various communication program campaigns, such as the utilization of print media, sensitization of key community leaders, radio/TV talk on anemia by leading practitioners, and other social marketing campaigns, contributed towards an increase in knowledge on anemia among the target population, leading to the acceptability of supplements. The total of seven descriptive themes contributed towards Knowledge, communication, and engagement.	Advocacy
		Behaviour change and acceptability of supplements
		Communication channels
		Adoption and reception of communication material
		Increase in knowledge
		Knowledge of TBAs and CHWs on IFA supplements
		Knowledge of anaemia
Programmatic and implementation challenges	Various Programmatic and implementation challenges were identified in the study, which acted as a barrier to the anemia control programme. From the employer's perspective, lack of employer support and recognition, high work burden, salary and job security concerns, precarious relationship with the target population had an indirect negative impact on the anemia control programme. Similarly, other factors such as weak supply chain monitoring and management systems and inadequate mechanisms for intersectoral collaboration were also identified as an initial obstacle for the progress of the programme.	Lack of employer support and recognition
		High work burden
		Relationship with mother
		Salary and job security concerns
		Strengthening supply chain management and monitoring systems to mobilize resources
		Teachers turn over in schools
		Delay in seeking timely ANC
		Intersectoral collaboration

Adoption of adherence partner: Adherence partner was identified to be an acceptable, low-cost social and behavior change strategy to increase adherence to IFA supplements as these strategies were accepted by the majority of the participants, and most of them were willing to try an adherence partner. Several women asked multiple people to support them, including husbands, children, and male and female relatives. The support was received from the family after they saw the improvement in health parameters, thereby leading to an increase in support over time.

“I will ask my husband because this is our common concern; my health problem will affect him. This baby belongs to both of us; I think he will remind me for the sake of the baby in the womb – 26-year-old primigravida, Ethiopia” (Martin 2016)

“Many helped me, many encouraged me...I was happy that many were on my side. They were also happy to encourage me to continue – 21-year-old primigravida, Kenya” (Martin 2016)

“Initially, I took it independently without others' help. I remembered to take them myself. My family encouraged me after they saw my health improve. – 27-year-old multigravida, Ethiopia” (Martin 2016)

“If my family were far, I could have forgotten to take the tablets. It helped that they were always by my side. They gave me a lot of support to take the tablets. – 27-year-old multigravida, Kenya” (Martin 2016)

“I told both my children to remind me to take the evening pills. I can remember the other. [The evening is] difficult because I could forget as we sit together and talk during the night. – 38-year-old multigravida, Ethiopia” (Martin 2016).

Some women only shared the information regarding iron supplements with their husbands and appreciated the support they received from them.

“I told my husband about the importance of the pills; how they are useful to my health and to my fetus...he reminds me to take them...My in-laws don't know anything about the pills I am taking. – 28-year-old multigravida, Ethiopia” (Martin 2016)

“I liked having my husband help me. I could have forgotten had he not been helping me. – 22-year-old multigravida, Ethiopia” (Martin 2016)

“I want my husband to continue...He reminds me if I have forgotten, brings them to me, gives me heart, and when he sees I have given up, gives me morale to continue...You know if someone loves and cares, he will help remind you about something concerning your life. – 26-year-old multigravida, Kenya” (Martin 2016).

However, several participants declined to select an adherence partner, and the reasons expressed by the women were ‘not having anyone to ask for help’, ‘do not need any help’, ‘Involvement of others might discourage them from consuming supplements’.

'It is just me... My husband never bothers with these tablets. He just knows that I take medicine. Who will come to ask that you are taking which tablets? It's just me. – 25-year-old multigravida, Kenya.' (Martin 2016)

"I am already adapted to pill taking. I don't want support. Previously, during the first two weeks, my husband was reminding me...but he has already forgotten and has not said anything to me. – 20-year-old multigravida, Ethiopia" (Martin 2016)

I would not recommend that others have someone remind them because people say different things about it... I personally do not share anything with anyone about the pill I am taking. – 28-year-old multigravida, Ethiopia (Martin 2016)

Availability of equipment to measure Hb: Medical equipment is one of the most important components of a health system, and it's a tool that is used to prevent, diagnose, monitor, and treat diseases. Shortage of medical equipment acts as a barrier for the health system to deliver quality services, where nurses at health centers and dispensaries were unable to measure hemoglobin due to a lack of laboratory facilities and equipment (Martin 2016).

"We can give them information regularly. But what about tablets? Who gives all that? We explain them about food and nutrition benefits... If there is anemia child what we do? We don't have the facility to take care them... Blood test is also a big problem. How can we check a child of having anemia?" (FGD #2, LHW 8)" (Shet 2017)

Availability of supplements: Less than half of the women reported receiving IFA supplements. Some women reported not receiving any pills to take home; a few had never heard of taking pills at home during pregnancy. Most women who received IFA during pregnancy lacked knowledge of the importance, and reported minimal information from the health care worker. Nurses at the dispensaries reported that due to low stocks of IFA or any iron supplements, they are allowed to provide supplements only to women with 'alarmingly low haemoglobin, like 9 [g/dL]' or to prescribe supplements to purchase elsewhere. Health workers also had concerns that the IFA supplement supplies will be over once the research trial activities are over.

"Now maybe you don't have enough iron, we don't just give to everybody...if you give everybody and you have a tin, a small one, most likely it will be finished, and maybe someone will come with signs of anaemia and there is nothing you can do. - Health centre nurse " (Martin 2016).

'We can say about diet. We can tell children to take something that is available at home. But about the tablet, we can provide it only if you can provide it to us. Otherwise [we cannot continue]... And about testing, you have to conduct a blood test. Otherwise no.' (FGD#3, LHW 1) (Shet 2016)

Inadequate access to food: Lack of a balanced diet or inadequate access to food was found to be a primary concern among pregnant women. Several women talked about the challenges pregnant women face in accessing enough food and eating a diverse diet.

"I've been feeling weak... I feel that I have very little blood... If you had money, you could buy food to boost blood formation. But money is hard to come by. - 32-year-old pregnant woman, five children" (Martin 2016).

Supplement consumption: The participants viewed iron supplements as medicines that cure anemia, and as such, do not need to be taken unless one is sick. School teachers as nutrition counselors were also effective in influencing the girls to take the supplements (Garcia 2005).

Knowledge, Communication, and Engagement

Various communication program campaigns, such as the utilization of print media, sensitization of key community leaders, radio/television talk on anemia by leading practitioners, and other social marketing campaigns, contributed towards an increase in knowledge on anemia among the target population, leading to the acceptability of supplements. The total of seven descriptive themes contributed towards Knowledge, communication, and engagement.

Knowledge on anemia: Women reported a range of knowledge on anemia, and the terms used for anemia were 'lack of blood' and 'low blood'. They had heard of anemia or 'low blood' but were not aware of its causative factors; more than one-third were able to describe its causes and treatment, and few had never heard of it before. Women experiencing fatigue and low blood pressure did not associate it with the need for health care and did not report it to the nurses. The community-based awareness interventions were effective in increasing knowledge about anemia and the importance of IFA consumption in preventing anemia (Ugwu, 2014; Srivastava 2015).

"Feeling fatigue all the time is not sickness...maybe it is a sickness but I don't think it is serious thing... Feeling fatigue, I never told the doctor about that. - 31-year-old post-partum woman, four children" (Martin 2016).

Knowledge of TBAs and CHWs on IFA supplements: TBAs and CHWs had limited knowledge and training on supplements, and several had never seen IFA supplements. Women did not mention CHWs or TBAs influencing adherence, but several TBAs and CHWs reported encouraging or reminding women to take supplements (Martin 2016). More than half of the participants received verbal instructions to take one pill per day, even when healthy, and a few also received written instructions (Lutsey 2007). But the capacity building initiatives of health providers resulted in better identification of target groups, better follow-up, and improved information sharing increased the levels of supplement consumption (Srivastava 2015).

Increase in knowledge: The Communication Programme campaign and the social marketing interventions were effective in increasing the knowledge of the participants, as more than half of the participants could name specific foods with high micronutrient content. Also, the percentage of facilitators who responded correctly to questions about folic acid and zinc increased significantly after training initiatives (Gross, 2006; Kanal, 2005). The social marketing campaign also improved the buying practices of the participants, and all the participants who bought the supplements reported using them regularly and expressed the benefits of consuming them as they felt stronger, less tired, and their sleep cycle had improved (Khan 2005).

Communication channels: Awareness of anemia and IFA consumption through print media, meeting and workshop with media personnels at different levels, radio / TV talk on Anemia by leading gynecologists, post card campaign with orientation meeting of Registered Medical Practitioners (RMPs), sensitization meeting for opinion leaders, sensitization of chemists and druggists, edutainment shows fairs and other public gatherings, school system for dissemination of take home messages for households, sensitization of the medical representatives helped increase knowledge on anemia and provision and consumption of IFA supplements (Srivastava 2015).

Behaviour change and acceptability of supplements: After the communication programme campaign consumption of supplements increased among women and adolescent girls, increased acceptability of the supplements, felt need for the iron supplementation, and intended to purchase supplements (Gross, 2006; Kanal, 2005).

Programmatic and implementation challenges

Various Programmatic and implementation challenges were identified in the study, which acted as a barrier to the anemia control programme. From the employer's perspective, lack of employer support and recognition, high work burden, salary and job security concerns, precarious relationship with the target population had an indirect negative impact on the anemia control programme. Similarly, other factors such as weak supply chain monitoring and management systems and inadequate mechanisms for intersectoral collaboration were also identified as an initial obstacle for the progress of the programme.

Lack of employer support and recognition: At the local level, village councils (Gram Panchayats) and their leaders played a significant role in health system and infrastructure strengthening. There was a lack of support and understanding at their levels as per the health workers.

'We are asking them from the past four years to close the drainage pit, but we didn't get any help from them' (FGD #3, LHW 1) 'They will put the signature, but they will not help us' (FGD #1, LHW 3) (Shet 2017)

"Sometimes I cry, for my legs hurt from walking that distance... Sometimes bus, auto, and bicycle also increase my body pain... I applied for a transfer many times, but no one listens or reads my request letters' (FGD #2, LHW 8)" (Shet 2017)

High work burden: Along with the health-related activities, the health workers were also engaged in a variety of educational (e.g., teaching pre-school) and administrative (e.g., maintaining voter records) duties in their village. The additional burden of extensive documentation and attending regular meetings adds to their responsibility.

"We have come here to do it, and now we will do it, however much the difficulty'. 'We will do whatever needs to be done... we have come to that level' (FGD #1, LHW 6)" (Shet 2017).

Relationship with mother: The lack of good interpersonal relationships with the mothers of anemic children resulted in poor engagement of mothers and disinterest in counseling sessions and educational activities.

"They [the mothers] ask us to make it fast. They keep checking the time every hour. They have to work with their cows and calves, etc.' '... they do not want to learn. They don't have much patience for these things.' (FGD #2, LHWs 3 & 8)" (Shet 2017).

"We can't tell too many things to them. We tell them slightly little more if we feel like they listen. If they show negligence or lethargy, we don't bother too much about them. We tell what needs to be told and return. Some show interest, others may have less interest slightly because of their busy work or visiting some place or in a hurry. It is possible that they can't give attention' (FGD #3, LHW 10) (Shet 2017).

Salary and job security concerns: According to health workers, the remuneration and recognition for the work were inadequate for the high work burden by their employer (state and national government), resulting in considerable dissatisfaction and demotivation towards work. Also, there were job security concerns for the health workers owing to the privatization of the services.

"We are working more and getting less salary... we are not satisfied. If we get at least Rs. 10,000 [about twice what they currently earn], we would be happy.' 'Our salaries are low. We don't get salaries proportionate to our work' (FGD#2, LHW 3)" (Shet 2017).

They have decided to privatize the whole sector. Privatization means they give ADC responsibilities to a private institution. They planned to give the whole authority to the Coca-Cola company. There is a big difference when responsibility is shifted to a private institution from the government. We may not get salary promptly. They may give us more work stress to us. We may attend without missing a day. We may not get casual leaves properly. We may face many problems. They... may expel any worker whenever they want.' (FGD #2, LHW 8)" (Shet 2017).

Strengthening supply chain management and monitoring system to mobilize resources: The process of data sharing is essential across departments to ensure timely commodity procurement by the district health offices.

"At the very beginning it was very difficult even to get a database of students to estimate the IFA stock for West Java... Now our head (provincial health office) is able to contact by phone her good friend at the provincial education office to get the data." Key informant interview, provincial health officer (May, 2018) (Roche 2018).

Teachers turn over in school: The turnover of staff and transfer of teachers to other regions is also being highlighted as one of the programmatic challenges for the delivery of supplementary and counseling sessions among adolescent girls (Roche 2018).

Delay in seeking timely ANC: The clinic fees and recommended number of ANC visits also act as a barrier to adhering to the supplement consumption.

"Attending clinic on a monthly basis is tiring if you are going to start that early. If you start late and attend for three or four months, it is much better. 28-year-old pregnant woman, three children" (Martin 2016)

Intersectoral collaboration: It was reported that the smooth functioning of the WIFAS activities and accountability for programme implementation across sectors require harmonization, monitoring and reporting across systems.

“Previously before the training of trainers, we hardly knew each other, although we were all working under the district government. We very rarely had coordination meetings with other sectors, but after the training of trainers, we have been getting along very well” Key informant interview, district religious affairs officer (May, 2018) (Roche 2018).

“The district education office’s mission is to educate children and young people... therefore we commit to working together and continue the [WIFAS] programme... if the children are not healthy, they will not be educated.” Key informant interview, district education officer (June, 2018) (Roche 2018).

Integration of quantitative and qualitative findings

The qualitative and quantitative findings from the review prove the conceptual framework (Figure 1) based on the transtheoretical model. The review shows that the causal process through which the interventions have an impact on the outcome is by making the individuals or target population aware or agree about the topic/issue/concern. The change in awareness level after intervention has been studied as knowledge outcomes. This is followed by the act mechanism wherein, the target population who have received the intervention adopts a particular behavior. This has been studied as adherence or compliance or consumption of supplements as the primary outcome for the review.

DISCUSSION

The present mixed-method rapid review reviews evidence on the impact of behavior change communication (BCC) and social marketing interventions on reducing anemia and on improving compliance with iron-folic acid supplements in LMICs. The review used the adapt, agree, and act framework based on the transtheoretical model for examining the causal process. A total of 30 studies were included in the review for quantitative and qualitative synthesis. The studies included in the present review have used education counseling, training education, and text messaging as strategies for behavior change communication. The different strategies of behavior change communication include messages related to knowledge gaps, beliefs, and attitudes related to anemia and IFA, consumption of supplements and their benefits, and communicating barriers resulting in low adherence to supplements. But still, there is a huge research gap addressing the adherence to supplements through behavior change communication. The studies included in the review used varied messages, modes, and channels for imparting behavior change communication across the targeted stakeholders. The broad domains identified from thematic synthesis include availability, accessibility, and adherence to supplements; knowledge, communication, and engagement; and programmatic and implementation challenges. The meta-analysis showed that the BCC strategies have an impact on reducing the prevalence of anemia by improving levels of hemoglobin and increasing adherence to supplement consumption.

A total of 6 studies were included with observational study designs. The interventions studied included awareness sessions, administration of weekly IFA supplementation, and provision of IEC material. The awareness sessions involved messaging, provision of IEC material, mass media (radio jingles, brochures, stickers, posters), and partnerships with women's groups and

others to disseminate messages about MNPs to generate demand for MNPs. All the studies adopted different definitions to define the compliance or adherence of IFAS. The definitions include the following indicators: consumption of supplements for 4 months (more or less) during pregnancy (Ugwu), number of antenatal care visits, and receipt of total supplementation (Lutsey and Lyoba). The other outcomes studied include knowledge of anemia regarding its causes, symptoms, consequences, and prevention methods of anemia (Lyoba); knowledge of Iron-Folic Acid Supplementation including physical appearance (color), time to start using IFAS, the recommended number of tablets, benefits of IFAS, and negative effects to mothers and children when the adequate tablets were not consumed. These cross-sectional studies have seen that there is an association between these interventions and a reduction in anemia severity among adolescent girls and boys (Shah), lower levels of hemoglobin (Ford), and higher compliance among pregnant women who have good knowledge of iron supplementation (Ugwu). There was a high correlation between the receipt of pills and the consumption of pills. However, the reduced compliance was explained by forgetfulness, unavailability of pills, and inconvenience of consumption (Lutsey). The factors associated with adherence to IFAS - the knowledge of anemia, knowledge of IFAS, time a woman attended an ANC visit, number of IFAS tablets provided, number of meals, number of children, and distance to the health facility (Lyoba).

The evidence on the utilization and compliance with iron supplementation is very scanty. The low levels of adherence or compliance to supplements (IFA/MMN) had an impact on productivity levels, immunity, and cognitive and physical development. Studies from Sub-Saharan Africa have shown that supplementation of more than 90 days determines adherence during pregnancy. The low levels of adherence were reported despite free-of-charge prenatal iron supplementation in Ethiopia. In low and middle-income countries like Bangladesh and Nepal, there is a need of trained health care workers to impart counselling regarding change in dietary practices, provision of free supplements, and community engagement. Anemia has been a public health priority, and national programs on anemia are based on the intersectoral strategies. The Anemia Mukht Bharat program of India employs a 6X6x6 strategy, which includes social and behavior change communication as one of the core components. Similarly, the Peruvian Health Ministry's anti-anemia program focuses on counselling families to adopt dietary behaviors, and Bangladesh's national strategy on anemia control focuses on behavior change through a counseling mechanism regarding the importance of taking iron and folic acid supplements.

Different approaches of social and behavioral change communication (SBCC), including interpersonal communication, media, and social/community mobilization, are being used for behavior change among families and individuals. Though these approaches vary in the content, scale and coverage and length, and intensity, evidence shows that these strategies are effective in increasing knowledge and improving behaviors. Systematic review by Lamstein et al shows that the SBCC approaches were effective in improving the consumption of animal source foods, fruits and vegetables, and increased consumption of nutrient supplements among young children. Education-based strategies were found to be most effective for improving prenatal supplement consumption. These strategies include individual counselling through different channels and mode of communication. These include midwives at ANC, pharmacists at the health center, or community health workers at home), through education sessions, pictorial handbooks, leaflets, and videos. social marketing approaches

also when combined with behavior change communication, also enhance the knowledge regarding anemia and IFA supplementation.

CONCLUSION

In conclusion, this mixed-method rapid review highlights the significant impact of behavior change communication (BCC) and social marketing interventions on reducing anemia and improving compliance with iron-folic acid (IFA) supplements in low- and middle-income countries (LMICs). Despite varied strategies and definitions across the included studies, the evidence consistently demonstrates that BCC interventions—ranging from educational counseling and training to mass media and community engagement—effectively enhance knowledge, attitudes, and behaviors related to anemia and IFA supplementation. The findings underscore the importance of addressing the multifaceted barriers to adherence, such as forgetfulness, unavailability of pills, and inconvenience, through comprehensive and tailored communication strategies. The review also identifies critical research gaps and calls for more rigorous studies to refine and expand effective BCC interventions.

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References

1. Ford, N. D., Ruth, L. J., Ngalombi, S., Lubowa, A., Halati, S., Ahimbisibwe, M., ... & Jefferds, M. E. (2020). An integrated infant and young child feeding and micronutrient powder intervention does not affect anemia, iron status, or vitamin A status among children aged 12–23 months in eastern Uganda. *The Journal of nutrition*, 150(4), 938–944. doi: 10.1093/jn/nxz314. PMID: 31923315; PMCID: PMC8127862.
2. Garcia, J., Datol-Barrett, E., & Dizon, M. (2005). Industry experience in promoting weekly iron-folic acid supplementation in the Philippines. *Nutrition reviews*, 63(suppl_2), S146-S151. <https://doi.org/10.1111/j.1753-4887.2005.tb00161.x>
3. Gross, U., Diaz, M. M., & Valle, C. (2006). Effectiveness of the communication program on compliance in a weekly multimicronutrient supplementation program in Chiclayo, Peru. *Food and nutrition bulletin*, 27(4_suppl4), S130-S142. doi: 10.1177/15648265060274S404. PMID: 17455399.
4. Gunnala, R., Perrine, C. G., Subedi, G., Mebrahtu, S., Dahal, P., & Jefferds, M. E. (2017). Identifying acceptability and price points for purchasing micronutrient powders for children 2 to 5 years old in Nepal. *Asia Pacific journal of clinical nutrition*, 26(1), 110. doi: 10.6133/apjcn.102015.07. PMID: 28049270; PMCID: PMC5486988.
5. Hoddinott, J., Ahmed, A., & Roy, S. (2018). Randomized control trials demonstrate that nutrition-sensitive social protection interventions increase the use of multiple-micronutrient powders and iron supplements in rural pre-school Bangladeshi children. *Public health nutrition*, 21(9), 1753-1761. doi: 10.1017/S1368980017004232. PMID: 29467053; PMCID: PMC5962883.
6. Iqbal, K., Hutchinson, C., & Tanasugarn, C. (2018). A social ecological approach to develop a nutrition education program for preventing iron deficiency anemia in young children in rural Pakistan. *Ecology of food and nutrition*, 57(6), 473-488. doi: 10.1080/03670244.2018.1544899. Epub 2018 Nov 19. PMID: 30451532.
7. Kamau M, Mirie W, Kimani S, & Mugoya I. (2019). Effect of community based health education on knowledge and attitude towards iron and folic acid supplementation among pregnant women in Kiambu County, Kenya: A quasi experimental study. *PloS One*, 14(11), e0224361. <https://doi.org/10.1371/journal.pone.0224361>
8. Kamau MW, Kimani ST, Mirie W, & Mugoya IK. (2020). Effect of a community-based approach of iron and folic acid supplementation on compliance by pregnant women in Kiambu County, Kenya: A quasi-experimental study. *PloS One*, 15(1), e0227351. <https://doi.org/10.1371/journal.pone.0227351>
9. Kanal, K., Busch-Hallen, J., Cavalli-Sforza, T., Crape, B., & Smitasiri, S. (2005). Weekly iron-folic acid supplements to prevent anemia among Cambodian women in three settings: process and outcomes of social marketing and community mobilization. *Nutrition reviews*, 63(suppl_2), S126-S133. doi: 10.1301/nr.2005.dec.s126-s133. PMID: 16466088.
10. Khan, N. C., Thanh, H. T. K., Berger, J., Hoa, P. T., Quang, N. D., Smitasiri, S., & Cavalli-Sforza, T. (2005). Community mobilization and social marketing to promote weekly iron-folic acid supplementation: a new approach toward controlling anemia among women of reproductive age in Vietnam. *Nutrition reviews*, 63(suppl_2), S87-S94. doi: 10.1301/nr.2005.dec.s87-s94. PMID: 16466084.
11. Khani Jeihooni, A., Rakhshani, T., Harsini, P. A., & Layeghiasi, M. (2021). Effect of educational program based on theory of planned behavior on promoting nutritional behaviors preventing Anemia in a sample of Iranian pregnant women. *BMC Public Health*, 21, 1-9. <https://doi.org/10.1186/s12889-021-12270-x>
12. Koné, S., Probst-Hensch, N., Dao, D., Utzinger, J., & Fink, G. (2023). Improving coverage of antenatal iron and folic acid supplementation and malaria prophylaxis through targeted information and home deliveries in Côte d'Ivoire: a cluster randomised controlled trial. *BMJ Global Health*, 8(4), e010934. doi: 10.1136/bmjgh-2022-010934. PMID: 37076197; PMCID: PMC10124199.

13. Kurzawa, Z., Cotton, C. S., Mazurkewich, N., Verney, A., Busch-Hallen, J., & Kashi, B. (2021). Training healthcare workers increases IFA use and adherence: Evidence and cost-effectiveness analysis from Bangladesh. *Maternal & child nutrition*, 17(2), e13124. doi: 10.1111/mcn.13124. Epub 2020 Dec 7. PMID: 33283461; PMCID: PMC7988844.
14. Lutsey, P. L., Dawe, D., Villate, E., Valencia, S., & Lopez, O. (2008). Iron supplementation compliance among pregnant women in Bicol, Philippines. *Public health nutrition*, 11(1), 76-82. doi: 10.1017/S1368980007000237. Epub 2007 May 22. PMID: 17519048.
15. Lyoba, W. B., Mwakatoga, J. D., Festo, C., Mrema, J., & Elisaria, E. (2020). Adherence to iron-folic acid supplementation and associated factors among pregnant women in Kasulu communities in north-western Tanzania. *International Journal of Reproductive Medicine*, 2020. doi: 10.1155/2020/3127245. PMID: 32566646; PMCID: PMC7293754.
16. Madestria, N. P. O., Moedjiono, A. I., Tahir, M., Suarayasa, K., Nur, R., & Syam, A. (2021). Effect of education through video and packaging modifications of iron tablets on female adolescent behavior in the iron supplementation intake in SMPN 2 and SMPN 1 Parigi. *Gaceta Sanitaria*, 35, S127-S130. doi: 10.1016/j.gaceta.2021.10.011. PMID: 34929794.
17. Martin, S. L., Omotayo, M. O., Chapleau, G. M., Stoltzfus, R. J., Birhanu, Z., Ortolano, S. E., ... & Dickin, K. L. (2017). Adherence partners are an acceptable behaviour change strategy to support calcium and iron-folic acid supplementation among pregnant women in Ethiopia and Kenya. *Maternal & child nutrition*, 13(3), e12331. doi: 10.1111/mcn.12331. Epub 2016 Aug 9. PMID: 27507135; PMCID: PMC6866070.
18. Martin, S. L., Seim, G. L., Wawire, S., Chapleau, G. M., Young, S. L., & Dickin, K. L. (2017). Translating formative research findings into a behaviour change strategy to promote antenatal calcium and iron and folic acid supplementation in western Kenya. *Maternal & child nutrition*, 13(1). doi: 10.1111/mcn.12233
19. Omotayo, M. O., Dickin, K. L., Pelletier, D. L., Martin, S. L., Kung'u, J. K., & Stoltzfus, R. J. (2018). Feasibility of integrating calcium and iron-folate supplementation to prevent preeclampsia and anemia in pregnancy in primary healthcare facilities in Kenya. *Maternal & child nutrition*, 14, e12437. doi: 10.1111/mcn.12437. PMID: 29493897; PMCID: PMC6866141.
20. Phuc, T. Q., Mhrshahi, S., Casey, G. J., Phu, L. B., Tien, N. T., Caruana, S. R., ... & Biggs, B. A. (2009). Lessons learned from implementation of a demonstration program to reduce the burden of anemia and hookworm in women in Yen Bai Province, Viet Nam. *BMC Public Health*, 9, 1-10. doi: 10.1186/1471-2458-9-266. PMID: 19638191; PMCID: PMC2724519.
21. Roche, M. L., Bury, L., Yusadiredja, I. N., Asri, E. K., Purwanti, T. S., Kusyuniati, S., ... & Izwardy, D. (2018). Adolescent girls' nutrition and prevention of anaemia: a school based multisectoral collaboration in Indonesia. *bmj*, 363. doi: 10.1136/bmj.k4541. Erratum in: *BMJ*. 2018 Dec 17;363:k5321. Yusadiredjai IN [corrected to Yusadiredja IN]. PMID: 30530813; PMCID: PMC6282733.
22. Senanayake, H. M., Premaratne, S. P., Palihawadana, T., & Wijeratne, S. (2010). Simple educational intervention will improve the efficacy of routine antenatal iron supplementation. *Journal of Obstetrics and Gynaecology Research*, 36(3), 646-650. doi: 10.1111/j.1447-0756.2010.01197.x. PMID: 20598050.
23. Shah, S. P., Shah, P., Desai, S., Modi, D., Desai, G., & Arora, H. (2016). Effectiveness and feasibility of weekly iron and folic acid supplementation to adolescent girls and boys through peer educators at community level in the tribal area of Gujarat. *Indian Journal of Community Medicine: Official Publication of Indian Association of Preventive & Social Medicine*, 41(2), 158-61. doi: 10.4103/0970-0218.173498. PMID: 27051093; PMCID: PMC4799641.
24. Sharifirad, G., Golshiri, P., Shahnazi, H., Shakouri, S., & Hassanzadeh, A. (2011). PRECEDE educational model for controlling iron-deficiency anaemia in Talesh,

- Iran. *JPM-A-Journal of the Pakistan Medical Association*, 61(9), 862-5. PMID: 22360024.
25. Sharma, S., Teijlingen, E. V., Belizán, J. M., Hundley, V., Simkhada, P., & Sicuri, E. (2016). Measuring What Works: An impact evaluation of women's groups on maternal health uptake in rural Nepal. *PloS one*, 11(5), e0155144. doi:10.1371/journal.pone.0155144
 26. Shet, A. S., Rao, A., Jebaraj, P., Mascarenhas, M., Zwarenstein, M., Galanti, M. R., & Atkins, S. (2017). Lay health workers perceptions of an anemia control intervention in Karnataka, India: a qualitative study. *BMC Public Health*, 17(1), 1-9. doi: 10.1186/s12889-017-4758-x. PMID: 28923041; PMCID: PMC5604152.
 27. Singh, J. K., Acharya, D., Paudel, R., Gautam, S., Adhikari, M., Kushwaha, S. P., ... & Lee, K. (2020). Effects of female community health volunteer capacity building and text messaging intervention on gestational weight gain and hemoglobin change among pregnant women in southern Nepal: a cluster randomized controlled trial. *Frontiers in Public Health*, 8, 312. doi: 10.3389/fpubh.2020.00312. PMID: 32766199; PMCID: PMC7379845.
 28. Srivastava, R. K., Kotecha, P. V., Singh, V., & Srivastava, M. (2015). Community based intervention (CBI) for demand generation of IFA consumption among rural pregnant women. *Int J Recent Sci Res*, 6, 5023-5026.
 29. Thaver, I., Ahmad, A. M., Ashraf, M., Asghar, S. K., & Mirza, M. S. (2020). Effect of multi-pronged interventions in reducing low birth weight and maternal anaemia among pregnant women. A community-based interventions research in non-agrarian resource constrained setting of rural Pakistan. *JPM-A. The Journal of the Pakistan Medical Association*, 70(12 (A)), 2092-2101. doi: 10.47391/JPM-A.1218. PMID: 33475578.
 30. Ugwu, E.O., Olibe, A.O., Obi, S.N. and Ugwu, A.O., 2014. Determinants of compliance to iron supplementation among pregnant women in Enugu, Southeastern Nigeria. *Nigerian journal of clinical practice*, 17(5), pp.608-612. doi: 10.4103/1119-3077.141427. PMID: 25244272.
 31. Balarajan, Y., Ramakrishnan, U., Özaltin, E., Shankar, A. H., & Subramanian, S. V. (2011). Anaemia in low-income and middle-income countries. *The Lancet*, 378(9809), 2123–2135.
 32. Gebreamlak, B., Dadi, A. F., & Atnafu, A. (2017). High adherence to iron/folic acid supplementation during pregnancy time among antenatal and postnatal care attendant mothers in governmental health centers in Akaki Kality Sub City, Addis Ababa, Ethiopia: Hierarchical negative binomial Poisson regression. *PLOS ONE*, 12(1), e0169415.
 33. Kassebaum, N. J., et al. (2014). A systematic analysis of global anemia burden from 1990 to 2010. *Blood*, 123(5), 615–624.
 34. Mclean, E., Cogswell, M., Egli, I., Wojdyla, D., & de Benoist, B. (2009). Worldwide prevalence of anaemia, WHO Vitamin and Mineral Nutrition Information System, 1993–2005. *Public Health Nutrition*, 12(4), 444–454.
 35. Osendarp, S. J. M., et al. (2021). The Importance of Tackling Malnutrition in All Its Forms to Achieve the Sustainable Development Goals. *Food Policy*, 101, 102025.
 36. Prochaska, J. O., & Velicer, W. F. (1997). The transtheoretical model of health behavior change. *American Journal of Health Promotion*, 12(1), 38–48.
 37. Stoltzfus, R. J. (2001). Iron-deficiency anemia: Reexamining the nature and magnitude of the public health problem. *The Journal of Nutrition*, 131(2), 697S–700S.
 38. Storey, J. D., Saffitz, G. B., & Rimon, J. G. (2011). Social marketing. In *Health Behavior and Health Education: Theory, Research, and Practice* (pp. 435–464). Jossey-Bass.
 39. Sununtnasuk, C., D'Agostino, A., & Fiedler, J. L. (2016). Iron+folic acid distribution and consumption through antenatal care: Identifying barriers across countries. *Public Health Nutrition*, 19(4), 732–742.

40. Taye, B., Abeje, G., & Mekonen, A. (2015). Factors associated with compliance of prenatal iron folate supplementation among women in Mecha district, Western Amhara: A cross-sectional study. *Pan African Medical Journal*, 20(1), 43.