PLOS Global Public Health

RESEARCH ARTICLE

Delivering balanced energy and protein (BEP) supplements to pregnant and breastfeeding women in low- and middle-income countries: A scoping review

Mihaela C. Kissell[1]*, Isabel Potani[2], Carolina Pereira[1], Elisabeth T. Mukendi[1], Vani Sethi[3], Filomena Gomes[1,4], Rimu Byadya[5], Lisa M. Rogers[5], Saskia J. M. Osendarp[1,6], Charity Zvandaziva[7], Saskia de Pee[8], Martin N. Mwangi[1,6]

1 Healthy Mothers Healthy Babies Consortium, Micronutrient Forum, Washington, District of Columbia, United States of America, **2** Independent Consultant, Ripple Global Health International, London, United Kingdom, **3** UNICEF Regional Office for South Asia, Kathmandu, Nepal, **4** NOVA Medical School, Universidade NOVA de Lisboa, Lisboa, Portugal, **5** Department of Nutrition and Food Safety, World Health Organization, Geneva, Switzerland, **6** Division of Human Nutrition and Health, Global Nutrition and Health Group, Wageningen University & Research, Wageningen, The Netherlands, **7** UNICEF, Lilongwe, Malawi, **8** Nutrition Division, World Food Programme HQ, Rome, Italy

* mihaela.ciulei@micronutrientforum.org

Check for updates

OPEN ACCESS

Citation: Kissell MC, Potani I, Pereira C, Mukendi ET, Sethi V, Gomes F, et al. (2026) Delivering balanced energy and protein (BEP) supplements to pregnant and breastfeeding women in low- and middle-income countries: A scoping review. PLOS Glob Public Health 6(11): e0007539. https://doi.org/10.1371/journal.pgph.0007539

Editor: Nicola L. Hawley, Yale University, UNITED STATES OF AMERICA

Received: May 19, 2026

Accepted: October 9, 2026

Published: November 2, 2026

Copyright: © 2026 Kissell et al. This is an open access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Data availability statement: All data are included in main text table, figure, and supplementary materials.

Funding: This work was funded by the "GATES FOUNDATION" (grant number INV-055523).

Abstract

In settings where more than 20% of women of reproductive age are classified as underweight, the World Health Organization recommends balanced energy and protein (BEP) supplementation during pregnancy to reduce adverse birth outcomes. However, guidance on contextually acceptable and feasible supplement delivery platforms remains limited, posing critical challenges for implementation. We synthesized literature on acceptable and feasible delivery platforms for BEP supplementation (direct evidence), as well as iron and folic acid (IFA) or multiple micronutrient supplements (MMS; indirect evidence) to pregnant and breastfeeding women (PBW) to broaden the search scope. A systematic search was conducted across five databases and grey literature to identify studies that addressed the acceptability and feasibility of BEP supplement delivery platforms in low- and middle-income countries (LMICs), at facility and community levels. We identified 48 studies conducted in LMICs: 22 specifically evaluated BEP supplement delivery, while 26 evaluated IFA or MMS. In the direct evidence, home delivery (11/22) was the most frequently mentioned delivery platforms of BEP supplements followed by community-level feeding centers (provided cooked meals or take-home rations) anchored by frontline community health workers (8/22 studies) and antenatal care (ANC) at health facilities (6/22; some studies assessed multiple delivery platforms). Only four studies assessed preferred BEP delivery platforms, and PBW favored home over facility-based delivery. Authors attributed this preference to the comprehensive nutrition education and

The funders had no role in the design, data collection, analysis, interpretation, or decision to publish this manuscript.

Competing interests: The authors have declared that no competing interests exist.

behavior change communication (BCC) provided during home delivery. Indirect evidence showed that enhancing delivery of IFA or MMS at health facilities (not specific) through strategies such as BCC and home visits may improve supplement compliance. Overall, limited evidence exists regarding market-based approaches for delivering any of these interventions. Based on existing evidence, scale-up delivery of BEP supplementation through ANC at health centers, enhanced by community health workers may be feasible in reaching PBW, especially when combined with BCC.

Introduction

Undernutrition during pregnancy is associated with adverse maternal and infant health outcomes, such as pre-eclampsia, stillbirth, and small-for-gestational-age (SGA) births [1]. To reduce the prevalence of stillbirths or SGAs, the World Health Organization (WHO) recommends providing balanced energy and protein (BEP) supplements to all pregnant women in settings with a high burden of undernutrition (≥ 20% underweight in women of reproductive age), rather than restricting supplementation only to individual participants defined as undernourished [2]. BEP supplements are commonly defined in the literature [3] as food products with varying macronutrient and micronutrient compositions aimed to improve the nutritional status of pregnant (and breastfeeding) women that provide less than 25% of energy from protein. Examples of BEP supplements include ready-to-use products such as lipid-based nutrient supplements, fortified flours such as corn-soya blends, or locally prepared foods or snacks such as prepared meals or eggs.

The WHO's 2016 antenatal guideline provides limited operational guidance on how to deliver BEP supplements, specifically on which delivery platforms are most suitable [2]. Further, the WHO guideline remarks that the distribution of BEP supplements may not be feasible through the local health facility-based ANC clinics [2]. The guideline indicates it is essential to identify delivery platforms that are acceptable and feasible to support successful nutrition interventions [2]. This combination of a clear recommendation to provide BEP supplements and a lack of specific guidance on delivery platforms creates a critical implementation gap for countries considering scaling up. To address this gap, we proposed a pragmatic evidence synthesis drawing on multiple sources of nutritional supplementation evidence. There is still limited information about the most acceptable and feasible coverage platform to deliver BEP supplements to pregnant (and breastfeeding) women. BEP supplements have been implemented in far fewer settings than iron and folic acid (IFA) or multiple micronutrient supplements (MMS) but WHO recommends all these interventions to be delivered in the antenatal care (ANC) settings [2,4]; thus, we treated IFA and MMS delivery evidence as informative in generating hypotheses about delivery and implementation of BEP supplementation where direct data were sparse. The objective of this work is to summarize direct and indirect evidence on the acceptability and feasibility of delivery platforms for BEP supplementation among pregnant (and breastfeeding) women in low- and middle-income countries (LMICs) to inform future BEP supplement programming.

Methods

This scoping review was conducted in accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines [5]. The PRISMA-ScR checklist is provided as S1 Checklist.

Search strategy

In this scoping review, a comprehensive literature search (S1 Table) was conducted with the assistance of a research librarian across five electronic databases (Cochrane Library, PubMed, Embase, CINAHL, and Web of Science), covering the period from inception until October 01, 2024, and updated on April 13, 2026. We used broad search terms, including keywords related to food supplementation in pregnancy and lactation/breastfeeding, to identify as many relevant articles as possible. The searches had no date, language, or other restrictions.

Inclusion and exclusion criteria

We included primary studies reporting on delivery platforms outcomes of BEP supplementation, IFA, or MMS because WHO recommends all to be delivered in the ANC context [2,4] and to inform hypotheses about delivery and implementation of BEP supplementation among pregnant and breastfeeding women in LMICs. We included only articles published in English. We considered BEP supplements, as defined in the Introduction section. IFA is a prenatal supplement containing iron and folic acid. MMS was defined according to WHO: a prenatal supplement containing at least three micronutrients in addition to iron and folic acid [4]. We excluded review articles, protocols, clinical trial registries, or conference abstracts, studies conducted in high-income countries, and non-human studies.

Data extraction

We screened titles and abstracts of the articles, followed by the full-texts screening for eligibility in Covidence [6] and Excel. At both screening stages, each study was screened in duplicate by any two of the four reviewers (IP, EM, CP, and MCK), who screened independently of each other. Disagreements were resolved by a third reviewer (EM, CP, or MCK) who had not been involved in the initial screening of the disputed article. From the eligible studies, we extracted the study author, year of publication, study design, aim, supplement tested, population, region, and delivery platforms information.

Data synthesis and analysis

Outcomes were categorized as direct evidence if they came from studies specifically addressing BEP supplementation, and as indirect evidence if they came from IFA or MMS studies. Within each evidence category, delivery platforms were identified, and country-specific platforms were outlined. The findings were summarized and presented in a table.

Results

The literature search identified 4,986 articles for screening (Fig 1). After removing duplicates and ineligible studies, 48 eligible studies were included in this review [7–53], of which 22 focused on BEP supplementation (direct evidence) and 26 focused on IFA and MMS (indirect evidence detailed in Results in S1 Appendix and corresponding S2 Table). The eligible studies were conducted among pregnant and breastfeeding women and assessed outcomes of delivery platforms related to health facilities, feeding centers, markets/pharmacies, and home delivery of supplements in LMICs (Table 1, S2 Table). The study designs included feasibility studies, randomized controlled trials (RCT), and mixed-methods quasi-experimental studies. The included primary studies (n = 22) analyzed data using quantitative and qualitative approaches to assess the acceptability and feasibility of the various delivery platforms.

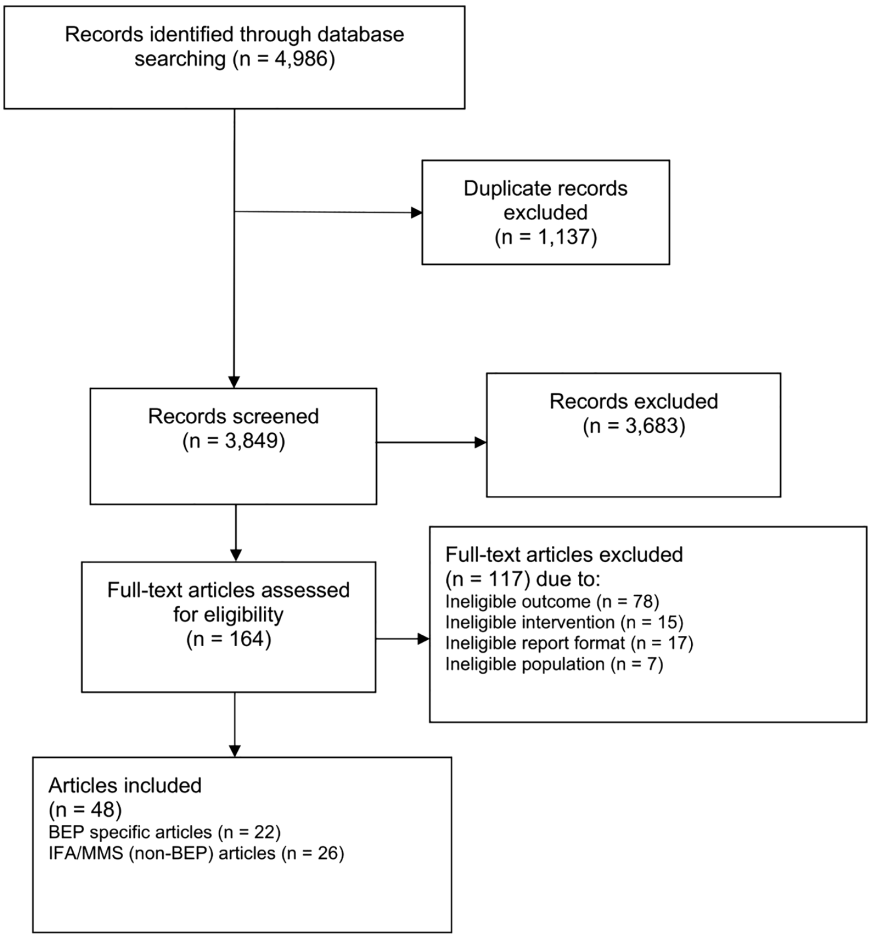


Fig 1. Prisma flow chart of study selection in a scoping review on balanced energy and protein supplementation. Abbreviations: BEP = Balanced energy and protein dietary supplementation; IFA = Iron and folic acid; MMS = Multiple Micronutrient Supplements.

https://doi.org/10.1371/journal.pgph.0007539.g001

Direct evidence on BEP supplements

There were 22 studies that provided direct evidence on BEP supplement delivery platforms [7,9,13–22,24–27,47–52]. BEP supplementation was delivered in diverse forms across studies, including ready-to-eat products (e.g., lipid-based nutrient supplements (LNS) or biscuits), fortified-blended foods or cereals (e.g., Corn-Soya Blend Plus (CSB+)), cooked meals, or meal ingredients (e.g., eggs). In South Asia, programs frequently provided either dry take-home rations (providing eggs, milk, locally made snacks, etc.) or freshly cooked meals, community/spot feeding programs, both under India's supplementary nutrition program called Integrated Child Development Services (ICDS) [21,24,26,48,52]. Some studies were exploratory and did not specify the BEP supplement form; they explored the effects, coverage, access of nutritious foods during pregnancy and breastfeeding without specifying the precise form [9,49,52].

Community feeding centers of BEP supplements

Community feeding centers were used as a primary BEP supplement delivery platform in eight of the 22 BEP supplementation studies identified, conducted in India, Bangladesh, and Haiti [21–24,26,27,47,48]. One of two studies on community feeding centers in Bangladesh (n = 48 pregnant women) reported that 16% of the participants consumed the supplement

Table 1. Description of included literature on balanced energy and protein (BEP) supplement delivery platforms in low- and middle-income countries.

Author	Study design/ data collection type	Country	Objective	Population at enrolment	BEP supplement form	Delivery platform reported results
Kalbarczyk et al., 2024 [9]	Formative study – qualitative methods	Bangladesh	To assess implementation outcomes for launching BEP supplementation	95 married women of reproductive age (some were pregnant and some had recently given birth),family members,health care providers,pharmacists	Not specified	Perceptions for home delivery, ANC clinic, and pharmacy delivery
Novak et al., 2006 [16]	Pilot study – qualitative methods	Bangladesh	To evaluate food supplementation, nutritional intake of recipients, and operational aspects of an integrated pilot nutrition initiative	Unspecified number of pregnant and breastfeeding mothers, adolescent girls in school (11–18 years old) and children below 2 years of age	Boiled, roasted flat rice, peanuts, and molasses rolled into balls	Home delivery
Kok et al., 2021 [17]	Randomized cross-over study – mixed methods	Burkina Faso	To evaluate home consumption of two fortified BEP supplements by pregnant women	A total of 80 pregnant women aged between 15 and 40 years	LNS peanut paste,vanilla biscuit	Home delivery
Janmohamed et al., 2016 [7]	Explanatory sequential study - qualitative methods	Cambodia	To identify factors affecting the acceptability and consumption of Corn Soya Blend Plus (CSB+) as a prenatal supplement	A total of 288 pregnant women for the structured interviews and 70 pregnant women to further explore attitudes, perceptions, and experiences related to CSB + use	(CSB+) Flour	Home delivery and health post collection
Eglovitch et al., 2024 [14]	Prospective pilot study - qualitative methods	Ethiopia	To assess the adherence and acceptability of BEP supplementation among pregnant women	A total of 40 pregnant women	(CSB+) Flour	Health post or home delivery, depending on the participant's preference
Lama et al., 2022 [15]	Formative research (phase 1)- qualitative methods	Nepal	To assess compliance with and acceptability of savory and sweet fortified supplements among pregnant women	A total of 40 pregnant women	Soup, sticks, bars, paste, biscuits, drinks	Home delivery and willingness to buy
Lama et al., 2022 [18]	Formative research (phase 2) -mixed-methods	Nepal	To assess and compare compliance with and acceptability of two BEP supplements, and to identify BEP supplements for subsequent inclusion in an efficacy trial	A total of 80 pregnant women	LNS peanut paste, and biscuit	Purchasing from markets
Isanaka et al., 2019 [19]	Two-part, multi-methods study - qualitative	Niger	To determine the acceptability and utilization of a lipid-based nutrient supplement formulated for pregnant women	A total of 25 pregnant women aged ≥ 18 years	MQ-LNS	ANC delivery and willingness to buy
Clermont et al., 2018 [13]	Two-faced longitudinal study with emergent design (phase 2) - qualitative methods	Niger	To evaluate the acceptability and utilization of three nutritional supplements during pregnancy	Pregnant women (84 interviews and 17 FGDs discussion in phase 1; 39 interviews and 12 FGDs in phase 2), household members, and study staff	MQ-LNS	Home delivery

(Continued)

Table 1. (Continued)

Author	Study design/ data collection type	Country	Objective	Population at enrolment	BEP supplement form	Delivery platform reported results
Adams et al., 2018 [25]	Longitudinal willingness-to-pay data from an RCT- mixed methods	Ghana and Malawi	To characterize private valuation of SQ-LNS over the course of recommended consumption and, using a diverse set of covariates, explore the factors associated with willingness to pay	A total of 792 and 626 pregnant women (<20 weeks of gestation) in Ghana and Malawi, respectively	SQ-LNS	Purchasing from markets
Ramakrishnan et al., 2012 [24]	Cross-sectional study - mixed methods	India (with a focus on 2 states: Tamil Nadu and Uttar Pradesh)	To evaluate the implementation of maternal nutrition programs in India	Pregnant women and breastfeeding women (diverse respondents)	Cooked food	Community feeding centers and home delivery
Singh et al., 2020 [47]	Nationally representative cross-sectional study – quantitative methods	India	To examine the socioeconomic, programmatic, and contextual factors associated with the consumption of IFA tablets/syrup for at least 100 days (IFA100) and receiving supplementary food (SF) by pregnant women in India	A total of 190,898 ever-married women aged 15–49 years who had at least one birth 5 years preceding the survey	Cooked meals or take-home rations	Community feeding centers
Bhatnagar et al., 1982 [26]	Prospective cohort study – quantitative methods	India	To study the weight gained by the mothers receiving defined supplementary nutrition and to compare it with the weight gain of a matched group of mothers not receiving the additional nutrition, and to compare birthweight and growth patterns of the infants of the two groups of mothers up to 3 months of age	Pregnant women (24 weeks of gestation)	Supplementary food: local recipe providing 16 g of protein, 300 kcals	Integrated Child Development Services (community feeding center) vs. non-Integrated Child Development Services women
Chudasama et al., 2016 [21]	Cross-sectional program evaluation study– quantitative methods	India	To evaluate the various aspects of the ICDS program in terms of inputs, process, and outcome (coverage), utilization, and issues related to the ICDS program	A total of 130 Anganwadi centers (95 rural and 35 urban)	Cooked food or take-home ration	Community feeding center
Hoque et al., 2010 [22]	Cross-sectional observational study – quantitative methods	Bangladesh	To determine the compliance to intake of food and micronutrient supplements among 48 rural pregnant women in two sub-districts under two divisions of Bangladesh	A total of 48 rural pregnant women	Cooked food	Communityfeeding centers
Coreil, 1987 [27]	Cross-sectional survey study – quantitative methods	Haiti	To monitor Maternal and Child Health Feeding Centers that provided Title II supplementary feeding programme	A total of 39 centers out of 519	Cooked or uncooked food	Community feeding centers
Sethi et al., 2019 [23]	Cross-sectional program evaluation-study – mixed methods	India	To evaluate the maternal spot feeding programs in 2 Southern Indian states	A total of 360 pregnant and breastfeeding women (of infants aged 0–6 months)	Cooked food	Community feeding centers

(Continued)

Table 1. (Continued)

Author	Study design/ data collection type	Country	Objective	Population at enrolment	BEP supplement form	Delivery platform reported results
Ashraf et al., 2025 [50]	Cross-sectional survey, quasi-experimental design – quantitative methods	Pakistan	To evaluate the effectiveness of a nutritional supplementation programme, underpinned with behavior change communication and implemented through Lady Health Workers	2,821 and 2,410 pregnant and lactating women at baseline and endline, respectively	Wheat Soya Blend (WSB)	Home delivery by CHW
Dhasmana et al., 2025 [48]	Exploratory study -qualitative methods	India	Explored opportunities to enhance dietary diversity and environmental sustainability within the Supplementary Nutrition Program under ICDS in Andhra Pradesh	Pregnant and lactating women but number not indicated	Take-home ration	Community feeding centers
Dolati et al., 2025 [49]	Retrospective field trial study – mixed methods	Iran	To compare the effects of the food basket program and the cash transfer program to support pregnant and lactating mothers in needy suffering from malnutrition in Iran.	1,331 pregnant and lactating women	Food basket and cash transfer	Health center and market delivery
Nguyen et al., 2024 [52]	Instrument development stud and cross-sectional survey study - mixed methods	India	To 1) develop and cognitively test household survey questions that measure coverage of nutrition-sensitive social protection programs in India; and 2) use these questions to estimate the coverage of nutrition-sensitive social protection programs and co-coverage with other nutrition-relevant interventions	6,627 mothers	1. reconstitutable food supplements; 2. grains and/or lentils; 3. cooked food; 4. cash	Market delivery (purchased food from ration shops); home delivery and cash (bank) transfers
Shifraw et al., 2026 [51]	Formative study – mixed methods	Ethiopia	Assessed the acceptability, adherence, and sharing practices of a ready-to-use BEP supplement among pregnant women in Addis Ababa, Ethiopia	45 pregnant women	MQ-LNS	Home delivery

BEP – Balanced energy and protein supplementation; RCT – Randomized controlled trial; FGD – Focus group discussion; CSB + – Corn Soya Blend Plus; LNS – Lipid-based nutrient supplement; ANC – Antenatal care; IFA – Iron and folic acid; MMS – Multiple micronutrient supplement; MQ-LNS – Medium-quantity lipid-based nutrient supplement; SQ-LNS – Small-quantity lipid-based nutrient supplement; ICDS – Integrated Child Development Services; N/A – Not applicable.

https://doi.org/10.1371/journal.pgph.0007539.t001

alone at the community feeding centers, while 24% shared it with other women there [22]. At home, 17% took the supplement alone and 9% shared it with family members. Additionally, 16% took the supplement home but did not consume it during the observation period, and 17% did not visit the centers to receive the supplement. Study authors speculated that the reasons for low attendance to collect BEP supplements were "due to a lack of cooperation by the Centre staff or lack of knowledge by both the mothers and the staff regarding supplements" [22]. In the second study from Bangladesh, which also examined BEP supplementation at feeding centers, mothers consumed about 75% of the food provided, and that the remainder of the food was shared mostly with young children, husbands, or other family members [16]. The study found that sharing was more common in larger households. It also noted that, although nutrition education was part of the original intervention design, it was not delivered alongside the BEP supplementation. The authors speculated that this lack of educational content may have led to increased sharing of the BEP supplements [16]. Similarly, in India, across Anganwadi community centers, inconsistency in training of community health workers and the need for cooks to cook for many people to improve meal acceptability, posed challenges [48]. Additional challenges reported include delays in receiving food ingredients and reimbursements, inadequate storage conditions, challenges in using web applications for food distribution,

and fluctuations in food costs [48]. In turn, these challenges led to inadequate program implementation and food quality [21,24]. Authors suggested promoting service integration, ensuring effective procurement platforms, establishing regional training facilities to improve program implementation, and strengthening program monitoring and evaluation could improve the challenges [24]. Sethi et al. reported that the enrollment in self-help groups and family members in India motivated 68% of pregnant and breastfeeding women to attend feeding centers; these delivery platforms enhanced maternal nutrition service quality and quantity [23]. Dhasmana et al. found that program workers find monthly nutrition education and skill-based training sessions helpful and important in providing good nutrition behavior such as consumption of fortified rice, which beneficiaries viewed as "plastic rice" due to its lighter texture [48]. In Haiti, a privately sponsored supplementary feeding program reported that postnatal nutrition supplementation was primarily used to incentivize women to attend family planning services [27].

Home delivery of BEP supplements

Eleven of the 22 included BEP supplementation studies [7,9,13–17,24,50–52] conducted home delivery. For instance, in Bangladesh, Niger, Ethiopia, and Cambodia, some participants were receptive to home delivery of BEP supplements [7,9,13,14]. In Niger, health assistants reported that the supplements were well accepted by participants, who found the weekly home visits helpful and convenient [13]. In addition to BEP supplement delivery, participants indicated the health assistants played a critical role in sensitizing them and their families to health topics. Because many of the health assistants were male, this was initially met with resistance from participants' husbands; however, study awareness campaigns were able to overcome this resistance. Similarly, in Cambodia, 99% of participants reported in interviews that if the supplement (CSB+ form) were free of cost, home delivery would be the preferred platform (as done during the study) rather than picking it up from the health center [7]. In an acceptability study conducted in Bangladesh, community health workers reported that delivering BEP supplements (in an unspecified form) to participants' homes enables them to provide comprehensive nutrition counseling; however, there is a need for more community health workers and higher pay for these services [9]. In contrast, one study in rural Pakistan reported challenges with providing BEP supplements (wheat-soya blend form) in participants homes by community health workers due to an interrupted supply chain, less supplement prioritization, and sharing of the supplement with households. The solution suggested was to conduct quality behavior change communication that address barriers and enablers through nutrition education [50].

Health facility delivery of BEP supplements

Integration of BEP supplement delivery within ANC at health facilities occurred in six studies conducted in Niger, Ethiopia, Burkina Faso, Cambodia, India, and Iran [7,9,14,17,19,49]. Notably, the Iranian study evaluated a national program that provided two types of interventions, one that provided BEP supplementation (food baskets) at the health center and another one that provided cash transfers via banks aimed at purchasing nutritious foods; all beneficiaries received health and nutrition education [49]. In Ethiopia, 74% participants indicated that they would like to receive the BEP supplement (CSB form) at a health center or community health post but did not specify the reason [14]. In this study, BEP supplements were initially provided at health centers at enrolment, and then the supplements were provided according to participants' preference at subsequent visits either at home or health center. In a Cambodian study, 80% of participants reported being happy to collect the BEP supplement (CSB form) from the health center; notably, the study protocol was to deliver the BEP supplement to participants' homes [7]. In Bangladesh, participants expressed concerns about the acceptability of integrating BEP supplementation into ANC services. Although clinics were viewed as a feasible distribution point due to their wide availability and participants' familiarity with attending them on scheduled days, many described them as overcrowded, of low quality, and affected by perceived corruption and diversion of medicines. Both participants and healthcare providers noted that distance to clinics reduced attendance and access to ANC counselling. Nonetheless, providers acknowledged that clinics offered advantages for delivering information directly to participants during their visits [9].

Notably, in Burkina Faso, recipients, health providers, and policymakers reported that health facilities are the best places for delivering supplements, even though the BEP supplement was delivered at home in the study [17].

Market delivery of BEP supplements

Seven studies conducted in Ghana, Malawi, Bangladesh, Iran, India, Niger, and Nepal explored market-based approaches, (i.e., purchasing or selling supplements at full cost, unless otherwise specified) from local markets or pharmacies [9,15,18,19,25,49,52]. As noted above, the Iranian study evaluated participants enrolled in national programs that either provided BEP supplements in the form of food baskets through health centers or cash transfers (USD 21 every two months) intended to purchase nutritious foods [49]. However, the study did not monitor what participants purchased with the cash transfers. Both programs also included health and nutrition education on beneficial foods during pregnancy and breastfeeding periods. The study did not report whether participants preferred receiving support through the health centers or cash transfers to bank accounts [49]. Another study from India reported two transfer modalities within national supplementary programs: food transfers and cash transfers [52]. Food transfers included reconstituted food supplements, grains and/or lentils, and cooked food often delivered at the community level by community health workers, while cash was transferred directly to bank accounts. However, the study provided limited details on the nutritional composition of the transferred foods and the food items purchased with the cash transfers [52].

There were mixed findings on the purchasing behavior of BEP supplements by pregnant and breastfeeding women [15,18,19,25]. In rural Nepal, one study found that participants would purchase BEP supplements (in the LNS form; 72–75 g ration), if they were available on the market [18] whereas others said they could not afford them [15]. Similarly, in Bangladesh, local pharmacies were described as a convenient and trusted channel for distributing BEP supplements (75 g ration). However, potential conflicts with existing commercially promoted products discouraged pharmacists from supporting BEP supplements distribution unless incentive structures were realigned [9]. Qualitative findings from rural Niger indicated that participants expressed willingness to pay on average USD 0.31 for BEP supplements in the form of LNS (40 g ration), which is equivalent to the average of amount last paid of one serving of favorite snack food [19]. Similarly, quantitative findings from a study conducted in Ghana showed that participants were willing to pay for LNS (20 g ration), for up to USD 0.66 (daily supply), whereas in Malawi, participants were willing to pay about USD 0.90 (weekly supply) [25]. In Ghana, willingness to pay for LNS was influenced by time since enrolment, respondent type (mother vs. head of household), household food security, and maternal morbidity. In Malawi, willingness to pay was associated with time since enrolment, seasonal food availability, and household food security. Specifically, in Ghana, willingness to pay declined with each additional month since enrolment (−USD 0.03/month, $p = .001$) and was lower among mothers than among heads of household (−USD 0.15/month, $p = .01$; −USD 0.08 long-term, $p = .05$). Household food insecurity was significantly associated with reduced willingness to pay, and mothers experiencing nausea or vomiting reported lower willingness to pay (−USD 0.08/day, $p = .05$; −USD 0.09 long-term, $p = .004$). Other morbidity indicators, such as poor appetite and diarrhea, were positive but not significantly associated with willingness to pay. In Malawi, willingness to pay increased with time since enrolment (+USD 0.03/month, $p = .05$). In both Malawi and Ghana, household food insecurity was negatively associated with willingness to pay ($p = .03$) [25].

Indirect evidence on IFA and MMS supplements

A total of 26 studies evaluated supplementation with IFA or MMS without any BEP supplementation [11,20, 28–45, 53–58] as shown in Results in S1 Appendix and corresponding S2 Table. Twenty-one studies examined IFA supplementation alone across LMICs, particularly in South Asia and sub-Saharan Africa. Three additional studies combined IFA with calcium supplementation and three studies focused on MMS. Health facility delivery was the most reported platform (17 studies), followed by home delivery (4 studies); one study reported on community feeding centers and another one on market delivery platform. This evidence is further described in the Results in S1 Appendix and corresponding S2 Table. Overall,

this indirect evidence showed mixed findings regarding ANC health facility delivery, home delivery (including direct observation of intake), and market delivery approaches. However, an important conclusion emerged, enhancing IFA or MMS delivery at health facilities (not specific) through strategies such as behavior change communication and home visits or community mobilization, may improve adherence.

Discussion

This scoping review summarizes direct and indirect evidence on the acceptability and feasibility of delivery platforms for BEP supplementation among pregnant (and breastfeeding) women from LMICs to inform future BEP supplementation programing. We found that hybrid facility-based BEP supplement delivery approaches, incorporating enhancements such as home deliveries and behavior change communication with health facility-based ANC services, are acceptable and may enhance supplement adherence. Despite the variations in the acceptability of BEP supplementation delivery platforms, home delivery was preferred over health facilities in most countries. The main reason was the convenience of home deliveries. Nevertheless, there were rare instances in which, Ethiopian participants preferred health facility to home delivery (74%). Further, if home delivery occurred, they indicated that they would prefer receiving the supplements twice per month rather than weekly (63%); however, details were not provided for this preference [59].

Given the limited evidence on the feasibility of BEP supplementation home delivery in non-study conditions, testing the feasibility of home-delivered food supplements among pregnant and breastfeeding women before implementation while considering product form, preparation type, and weight, transportation and distribution (including frequency of delivery), storage, cost, and household sharing of these supplements would be worthwhile in each setting. Delivery approaches that bring BEP supplementation closer to the homes of pregnant and breastfeeding women may particularly improve access to adequate nutrition in remote or marginalized communities [60].

Studies document community health workers provide supplementary or therapeutic foods to undernourished children at community health posts in Africa. Expanding these services to eligible pregnant and breastfeeding women and not only those treated at supplementary feeding programs may improve their nutritional status [61–63]. Although these are not home deliveries to pregnant and breastfeeding women, these delivery points are closer to the recipients' (children with undernutrition) homes. The indirect evidence from IFA and MMS (Results in S1 Appendix and corresponding S2 Table) also supports this model of enhancing health facility delivery with home delivery and/or community mobilization in promoting supplement adherence [29,32,37,40,43,58]. Health posts rather than health centers could facilitate the delivery of BEP supplementation interventions for pregnant or breastfeeding women as well. However, the feasibility of this hypothesis (i.e., using community health workers to deliver BEP supplements to beneficiaries) would need to be tested before implementation in ANC.

We postulate that community-based delivery (including home or health post-delivery) of the BEP supplement may be as effective as health facility delivery in improving nutrition outcomes for pregnant and breastfeeding women, based on evidence from children. For instance, the proportion of children recovered from undernutrition in community-based deliveries of supplementary or therapeutic food supplements is similar to that in facility-based deliveries [61,62,64]. However, there are concerns about the home delivery of BEP supplements by community health workers, including inadequate skilled human resources (such as knowledgeable community health workers) and a lack of safe storage (due to pests and rodents, and inadequate temperatures and ventilation) for the supplements [48,63,65]. This aspect was also noted in the indirect evidence on IFA and MMS (Results in S1 Appendix and corresponding S2 Table) and in some settings community health workers were limited to providing only nutrition counselling [57]. Notably, in 2018, WHO recognized the potential of community health workers in delivering health interventions but highlighted the need for supportive systems to ensure effective health service delivery [66]. Specific to therapeutic food distribution, the 2023 WHO guideline on managing acute malnutrition in children allows community health workers to treat undernutrition, but they need to receive adequate training and supervision [66]. WHO could consider recommending individual screening of women with undernutrition, in addition to population-level screening when resources are limited.

Although some pregnant and breastfeeding women reported willingness to pay BEP supplements in the form of LNS, no published studies have tested this mode of delivery instead, participants were only asked about their willingness to pay for these supplements. Notably, two studies that tested willingness to pay for BEP supplements in LNS form should be interpreted with caution. These supplements provide 237 kcals and 5.2 g of protein for a 40 g ration [19] and 118 kcals and 3 g of protein for a 20 g ration [25], respectively, which although the energy provided from protein is still less than 25% (per definition of BEP supplements), the total energy and protein may not be enough to cover the energy needs of pregnant or breastfeeding women. In addition, the studies that provided food baskets, food supplements, grains, and cash transfers did not report on the nutrition composition of these foods or what participants purchased; as such, we are not certain if they would qualify as BEP supplements. Separately, based on the indirect evidence on IFA and MMS (Results in S1 Appendix and corresponding S2 Table), an ongoing trial aims to assess the effectiveness of delivering IFA supplements through market-based approaches and will provide more insights on the purchasing behavior of pregnant women [10]. Nevertheless, there is still a need for more studies investigating the purchasing behavior of pregnant and breastfeeding women, specifically for food supplements like BEP supplements, rather than only tablets like IFA or MMS, across different factors such as price points and affordability.

Key strengths of this scoping review include its comprehensiveness, recency, and novelty in focusing on BEP supplements. A similar review previously conducted assessed the evidence of community-based distribution of maternal nutrition supplements in LMICs and emphasized coverage and adherence [67]. A notable difference from the earlier review is that it identified only four studies, whereas we identified 22 (plus 26 studies focused on IFA and MMS), indicating a broader, more diverse evidence base. Another similar review, which focused solely on IFA supplementation, concluded that community-based platforms, such as door-to-door delivery and health posts, improved uptake and compliance [68]. Notably, some of the included studies recruited children, men, and women of reproductive age. Home delivery was implemented by community health workers and community volunteers. Most of the literature on the home distribution of IFA in earlier reviews was from South Asia, where community health workers provided IFA supplementation at home. In their narrative review, Kavle and Landry [68] concluded that community-based platforms, such as door-to-door delivery and health posts, improved uptake and compliance [68]. A key limitation of this scoping review is the lack of direct evidence on the acceptability and feasibility of different BEP supplementation delivery platforms given in the ANC context, especially along co-interventions. We also evaluated the IFA and MMS indirect evidence to inform hypotheses on delivery mechanisms for BEP supplementation. However, the delivery platforms for IFA and MMS are not directly comparable to BEP supplementation delivery platforms for pregnant and breastfeeding women because BEP supplements tend to be heavier and bulkier, differ in form and preparation, are costlier and more vulnerable to damage during storage and transport. In addition, they are often shared with household members unlike tablets like MMS and IFA.

Conclusion

Across LMIC settings, BEP supplements reached pregnant and breastfeeding participants through several platforms, community feeding centers, home delivery, health facility, and market delivery. However, two patterns stood out: home delivery, either as the primary channel or as an enhanced ANC model that pairs routine health facility distribution with home visits, behavior-change counseling, directly observed intake, or social mobilization. The latter delivery platform appears more promising than health facility-only delivery. Next, community feeding centers were primarily used in South Asia, and evidence of market-based approaches remains scarce. Given substantial heterogeneity in health-system capacity, geography, and social norms, no single delivery platform is universally optimal. In addition, future studies should assess the requirements to include BEP supplements to the existing ANC services provided and the most feasible platform. Policymakers and implementers may consider approaches that adopt a flexible, context-specific, and evidence-driven approach that combines facility- and community-based delivery to strengthen reach and adherence. National programs are encouraged to embed formative research into planning cycles to identify context-specific delivery

barriers and enablers, and to commission pragmatic evaluations. Evidence from such evaluations should inform adaptive policy design and sustainable scale-up strategies.

Supporting Information

S1 Checklist. Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist.
(DOCX)

S1 Table. Web of Science Search Strategy for Balanced Energy and Protein (BEP) Supplementation Delivery Platforms: Scoping Review.
(DOCX)

S2 Table. Included Studies on Delivery Platforms for Iron and Folic Acid, and Multiple Micronutrient Supplements Among Pregnant and Breastfeeding Women.
(DOCX)

S1 Appendix. Indirect Evidence on IFA and MMS Supplementation.
(DOCX)

Author contributions

Conceptualization: Mihaela Ciulei Kissell, Isabel Potani, Filomena Gomes, Rimu Byadya, Lisa M. Rogers.

Data curation: Isabel Potani.

Formal analysis: Mihaela Ciulei Kissell, Isabel Potani, Carolina Pereira, Elisabeth T. Mukendi.

Funding acquisition: Martin N. Mwangi.

Investigation: Mihaela Ciulei Kissell, Isabel Potani.

Methodology: Mihaela Ciulei Kissell, Isabel Potani, Filomena Gomes, Rimu Byadya, Lisa M. Rogers.

Project administration: Mihaela Ciulei Kissell, Martin N. Mwangi.

Resources: Mihaela Ciulei Kissell, Martin N. Mwangi.

Software: Martin N. Mwangi.

Supervision: Mihaela Ciulei Kissell, Martin N. Mwangi.

Validation: Mihaela Ciulei Kissell, Isabel Potani, Vani Sethi, Charity Zvandaziva, Saskia de Pee.

Visualization: Isabel Potani.

Writing – original draft: Isabel Potani.

Writing – review & editing: Mihaela Ciulei Kissell, Isabel Potani, Carolina Pereira, Elisabeth T. Mukendi, Vani Sethi, Filomena Gomes, Saskia J.M. Osendarp, Charity Zvandaziva, Saskia de Pee, Martin N. Mwangi.

References

1. Bhutta ZA, Das JK, Rizvi A, Gaffey MF, Walker N, Horton S, et al. Evidence-based interventions for improvement of maternal and child nutrition: what can be done and at what cost?. Lancet. 2013;382(9890):452–77. https://doi.org/10.1016/S0140-6736(13)60996-4 PMID: 23746776
2. World Health Organization. WHO recommendations on antenatal care for a positive pregnancy experience. World Health Organization. 2016.
3. Ota E, Hori H, Mori R, Tobe-Gai R, Farrar D. Antenatal dietary education and supplementation to increase energy and protein intake. Cochrane Database Syst Rev. 2015;2015(6):CD000032. https://doi.org/10.1002/14651858.CD000032.pub3 PMID: 26031211

4. WHO antenatal care recommendations for a positive pregnancy experience: nutritional interventions update: multiple micronutrient supplements during pregnancy. Geneva: World Health Organization. 2020. http://www.ncbi.nlm.nih.gov/books/NBK560384/
5. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. Ann Intern Med. 2018;169(7):467–73. https://doi.org/10.7326/M18-0850 PMID: 30178033
6. Veritas Health Innovation. Covidence systematic review software. Meldborne, Australia: Veritas Health Innovation.
7. Janmohamed A, Karakochuk CD, Boungnasiri S, Whitfield KC, Chapman GE, Janssen P, et al. Factors affecting the acceptability and consumption of Corn Soya Blend Plus as a prenatal dietary supplement among pregnant women in rural Cambodia. Public Health Nutr. 2016;19(10):1842–51. https://doi.org/10.1017/S1368980015003018 PMID: 26471409
8. Silubonde TM, Draper CE, Baumgartner J, Ware LJ, Smuts CM, Norris SA. Barriers and facilitators of micronutrient supplementation among non-pregnant women of reproductive age in Johannesburg, South Africa. PLOS Glob Public Health. 2022;2(11):e0001310. https://doi.org/10.1371/journal.pgph.0001310 PMID: 36962846
9. Kalbarczyk A, de Boer M, Khaled N, Chakraborty B, Rahman A, Zavala E, et al. Assessing implementation outcomes for launching balanced energy protein supplementation: A formative study in rural Bangladesh. Matern Child Nutr. 2024;20 Suppl 6(Suppl 6):e13606. https://doi.org/10.1111/mcn.13606 PMID: 38087927
10. Hossain M, Sanin KI, Haque MA, Mbuya MNN, Ghosh S, Aksari S, et al. Evaluating the impact of a countrywide, market-based roll-out of multiple micronutrient supplementation on low birth weight in Bangladesh: protocol for a two-arm, quasi-experimental and mixed-methods evaluation study. BMJ Open. 2022;12(5):e060230. https://doi.org/10.1136/bmjopen-2021-060230 PMID: 35636782
11. Ahamed F, Yadav K, Kant S, Saxena R, Bairwa M, Pandav CS. Effect of directly observed oral iron supplementation during pregnancy on iron status in a rural population in Haryana: A randomized controlled trial. Indian J Public Health. 2018;62(4):287–93. https://doi.org/10.4103/ijph.IJPH_313_17 PMID: 30539891
12. Shamim AA, Hanif AAM, Merrill RD, Campbell RK, Kumkum MA, Shaikh S, et al. Preferred delivery method and acceptability of Wheat-Soy Blend (WSB++) as a daily complementary food supplement in northwest Bangladesh. Ecol Food Nutr. 2015;54(1):74–92. https://doi.org/10.1080/03670244.2014.930030 PMID: 25427283
13. Clermont A, Kodish SR, Matar Seck A, Salifou A, Rosen J, Grais RF, et al. Acceptability and Utilization of Three Nutritional Supplements during Pregnancy: Findings from a Longitudinal, Mixed-Methods Study in Niger. Nutrients. 2018;10(8):1073. https://doi.org/10.3390/nu10081073 PMID: 30103529
14. Eglovitch M, Abate FW, Shifraw T, Shiferie F, Amanuel H, Tadesse AW, et al. Balanced Energy Protein Supplementation in Pregnancy: Adherence and Acceptability among Pregnant Women in Rural Ethiopia. Curr Dev Nutr. 2024;8(7):103796. https://doi.org/10.1016/j.cdnut.2024.103796 PMID: 39055242
15. Lama TP, Khatry SK, Isanaka S, Moore K, Jones L, Bedford J, et al. Acceptability of 11 fortified balanced energy-protein supplements for pregnant women in Nepal. Matern Child Nutr. 2022;18(3):e13336. https://doi.org/10.1111/mcn.13336 PMID: 35263004
16. Novak M. Food supplementation, nutritional intake of recipients and operational aspects: an integrated pilot nutrition initiative of BRAC. Public Health Nutr. 2006;9(5):557–62. https://doi.org/10.1079/phn2005896 PMID: 16923286
17. de Kok B, Moore K, Jones L, Vanslambrouck K, Toe LC, Ouédraogo M, et al. Home consumption of two fortified balanced energy protein supplements by pregnant women in Burkina Faso. Matern Child Nutr. 2021;17(3):e13134. https://doi.org/10.1111/mcn.13134 PMID: 33405368
18. Lama TP, Moore K, Isanaka S, Jones L, Bedford J, de Pee S, et al. Compliance with and acceptability of two fortified balanced energy protein supplements among pregnant women in rural Nepal. Matern Child Nutr. 2022;18(2):e13306. https://doi.org/10.1111/mcn.13306 PMID: 34908227
19. Isanaka S, Kodish SR, Mamaty AA, Guindo O, Zeilani M, Grais RF. Acceptability and utilization of a lipid-based nutrient supplement formulated for pregnant women in rural Niger: a multi-methods study. BMC Nutr. 2019;5:34. https://doi.org/10.1186/s40795-019-0298-3 PMID: 32153947
20. Nguyen PH, Kachwaha S, Tran LM, Avula R, Young MF, Ghosh S. Strengthening nutrition interventions in antenatal care services affects dietary intake, micronutrient intake, gestational weight gain, and breastfeeding in Uttar Pradesh, India: Results of a cluster-randomized program evaluation. J Nutr. 2021;151:2282–95.
21. Chudasama RK, Patel UV, Kadri AM, Mitra A, Thakkar D, Oza J. Evaluation of integrated Child Development Services program in Gujarat, India for the years 2012 to 2015. Indian J Public Health. 2016;60(2):124–30. https://doi.org/10.4103/0019-557X.184544 PMID: 27350706
22. Waheedul Hoque AM Jr. Compliance to Intake of Prenatal Supplements among Rural Pregnant Women - an Observational Study in Two Sub-districts in Rural Bangladesh. Malays J Nutr. 2010;16(2):323–5. PMID: 22691936
23. Sethi V, Tiwari K, Sareen N, Singh S, Mishra C, Jagadeeshwar M, et al. Delivering an Integrated Package of Maternal Nutrition Services in Andhra Pradesh and Telangana (India). Food Nutr Bull. 2019;40(3):393–408. https://doi.org/10.1177/0379572119844142 PMID: 31204503
24. Ramakrishnan U, Lowe A, Vir S, Kumar S, Mohanraj R, Chaturvedi A, et al. Public health interventions, barriers, and opportunities for improving maternal nutrition in India. Food Nutr Bull. 2012;33(2 Suppl):S71-92. https://doi.org/10.1177/15648265120332S105 PMID: 22913108
25. Adams KP, Vosti SA, Ayifah E, Phiri TE, Adu-Afarwuah S, Maleta K, et al. Willingness to pay for small-quantity lipid-based nutrient supplements for women and children: Evidence from Ghana and Malawi. Matern Child Nutr. 2018;14(2):e12518. https://doi.org/10.1111/mcn.12518 PMID: 28960913
26. Bhatnagar S, Dharamshaktu NS, Sundaram KR, Seth V. Effect of food supplementation in the last trimester of pregnancy and early post-natal period on maternal weight and infant growth. Indian J Med Res. 1983;77:366–72. PMID: 6874019

27. Coreil J. Maternal-child supplementary feeding programmes in Haiti. J Trop Pediatr. 1987;33(4):203–7. https://doi.org/10.1093/tropej/33.4.203 PMID: 3669138
28. Palivela D, Shehnaz SI, Chaturvedula L. Effect of direct monitoring by family members and counseling by health professionals on iron-folic acid supplementation: A cross-sectional study among pregnant women in Puducherry, India. J Family Community Med. 2021;28(2):85–93. https://doi.org/10.4103/jfcm.JFCM_445_20 PMID: 34194272
29. Koné S, Probst-Hensch N, Dao D, Utzinger J, Fink G. 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 Glob Health. 2023;8(4):e010934. https://doi.org/10.1136/bmjgh-2022-010934 PMID: 37076197
30. Ouedraogo CT, Wessells KR, Young RR, Bamba IF, Faye MT, Banda N, et al. The mixed effects of a package of multilevel interventions on the health and care of pregnant women in Zinder, Niger. BMJ Glob Health. 2019;4(6):e001200. https://doi.org/10.1136/bmjgh-2018-001200 PMID: 31908852
31. Seck BC, Jackson RT. Determinants of compliance with iron supplementation among pregnant women in Senegal. Public Health Nutr. 2008;11(6):596–605. https://doi.org/10.1017/S1368980007000924 PMID: 17764606
32. Zeng L, Yan H, Cheng Y, Dang S, Dibley MJ. Adherence and costs of micronutrient supplementation in pregnancy in a double-blind, randomized, controlled trial in rural western China. Food Nutr Bull. 2009;30(4 Suppl):S480-7. https://doi.org/10.1177/15648265090304S402 PMID: 20120789
33. Gebremichael TG, Welesamuel TG. Adherence to iron-folic acid supplement and associated factors among antenatal care attending pregnant mothers in governmental health institutions of Adwa town, Tigray, Ethiopia: Cross-sectional study. PLoS One. 2020;15(1):e0227090. https://doi.org/10.1371/journal.pone.0227090 PMID: 31910215
34. Mbhenyane X, Cherane M. Compliance with the consumption of iron and folate supplements by pregnant women in Mafikeng local municipality, North West province, South Africa. Afr Health Sci. 2017;17(3):657–70. https://doi.org/10.4314/ahs.v17i3.8 PMID: 29085393
35. Paulino LS, Angeles-Agdeppa I, Etorma UMM, Ramos AC, Cavalli-Sforza T. Weekly iron-folic acid supplementation to improve iron status and prevent pregnancy anemia in Filipino women of reproductive age: the Philippine experience through government and private partnership. Nutr Rev. 2005;63(12 Pt 2):S109-15. https://doi.org/10.1301/nr.2005.dec.s109-s115 PMID: 16466086
36. Ridwan N, Shafi A. Adherence to iron folate supplementation and associated factors among pregnant women attending antenatal care at public hospitals in Jigjiga Town, Somali Region, Ethiopia. Pan Afr Med J. 2021;40:196–196. https://doi.org/10.11604/pamj.2021.40.196.27958
37. Shankar AV, Asrilla Z, Kadha JK, Sebayang S, Apriatni M, Sulastri A, et al. Programmatic effects of a large-scale multiple-micronutrient supplementation trial in Indonesia: using community facilitators as intermediaries for behavior change. Food Nutr Bull. 2009;30(2 Suppl):S207-14. https://doi.org/10.1177/15648265090302S204 PMID: 20496613
38. Kamau MW, Kimani ST, Mirie W, Mugoya IK. 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. 2020;15(1):e0227351. https://doi.org/10.1371/journal.pone.0227351 PMID: 31923240
39. Nguyen PH, Frongillo EA, Sanghvi T, Kim SS, Alayon S, Tran LM, et al. Importance of coverage and quality for impact of nutrition interventions delivered through an existing health programme in Bangladesh. Matern Child Nutr. 2018;14(4):e12613. https://doi.org/10.1111/mcn.12613 PMID: 29656488
40. Risonar MGD, Rayco-Solon P, Tengco LW, Sarol JN, Paulino LS, Solon FS. Effectiveness of a redesigned iron supplementation delivery system for pregnant women in Negros Occidental, Philippines. Public Health Nutrition. 2009;12:932–40. https://doi.org/10.1017/S1368980008003418
41. Kim SS, Zagré RR, Ouédraogo CT, Sununtnasuk C, Ganaba R, Zafimanjaka MG, et al. Intensified Nutrition Interventions in Antenatal Care Services Increased Consumption of Iron and Folic Acid Supplements and Early Breastfeeding Practices in Burkina Faso: Results of a Cluster-Randomized Program Evaluation. J Nutr. 2023;153(10):3058–67. https://doi.org/10.1016/j.tjnut.2023.06.016 PMID: 37336320
42. Birhanu Z, Chapleau GM, Ortolano SE, Mamo G, Martin SL, Dickin KL. Ethiopian women's perspectives on antenatal care and iron-folic acid supplementation: Insights for translating global antenatal calcium guidelines into practice. Matern Child Nutr. 2018;14 Suppl 1(Suppl 1):e12424. https://doi.org/10.1111/mcn.12424 PMID: 29493899
43. Nguyen PH, Kim SS, Sanghvi T, Mahmud Z, Tran LM, Shabnam S, et al. Integrating Nutrition Interventions into an Existing Maternal, Neonatal, and Child Health Program Increased Maternal Dietary Diversity, Micronutrient Intake, and Exclusive Breastfeeding Practices in Bangladesh: Results of a Cluster-Randomized Program Evaluation. J Nutr. 2017;147(12):2326–37. https://doi.org/10.3945/jn.117.257303 PMID: 29021370
44. Omotayo MO, Dickin KL, Pelletier DL, Martin SL, Kung'u JK, Stoltzfus RJ. Feasibility of integrating calcium and iron-folate supplementation to prevent preeclampsia and anemia in pregnancy in primary healthcare facilities in Kenya. Matern Child Nutr. 2018;14 Suppl 1(Suppl 1):e12437. https://doi.org/10.1111/mcn.12437 PMID: 29493897
45. Khan NC, Thanh HTK, Berger J, Hoa PT, Quang ND, Smitasiri S, et al. 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. Nutr Rev. 2005;63(12 Pt 2):S87-94. https://doi.org/10.1301/nr.2005.dec.s87-s94 PMID: 16466084
46. Khaled N, Kalbarczyk A, Zavala E, Rahman A, de Boer M, Chakraborty B, et al. A formative study of the sociocultural influences on dietary behaviours during pregnancy in rural Bangladesh. Matern Child Nutr. 2024;20 Suppl 6(Suppl 6):e13713. https://doi.org/10.1111/mcn.13713 PMID: 39212336

47. Singh PK, Dubey R, Singh L, Kumar C, Rai RK, Singh S. Public health interventions to improve maternal nutrition during pregnancy: a nationally representative study of iron and folic acid consumption and food supplements in India. Public Health Nutr. 2020;23(15):2671–86. https://doi.org/10.1017/S1368980020001007 PMID: 32605672

48. Dhasmana A, Seferidi P, Sharma V, Kohli S, Ghosh-Jerath S. Opportunities for enhancing dietary diversity and environmental sustainability of supplementary nutrition program under the Integrated Child Development Services Scheme - a qualitative study in Srikakulam district, Andhra Pradesh. BMC Public Health. 2025;25(1):3238. https://doi.org/10.1186/s12889-025-24313-8 PMID: 41029566

49. Dolati S, Barzegar A, Mohammadi-Nasrabadi F, Abdollahi M, Khodayari-Zarnaq R. Cash transfer program on pregnancy outcomes and infant growth in deprived pregnant and lactating mothers in iran: a field trial. BMC Public Health. 2025;25(1):2219. https://doi.org/10.1186/s12889-025-23451-3 PMID: 40604603

50. Ashraf K, Dibley MJ, Ikram J, Umer M, Khan GN, Chauhadry IA, et al. The Effectiveness of Nutritional Interventions on Maternal and Childhood Anaemia in Sindh, Pakistan. Nutrients. 2025;17(23):3701. https://doi.org/10.3390/nu17233701 PMID: 41373992

51. Shifraw T, Berhane HY, Tsegaye S, Gulema H, Sime H, Berhane YY, et al. Acceptability and adherence of Balanced Energy Protein (BEP) supplementation among pregnant women in Addis Ababa, Ethiopia: A Formative Study. PLoS One. 2026;21(3):e0344089. https://doi.org/10.1371/journal.pone.0344089 PMID: 41790767

52. Nguyen PH, Avula R, Neupane S, Akseer N, Heidkamp R. Identifying measures for coverage of nutrition-sensitive social protection programs: Learnings from India. Matern Child Nutr. 2024;20(4):e13661. https://doi.org/10.1111/mcn.13661 PMID: 38864174

53. Sahu DP, Preeti PS, Singh AK, Bhatia V. Service Gap Assessment of Village Health and Nutrition Day Services in a Rural Block of Eastern Odisha: A Mixed-method Study. Indian J Community Med. 2025;50(Suppl 1):S35–40. https://doi.org/10.4103/ijcm.ijcm_293_23 PMID: 40949520

54. Sununtnasuk C, D'Agostino A, Fiedler JL. Iron+folic acid distribution and consumption through antenatal care: identifying barriers across countries. Public Health Nutr. 2016;19(4):732–42. https://doi.org/10.1017/S1368980015001652 PMID: 26022914

55. Titaley CR, Dibley MJ. Factors associated with not using antenatal iron/folic acid supplements in Indonesia: the 2002/2003 and 2007 Indonesia Demographic and Health Survey. Asia Pac J Clin Nutr. 2015;24(1):162–76. https://doi.org/10.6133/apjcn.2015.24.1.10 PMID: 25740755

56. Wana EW. Predictors of prenatal iron folic acid supplement utilization in Wolaita, South Ethiopia: a community based cross-sectional study (quantitative and qualitative approach). BMC Pregnancy Childbirth. 2020;20(1):243. https://doi.org/10.1186/s12884-020-02883-2 PMID: 32334544

57. Siekmans K, Roche M, Kung'u JK, Desrochers RE, De-Regil LM. Barriers and enablers for iron folic acid (IFA) supplementation in pregnant women. Matern Child Nutr. 2018;14 Suppl 5(Suppl 5):e12532. https://doi.org/10.1111/mcn.12532 PMID: 29271115

58. Hess SY, Ouédraogo CT, Bamba IF, Wessells KR, Keith N, Faye T, et al. Using formative research to promote antenatal care attendance and iron folic acid supplementation in Zinder, Niger. Matern Child Nutr. 2018;14(2):e12525. https://doi.org/10.1111/mcn.12525 PMID: 28924978

59. Eglovitch M, Abate FW, Shifraw T, Shiferie F, Amanuel H, Tadesse AW, et al. Balanced Energy Protein Supplementation in Pregnancy: Adherence and Acceptability among Pregnant Women in Rural Ethiopia. Curr Dev Nutr. 2024;8(7):103796. https://doi.org/10.1016/j.cdnut.2024.103796 PMID: 39055242

60. Donnelly A. Review of the Use of Balanced Energy Protein (BEP) Supplementation for Pregnant and Breastfeeding Women and Girls (PBW/G). Global Nutrition Cluster, WFP, United Nations World Food Programme. 2023. https://resourcecentre.savethechildren.net/document/review-of-the-use-of-balanced-energy-protein-bep-supplementation-for-pregnant-and-breastfeeding-women-and-girls-pbw-g/

61. Puett C, Sadler K, Alderman H, Coates J, Fiedler JL, Myatt M. Cost-effectiveness of the community-based management of severe acute malnutrition by community health workers in southern Bangladesh. Health Policy Plan. 2013;28(4):386–99. https://doi.org/10.1093/heapol/czs070 PMID: 22879522

62. Van Boetzelaer E, Zhou A, Tesfai C, Kozuki N. Performance of low-literate community health workers treating severe acute malnutrition in South Sudan. Matern Child Nutr. 2019;15 Suppl 1(Suppl 1):e12716. https://doi.org/10.1111/mcn.12716 PMID: 30748111

63. López-Ejeda N, Charle Cuellar P, Vargas A, Guerrero S. Can community health workers manage uncomplicated severe acute malnutrition? A review of operational experiences in delivering severe acute malnutrition treatment through community health platforms. Matern Child Nutr. 2019;15(2):e12719. https://doi.org/10.1111/mcn.12719 PMID: 30315743

64. Puett C, Coates J, Alderman H, Sadler K. Quality of care for severe acute malnutrition delivered by community health workers in southern Bangladesh. Matern Child Nutr. 2013;9(1):130–42. https://doi.org/10.1111/j.1740-8709.2012.00409.x PMID: 22515318

65. Puett C, Coates J, Alderman H, Sadruddin S, Sadler K. Does greater workload lead to reduced quality of preventive and curative care among community health workers in Bangladesh?. Food Nutr Bull. 2012;33(4):273–87. https://doi.org/10.1177/156482651203300408 PMID: 23424894

66. World Health Organization. WHO guideline on the prevention and management of wasting and nutritional oedema (acute malnutrition) in infants and children under 5 years. World Health Organization. 2023. https://www.ncbi.nlm.nih.gov/books/NBK601660/

67. McKerricher L, Petrucka P. Maternal nutritional supplement delivery in developing countries: a scoping review. BMC Nutr. 2019;5:8. https://doi.org/10.1186/s40795-019-0270-2 PMID: 32153922

68. Kavle JA, Landry M. Community-based distribution of iron-folic acid supplementation in low- and middle-income countries: a review of evidence and programme implications. Public Health Nutr. 2018;21(2):346–54. https://doi.org/10.1017/S1368980017002828 PMID: 29061205