

A conceptual model and framework of nutrition-sensitive and specific interventions across Life stages in India

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ABSTRACT

A large segment of the maternal and child population in low- and middle-income countries (LMIC) is malnourished. There has been a considerable amount of literature on different evidence-based actions that work well with pregnant women or lactating mothers. However, we lack a comprehensive framework of evidence-based nutrition interventions for LMIC that endorse actions along the life course, that is, from adolescence to lactation and childhood, for improved child health and nutrition. Considering the need, this study aimed to explore and design a model and framework for improving maternal and child nutrition. A systematic review of the literature was conducted to identify evidence-based interventions that reduce malnutrition and improve maternal and child health and nutrition. The literature search was made using Google, Google Scholar, and PubMed. The search of the literature in the last 5 years was made. Our conceptual model illustrates key nutrition approaches at different levels (from individual to system levels). The promotion, prevention, monitoring, and management framework (based on nutrition-specific interventions) sorts out actions across each set of the population (pregnant, lactating, and newly married women and adolescent girls) for improved nutrition and health. Our nutrition-sensitive intervention framework, in the way to target basic causes of undernutrition, highlight actions that may result in improved maternal and child health and nutrition in the long run. Encapsulating the wide array of interventions across the life course, our model and framework hold importance as they contain evidence-based actions as suggested by the international agencies and are contextualized for India.

Keywords: Anemia, implementation science, life cycle stages, malnutrition, micronutrients

Introduction

Nutrition has become a significant global agenda. The global nutrition report underlined that 12 out of 17 Sustainable Development Goals (SDG) contain indicators, which are highly relevant for nutrition.^[1] In the recent advances, the World Health Organization, governments of India and other low middle-income countries (LMIC), and global advocates of maternal and child health have highlighted the need to act immediately on the nutritional gaps prevailing worldwide.^[2] The background for

such a heightened response from the international community comes from the poor nutritional status of a large segment of the maternal and child population in LMIC, enhanced after the COVID-19 pandemic.^[3]

Globally, 150 million children under-5 years of age are stunted (characterized by short height-for-age), and an estimated 50 million children are wasted (characterized by low weight-for-height). Nearly 20 million children are born with low-birth weight (birth weight less than 2500 g) worldwide, and half of these births occur in only three countries (India, Pakistan, and Nigeria). India alone makes up 38% of the global number.^[4] Also, globally, an estimated 2 billion people are affected by deficiencies in at least one of the five essential micronutrients (Iron, Vitamin A, Iodine, Zinc, and Folate).^[5]

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One of the major underlying causes of the poor nutritional status of children in LMIC is the poor nutritional status of women, which, at large, is determined by their poor socio-demographic status.^[6] Globally, 613 million women (both pregnant and lactating mothers and adolescent girls) suffer from anemia, and an over half of these live in Asia.^[4] At the global level, the maternal mortality ratio is 211 per 1,00,000 live births (2017).^[7] The adolescent birth rate is 44 births per 1000 girls globally.^[8] Other determinants of the nutritional status of children include poverty and safe drinking water, and sanitation hygiene.^[9] An estimated 34% of children worldwide live with multidimensional poverty.^[10] Around 60% of the world lack access to safely managed sanitation services, and 3 out of 10 lack safely managed water services.^[11,12]

Amidst these poor nutritional and hygiene indicators, the nations that bear this burden have not only unhealthy and less productive populations but also face economic losses. It has been proposed that all forms of malnutrition (undernutrition, micronutrient deficiencies, and over-nutrition) cost the global economy an estimated US\$ 3.5 trillion per year. What makes up interesting learning from these figures and studies in the past is to invest in interventions at the primary level of prevention such as health education and promotion than secondary or tertiary level such as treatment and cure for these illnesses. Returns on every dollar invested in attaining global nutrition targets range from US\$ 4 for wasting to US\$ 11 for stunting and could be as high as US\$ 35 for breastfeeding promotion.^[13]

Looking at the gaps and scope to implement evidence-based actions for improving the nutritional status of children, the 1000 days approach is the most effective option. The first 1000 days of a child provides an opportunity for interventionists to prevent the transgenerational transfer of malnutrition and micronutrient deficiencies. In the 1000 days framework, the first 300 days revolves around the time of conception and spans the duration of pregnancy and the first several weeks of life.^[14] The development origin of health and diseases (DOHAD) concept illustrates how important the health and nutritional status of the mother during pregnancy is, such that it influences the development of a fetus that has an impact for rest of his life.^[15] The next 700 days are crucial for a newborn. The establishment of successful infant and young child feeding (IYCF) practices not only has influences on child mortality but also long-term effects on the physical and cognitive development of a child and economic consequences for the nation.^[14] For obtaining outcomes and results with a significant impact on child health, it is indeed essential to work or engage with other groups of beneficiaries besides pregnant women, such as newly married women and adolescents. There has been a considerable amount of literature on different evidence-based actions that work well with pregnant women or lactating mothers. However, we lack a comprehensive framework of evidence-based nutrition interventions for LMIC that endorse actions along the life course, that is, from adolescence to lactation and childhood, for improved child health and nutrition. Considering the need, this

study aimed to explore and design a model and framework for improving maternal and child nutrition.

Methods

A systematic review of the literature was conducted to identify evidence-based interventions that reduce malnutrition and improve maternal and child health and nutrition. The literature search was made using Google, Google Scholar, and PubMed. The search of the literature in the last five years was made. Besides, the websites of the agencies working comprehensively on nutrition were also searched for the relevant literature. Four groups of populations along the life course, namely pregnant women, lactating mothers, newly married women, and adolescent girls, were identified to deliver nutrition interventions and improved maternal and child health and nutrition. A model and two frameworks (nutrition-sensitive and specific) were developed manually.

Results

Nutrition interventions should be delivered at different levels, that is, from an individual (household level) to community to system levels. At the individual level, our model acknowledges three approaches during pregnancy and post-pregnancy, including iron-folic acid (IFA) and calcium supplementation, deworming, quality antenatal and postnatal care visits (with monitoring of weight, height, and hemoglobin levels during the antenatal and postnatal period, and counseling received on IYCF, and IFA, calcium, and healthy diet consumption during and after pregnancy), and visits at *Anganwadi* centers for supplementary food and health education [Figure 1]. Similarly, for adolescents, IFA/calcium supplementation and mid-day meals in schools, good water, sanitation and hygiene practices, and deworming are the proposed approaches.

We proposed three approaches for newly married women, including preconception care (screening for anemia, diabetes, hypertension, obesity or undernutrition, counseling for delayed pregnancy and any infections, such as reproductive tract or sexually transmitted infections), IFA, and calcium supplementation, and delay in the first pregnancy. For under-5 children, five approaches primarily, IFA, vitamin A, and zinc supplementation (during diarrheal episode), IYCF practices (exclusive breastfeeding, continued breastfeeding up to 23 months, colostrum feeding and early initiation of breastfeeding; and timely initiation of complementary feeding, minimally acceptable diet consumption), visit at *Anganwadi* centers for supplementary food, growth monitoring, and early childhood development, and screening and management of malnourished children with linkage to nutrition rehabilitation centers if needed.

Overall, at the household level, we advocate for five major approaches, including food security (through targeted public distribution), dietary diversification (enhanced micronutrients and bioavailability of diets), use of ⁺F fortified food and

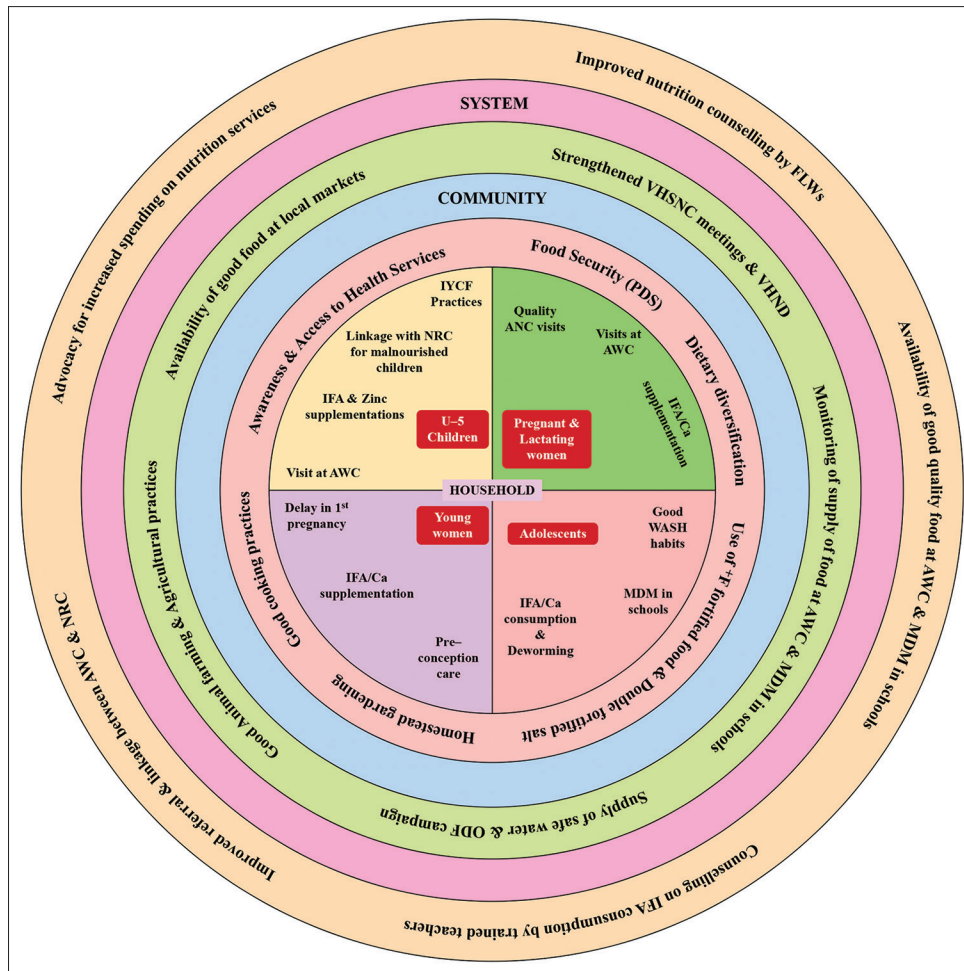


Figure 1: The conceptual model of nutrition interventions that are delivered at different levels, that is, from an individual (household level) to community to system levels. Abbreviations: AWC: Anganwadi Center; ANC: Antenatal Care; Ca: Calcium; FLWs: Frontline Workers; IFA: Iron Folic Acid; IYCF: Infant and Young Child Feeding Practices; MDM: Mid-day Meal; NRC: Nutrition Rehabilitation Center; ODF: Open Defecation Free; PDS: Public Distribution System; VHSNC: Village Health Sanitation and Nutrition Committee; VHND: Village Health and Nutrition Day; WASH: Water and Sanitation Hygiene

double fortified salt, homestead gardening (kitchen gardens), good cooking practices, and health literacy through increased awareness about balanced diet and access to health services. At the community level, five approaches include regular observation of village health sanitation and nutrition committee meetings, and village and health nutrition days, monitoring of the regular and good quality supply of supplementary food at *Anganwadi* centers and mid-day meals in schools, regular and continuous supply of safe drinking water, and strengthened open defecation free (ODF) campaign, sustainable and good animal farming and agricultural practices, and availability of nutritious, good quality, and fresh foods in the local markets.

At last, at the system level, we advocate for basic five approaches, including improved nutrition counseling to pregnant and lactating women by frontline workers (counseling on dietary diversification of mothers, IFA/calcium consumption of mothers and children, diarrhea management in children, and IYCF), availability of good quality food at *Anganwadi* centers and mid-day meals in schools, improved counseling by school teachers on IFA

consumption to adolescents, improved referral and linkage between *Anganwadi* centers and nutrition rehabilitation centers, and increased spending on nutrition services through dedicated nutrition budget.

Keeping UNICEF’s framework of nutrition-specific and sensitive interventions at the center stage, we developed a framework of nutrition-specific interventions. The nutrition-specific interventions that address immediate causes of malnutrition have been categorized into four domains (promotion, prevention, management, and monitoring; p^2m^2) for each of the four groups of populations (pregnant women, lactating mothers, newly married women, and adolescent girls), which provide us with opportunities to implement cost-effective and sustainable actions [Figure 2]. Similarly, nutrition-sensitive interventions that address the basic causes of undernutrition were listed for each of the four groups of populations [Figure 3]. The framework, as shown in Figure 1 that takes into account broad themes, which can be delineated further into granular details during activities in the field. The four domains of nutrition-sensitive

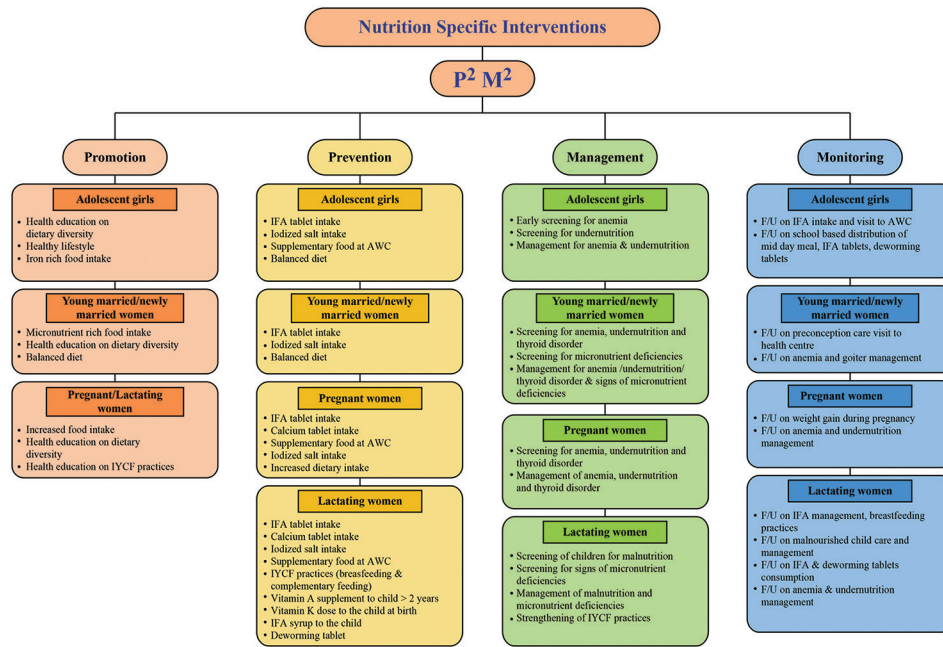


Figure 2: Nutrition-Specific Interventions framework categorized into four domains (promotion, prevention, management, and monitoring; p2m2) for each of the four groups of populations (pregnant women, lactating mothers, newly married females, and adolescent girls). Abbreviations: AWC: Anganwadi Center; IFA: Iron Folic Acid; IYCF: Infant and Young Child Feeding Practices; F/U: Follow-up

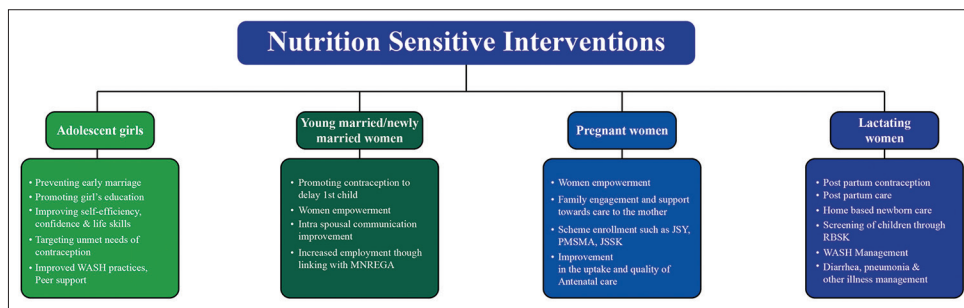


Figure 3: Nutrition-sensitive interventions listed for each of the four groups of populations (pregnant women, lactating mothers, newly married females, and adolescent girls) Abbreviations: JSY: Janani Suraksha Yojna; JSSK: Janani Shishu Suraksha Karyakaram; MNREGA: Mahatma Gandhi National Rural Employment Guarantee Act; PMSMA: Pradhan Mantri Surakshit Matritva Abhiyan; RBSK: Rashtriya Bal Swasthya Karyakaram; WASH: Water and Sanitation Hygiene

interventions (p²m²) revolve around the primary and secondary levels of prevention.

Nutrition-sensitive interventions for adolescents include prevention of early marriage, promotion of girls' education, improving self-efficacy, confidence, and life skills of adolescents, targeting their unmet needs of contraception, improved water and sanitation hygiene (WASH) practices, and peer support (under National Adolescent Health Program; *Rashtriya Kishore Swasthya Karyakaram*). Promoting contraception use to delay the first child, women empowerment (social, economic, and educational) for improved social well-being and decision-making, improved intra-spousal communication to promote women's role in household decision-making, and improved employment of women through linkage with employment generation schemes like the *Mahatma Gandhi National Rural Employment Guarantee Act* (MGNREGA) in

rural areas, urban livelihood mission, etc. are the major nutrition-sensitive interventions for young married women. Similarly, women empowerment for improved social well-being and decision-making, increased familial engagement, support, and care to mothers, enrollment in maternity schemes or programs like *Janani Suraksha Yojna* (conditional maternity benefit scheme), *Pradhan Mantri Surakshit Matritva Abhiyan*, *Pradhan Mantri Matru Vandana Yojna*, and *Janani Shishu Suraksha Karyakaram* (JSSK), and other state-specific schemes, and improved uptake of quality antenatal care. At last, for lactating mothers, enhanced post-partum contraception and care, home-based care of the newborn and infant, increased screening of children for defects, delays in development, diseases, and deficiencies under the national children health program (*Rashtriya Bal Swasthya Karyakaram*; RBSK) and effective management of diarrhea, pneumonia, and other childhood illnesses, and improved immunization.

Discussion

The conceptual model and intervention framework, as proposed in our study, highlight the key evidence-based interventions across the life course that save lives and are cost-effective. The Lancet Commission on maternal and child nutrition 2013 identified ten core interventions that affect adolescents, women of reproductive age, pregnant women, newborn babies, infants, and children.^[16] Most of our interventions in the model or framework are excerpts from the evidence-based interventions identified by the commission. Also, our model and framework work on the similar lines to UNICEF's conceptual framework of malnutrition, addressing most of the basic, underline, and immediate causes of malnutrition.^[17] However, the interventions suggested in our model or framework are contextualized for the Indian populations (system).

These interventions can be delivered through the existing platforms or programs of health and nutrition services. The national food security act 2013 guarantees people to receive highly subsidized food grains to meet their needs of basic foods for their active and healthy life. A life course approach to food security helps women ensuring basic foods.^[18] Anemia control among vulnerable populations has been emphasized under *Anemia Mukta Bharat* (AMB) program. The AMB program underlines six strategies, including increased testing and follow-up for hemoglobin, IFA tablets supplementation, deworming, intensive behavior change communication, mandatory provision of IFA fortified foods in public health programs, and address of non-nutritional causes of anemia, such as malaria, etc. The IFA supplementation is provided to all children between 6 months and 10 years, adolescents (10–19 years), women of reproductive age group (15–49 years), and pregnant and lactating women.^[19] With 46 years of existence, Integrated Child Development Service Scheme (ICDS) is one of the flagship programs of India that aims to improve the nutritional status of children (0–6 years) and pregnant and lactating women. The program envisages the provision of supplementary foods and health and nutrition education to children and their mothers through *Anganwadi* centers.^[20]

In 2018, the government of India launched *Poshan Abhiyan* (National Nutrition Mission) as an umbrella program to support nutrition interventions for children, adolescents, and mothers. Besides, the Abhiyan embraces the real-time monitoring of the ongoing nutrition programs in the country, improved training, and capacity building of frontline workers on nutrition (*Anganwadi* workers, *Accredited Social Health Activists*) through incremental learning approach and establishment of nutrition resource centers.^[21] Nutrition rehabilitation centers have been established in the country to restore severely acutely malnourished children.^[22] To ensure food security to children and adolescents in schools and improve school retention, the government of India has been running a mid-day meal program since 1997-98 across the country. The cooked food served in schools through mid-day meals aims to cover one-third

of the total calories and half of the protein requirements of children.^[23]

To address micronutrient deficiencies across populations, the government is operating programs like calcium supplementation during pregnancy and lactation, vitamin A prophylaxis program of under-5 children, vitamin K prophylaxis program for newborns in hospitals, and double fortification of food (+F for iron and iodine in salt).^[24-27] Breastfeeding promotion and appropriate complementary feeding practices have been prioritized in the country, and programs like Mothers Absolute Affection (MAA) and *Poshan Abhiyan* have pushed for this cause.^[21,28] Community health workers and other frontline workers have been trained on one-day orientation or 4-days training modules of infant and young child feeding practices.^[28]

The government is running multiple programs to address nutrition-sensitive interventions, such as the MGNREGA scheme to provide 100 days of work or unemployment wages for financial security to the poor. Various women empowerment schemes to support women socially and economically, like *Sudhar Greh*, *Naari Shakti*, etc., and *Sarv Shiksha Abhiyan* to increasing enrollment and retention of children in schools also exist.^[29-31] There is a list of cash transfer schemes that aim to improve maternal nutrition and care by providing cash incentives, such as *Pradhan Mantri Matru Vandana Yojna* (PMMVY), *Janani Suraksha Yojna* (JSY), and *Janani Shishu Suraksha Yojna* (JSSK). To ensure basic health and care facilities, including blood tests and other check-ups for pregnant women, *Pradhan Mantri Surakshit Matritva Abhiyan* (PMSMA) is observed 9th of every month.^[32] All the efforts need to be made to mobilize women for this *Abhiyan* and other conditional cash transfer schemes. Additionally, *Rashtriya Bal Swasthya Karyakaram* (RBSK) aims to ensure the screening of children from birth until 18 years of age for diseases, deficiencies, defects, and delays in development.^[33]

Adolescents are a nutritionally vulnerable group with high nutritional requirements of energy and proteins due to rapid growth and the greater demands in development.^[34] Adolescence provides a window of opportunity to prepare a woman for the additional demands of pregnancy and lactation. Also, increased nutrition knowledge and behavior during adolescence have long-lasting benefits on household dietary approaches.^[35] Adolescent girls who become pregnant are at very high probability of giving births to low birth weight and premature babies.^[34,35] Protein-energy supplementation is a proven effective intervention to address under-nutrition in adolescents and prevent adverse prenatal outcomes. Implementation of schemes such as *Kishori Shakti Yojna*, Rajiv Gandhi Scheme for the empowerment of Adolescent Girls (SABLA), *Beti Bachao Beti Padoo*, *Balika Samridhi Yojna*, is one of the steps in this direction in India.^[30]

Some of the nutrition-sensitive elements, such as prevention of intimate partner violence, birth spacing, prevention and treatment of STI/RTI/HIV/AIDS, tuberculosis, and vaccination against vaccine-preventable disease, are crucial. Further, besides the core

actions, other less addressed issues that need more strengthened implementation, such as deworming, screening, diagnosis and management of mental health disorders (depression or anxiety), and lifestyle modification (second-hand smoke exposure, substance abuse, and eating disorders).^[16,36] There is a need to include other determinants of health, such as the provision of sanitation and access to clean water, elimination of disease vectors, decreased indoor air pollution, and reducing exposure to lead, pesticides and chemicals.^[36]

Despite the plethora of programs and schemes in India, the country struggles with many health and nutrition challenges affecting millions of vulnerable women and children. Multiple studies highlight the poor implementation, monitoring, and evaluation of the national health and nutrition programs. Besides, the health workers need to be empowered technically and skillfully.^[37,38]

Relevance for primary care physicians

The model and framework embrace interventions that focus on a complex nutrition ecosystem affecting maternal and child nutrition. It can act as a reference tool for physicians and frontline workers to perform nutrition-specific actions from an individual to system level. Moreover, the paper highlights the key national health and nutrition programs/schemes directly or indirectly related to maternal and child nutrition. This will help primary physicians understand and roll out public health programs effectively in an integrated manner. The life course strategy, as detailed in the paper, broadens the thinking horizon of physicians from a vertical to a horizontal approach for managing malnutrition.

Conclusions

Encapsulating the wide array of interventions across the life course, our model and framework hold importance as they contain evidence-based actions as suggested by the international agencies and are contextualized for India. The public health specialist and interventionists at the ground level can refer to this model and framework for their communities. The conceptual model illustrates key nutrition approaches at different levels (from individual to system levels). The promotion, prevention, monitoring, and management framework (based on nutrition-specific interventions) sorts out actions across each set of population (pregnant, lactating, and newly married women and adolescent girls) for improved nutrition and health. Our nutrition-sensitive intervention framework in the way to target basic causes of undernutrition, highlight actions that may result in improved maternal and child health and nutrition in the long run.

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Conflicts of interest

There are no conflicts of interest.

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