Ready-to-use foods for management of moderate acute malnutrition: Considerations for scaling up production and use in programs

Saskia Osendarp, Beatrice Rogers, Kelsey Ryan, Mark Manary, Peter Akomo, Paluku Bahwere, Hilina Belete, Mamane Zeilani, Munirul Islam, Filippo Dibari, and Saskia de Pee

Abstract

Ready-to-use foods are one of the available strategies for the treatment of moderate acute malnutrition (MAM), but challenges remain in the use of these products in programs at scale. This paper focuses on two challenges: the need for cheaper formulations using locally available ingredients that are processed in a safe, reliable, and financially sustainable local production facility; and the effective use of these products in large-scale community-based programs.

Linear programming tools can be used successfully to design local compositions that are in line with international guidelines, low in cost, and acceptable, and the efficacy of these local formulations in the treatment of MAM was recently demonstrated in Malawi.

The production of local formulations for programs at scale relies on the existence of a reliable and efficient local production facility. Technical assistance may be required in the development of sustainable business models at an early stage in the process, taking into account the stringent product quality and safety criteria and the required investments.

The use of ready-to-use products, as of any food supplement, in programs at scale will be affected by the practice of household sharing and diversion of these products for other uses. Additional measures can be considered to account for sharing. These products designed for the treatment and prevention of MAM are to be used in community-based programs and should therefore be used in conjunction with other interventions and designed so that they do not replace the intake of other foods and breastmilk. Remaining challenges and implications for the (operations) research agenda are discussed.

Key words: Local formulation, local production, moderate acute malnutrition, ready-to-use foods, scale-up programs

Introduction

The treatment of moderate acute malnutrition (MAM) in children below the age of 5 years requires the consumption of nutritionally adequate foods, including exclusive breastfeeding before 6 months of age [1]. In addition, clean drinking water, good sanitation practices, and preventive (vitamin A supplementation, immunization) and curative services need to be available to children to optimize growth, development, and survival [2].

In their technical note on foods for the treatment of MAM [3], the World Health Organization (WHO) recommends that the dietary management of MAM should be based normally on the optimal use of locally available, nutrient-dense foods, using a number of approaches to ensure adequate intakes of nutrients, including dietary diversification and fortification of certain staple foods. Unfortunately, available and affordable foods often fail to meet nutrient needs, particularly when families cannot afford frequent consumption of animal-source foods [4] or in situations of food shortage and emergencies. In such conditions, specially formulated supplementary foods are usually required to contribute to an adequate intake of required nutrients.

Saskia Osendarp is affiliated with the Micronutrient Initiative, Ottawa; Beatrice Rogers is affiliated with Tufts University, Boston; Kelsey Ryan and Mark Manary are affiliated with Washington University School of Medicine, St. Louis, Missouri, USA; Peter Akomo and Paluku Bahwere are affiliated with Valid Nutrition, Oxford, UK; Hilina Belete is affiliated with Hilina Enriched Food, Addis Ababa, Ethiopia; Mamane Zeilani is affiliated with NutriSet S.A.S., Malaunay, France; Munirul Islam is affiliated with the Centre for Nutrition and Food Security, International Centre for Diarrhoeal Disease Research, Bangladesh Dhaka, Bangladesh; Filippo Dibari is affiliated with the World Food Programme, Rome; Saskia de Pee is affiliated with the World Food Programme, Rome, and the Gerald J. and Dorothy R. Friedman School of Nutrition Science and Policy, Tufts University, Boston.

Please direct queries to the corresponding author: Saskia Osendarp, The Micronutrient Initiative, 180 Elgin St., Suite 1000, Ottawa K2P 2K3, Canada; e-mail: sosendarp@micronutrient.org.

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The development of specially formulated ready-to-use therapeutic foods (RUTFs) has enabled treatment of severe acute malnutrition (SAM) in the community and made a difference to child survival [5]. This has resulted in a growing interest in using these types of products for the management of MAM as well, and ready-to-use supplementary foods (RUSFs) have been developed and are increasingly being used for the management of MAM [4].

A systematic review evaluating the effectiveness of interventions for MAM in children under 5 years of age concluded that children receiving RUSFs were significantly more likely to recover from MAM than children receiving standard corn–soy blend (CSB), but the actual differences in weight gain were small [6]. In addition, due to the limited available evidence, the systematic review could not evaluate a new generation of fortified blended foods (e.g., Super Cereal Plus), which have specifically been formulated to be in line with the 2012 WHO technical note on foods for treatment of MAM [3].

While the debate continues on the exact contribution of these products next to other important interventions for treatment and prevention of MAM, ready-to-use foods are already commonly used in many programs. The different nutrient compositions of specially formulated foods, including ready-to-use foods, have been described in detail by de Pee and Bloem [5], and in a separate paper in this Supplement, Briend et al. [7] describe the lessons learned in the development of RUTF and how these can inform further optimization of RUTF, RUSF, and other lipid-based nutrient supplements (LNSs).

There are a number of challenges that affect the use of products for treatment of MAM in programs at scale, and this paper will focus on two of them. First, cost constraints and the reliance on manufactured, often imported, products limit utilization. There is a need for cheaper products, using locally available ingredients as much as possible, while maintaining strict quality and safety criteria. Second, the use of ready-to-use foods in large-scale programs requires more insight into how these products are being used at the household level and how an effective use of these products by the target population most at risk can be ensured.

Ready-to-use foods

RUTFs and RUSFs are energy- and nutrient-dense products that are formulated as lipid pastes or compressed bars, delivering energy, high-quality protein, essential fatty acids, and micronutrients. Most formulations consist of legumes, cereals, oil, sugar, and dairy products such as dried skimmed milk or whey protein concentrate. All the formulations contain an industrial premix of micronutrients to ensure that the required vitamin and mineral densities are met. The lipid-based ready-to-use foods are nutritionally balanced, nutrient and energy dense, easy to store, and resistant to bacterial growth. The development of these products and approaches for targeting and delivering them has evolved rapidly during the past decade [5], in particular as they enabled a shift from institutional to community-based management of SAM and MAM.

Different categories of LNS have been developed: RUTFs are now commonly used to treat SAM, particularly in outpatient programs, and provide 100% of the energy needed from foods other than breastmilk, thereby temporarily replacing most or all foods other than breastmilk during treatment. RUSFs have been designed to treat MAM and are to be consumed in smaller quantities (500 kcal/day) than RUTFs. The so-called medium-quantity LNS (250 kcal/day) is recommended to complement diets of young children to prevent acute malnutrition during temporary periods of food shortage, and eligibility is typically based on age rather than nutritional status [4]. This has implications for the composition of the products used for MAM versus those used for SAM treatment. The nutrient density of ready-to-use products for MAM treatment needs to be carefully balanced so that it meets the dietary needs of children with MAM, in combination with the home diet including breastmilk, allowing them to synthesize adequate lean and fat tissues and achieve adequate catch-up growth [8, 9] without replacing the intake of local foods and breastmilk.

Finally, small-quantity LNSs deliver a lower energy dose (100 to 120 kcal/day) but a full complement of micronutrients, macrominerals, and essential fatty acids and are more suitable as home fortificants, for longer-duration use in more food-secure situations to fill certain nutrient gaps in the diet [4].

Local formulations of ready-to-use foods

Local formulations of ready-to-use foods can be designed using linear programming tools: mathematical tools that can be used, among others, for optimizing improved, novel food-based formulations by choosing combinations of foods within specified criteria for composition and lowest possible costs [10, 11]. Examples of linear programming tools available include the soon to be released program Optifood, which has been designed to develop dietary guidance [12], the Cost of the Diet [13], and the open-source, add-in function called *solver*, existing in the latest versions of the spreadsheet application Microsoft Excel [10].

Linear programming has recently been used to design ready-to-use foods for the treatment of MAM and SAM in children and adults using locally available commodities in, among others, East Africa, Malawi, and Bangladesh. Details of the linear programming

process [14], its challenges [15, 16], and methods of testing the safety and/or acceptability of improved formulations [17, 18] have been described. Locally adapted formulations include commodities such as chickpea, sesame, soybean, maize, and sorghum in East Africa [14, 15]; soy and whey permeate in Malawi [15]; rice-lentils or chickpeas in Bangladesh [19], Pakistan, and Ethiopia; and almonds in Afghanistan. The formulations contain less milk powder, which is a costly ingredient, use exclusively or primarily locally available ingredients, and are mostly peanut free. These prototypes were found to be safe and acceptable among adults [17] and young children [18, 20].

The efficacy of these local formulations in the treatment of MAM was demonstrated in Malawi [21], and further assessments of effectiveness for prevention or treatment of SAM are currently under way in Bangladesh and Ethiopia, among others.

However, challenges remain regarding the use of these local formulations in programs. First, the availability and cost of ingredients for the formulations are context-specific and may vary depending on the season and agricultural output, which needs to be taken into account while designing formulations. Second, the costs of local formulations may, at least initially, not be cheaper than those of imported ready-to-use foods, even when the costs of transport are taken into account, due to high raw material costs of some of the local ingredients, such as milk powder, costs for import of premixes, and required investments to ensure a production that satisfies current international quality standards [22]. Third, most of the local formulations rely on staple foods that are relatively high in phytic acid, which may affect mineral bioavailability [23]. The determination of mineral bioavailability from products requires expensive stable isotope trials.

Fourth, the validity of the linear programming tool in the development of these local formulations depends on the accurate application of national and international food composition databases. International food composition databases often have a wide range of nutrient values, in an attempt to reflect global variation, whereas the validity of national food composition databases may be questionable for some foods due to a lack of appropriate analytical resources to confirm the nutrient values of local commodities. Other common challenges with food composition databases that also affect the validity of local formulations developed with linear programming include the fact that these databases do not take into account the dynamics of global food markets, resulting in a rapid geographic turnover of food commodities that are internationally traded. In addition, the nutrient values of foods can differ substantially from the values reported in food composition databases. For instance, the protein content of cereals and pulses can vary by a factor of two, depending on variety and fertilizer usage [24]. Once a local formulation has been designed with the help of linear programming, confirmation of the composition by biochemical analysis is therefore always required. Finally, the production of local formulations for programs at scale relies on the existence of a reliable and efficient local production facility, as will be described in more detail in the next section.

Local production at scale

The use of locally made supplementary foods, including ready-to-use foods, has increased over the past decade. For instance the World Food Programme's use of locally made LNSs has increased from 7% of all LNSs used in programs in 2010 to 27% in 2013 (unpublished data from World Food Programme). Local production at scale requires a sound business model for the manufacturer at an early stage in the process, predicting earnings that justify the investments, taking into account, among others, steady and predictable demand for the product, as well as the stringent quality and safety criteria for these products and investments required in production-line equipment and technical assistance. The costs and availability of local raw materials may vary, resulting in a permanent or temporary need to import certain raw materials, such as milk powder. Vitamin and mineral premixes almost always have to be imported and may be subject to large import duties, as has been reported from various countries. The GAIN Premix Facility [25] can assist local producers with payment procedures, offering specific credit terms.

Local producers may require specialized technical assistance when moving from pilot production to production at scale. For example, the World Food Programme experienced various issues when moving from pilot to at-scale production, related to the fluidity and stickiness of the product in the production line, and oil leakages from packages that were not adequately sealed.

Specialized technical knowledge and assistance are also required to ensure safe production and product handling. Contamination of raw materials with aflatoxin and the presence or introduction of pathogens during production are of great concern, particularly for these ready-to-eat products, which are not cooked and which target vulnerable children. Preventing contamination requires good environmental control, management of raw material suppliers, good manufacturing practices (GMP), minimizing manual handling, possibly a heat killing step, and continuous monitoring [26]. The manufacturing of any food requires the application of the Hazard Analysis and Critical Control Points (HACCP) program to ensure that products are produced in a cost-effective, safe, and hygienic manner [27].

The requirements as described above may make it

time and resource intensive to set up local production and risky for individual local producers to set up a compliant, successful business. Import of products will remain necessary until safe and sufficient quantities of products can be produced locally or in the region. Networks of local producers of ready-to-use foods provide technical assistance, including the transfer of technologies, and facilitate regional collaboration and sharing of information and lessons learned. An example of such a network is the PlumpyField network, established by a private sector producer of these products. The independent factories combined in this network, located in sub-Saharan Africa, Asia, and the Caribbean, currently produce one-third of the world supply of ready-to-use foods. Local manufacturing at scale by other producers also takes place in a number of countries, including India, Pakistan, Ethiopia, and Sierra Leone.

Issues around the use of ready-to-use foods in community-based programs

Little empirical information is available about sharing of supplementary foods in community-based programs, and the majority of such studies have appeared in the nonrefereed literature. The existing literature and common experience suggest that sharing of supplementary foods, both ready-to-use foods and fortified blended foods, at least among children in the household, but also outside the household, is the norm across cultural settings. Factors affecting the degree of sharing or diversion of the supplement may include household composition, food insecurity, social norms, effectiveness of social and behavioral change communication strategies, mothers' involvement in child feeding, child age, and desirability of the supplementary food or its components, if the components are provided separately in the case of fortified blended foods that are to be mixed with oil and sometimes also sugar. Two recent studies examined the sharing and diversion of supplementary foods in Malawi and Sierra Leone and demonstrated a great degree of sharing of porridges with other siblings and children in the household. In Malawi, CSB was given away more than oil, suggesting that the household placed a higher value on keeping the oil than on keeping the CSB.

Sharing and lending cannot and should not always be avoided, as they may have important advantages for a household in terms of building social capital and responding to cultural expectations. However, program implementers should be aware that sharing will happen and consider mitigating measures such as ensuring that caregivers understand the nutritional value of specific products for specific household members, and possibly by providing additional assistance for both the target child and other household members. Program implementers should record the level of sharing and lending, preferably by observation, when trying to establish the coverage and effectiveness of their programs. In a study in Burkina Faso supplementing young children with small-quantity LNS, adherence based on the mother's reporting was much higher than adherence based on direct observations (97% vs. 54%) [28], as was also the case with reported and observed sharing of products in Malawi (73% and 94%, respectively).

Discussion and conclusions

Ready-to-use foods have been shown to be effective in the treatment of MAM and can be successfully produced locally. However, challenges remain, and experiences should continue to be shared to inform and further guide the most cost-effective formulations and production strategies and use of these products in programs at scale.

Future research on the composition of these products should include optimizing their formulation, especially with regard to costs and use of locally available ingredients, while maintaining nutritional quality, including nutrient bioavailability, shelf life, and safety. Linear programming tools can be used successfully to design local formulations that are acceptable to the population, but they would benefit from improved local food composition data and will require laboratory analyses to confirm the nutrient composition. In addition, more evidence is required on the bioavailability of key nutrients, including iron and zinc, in these local ready-to-use food formulations and on the effectiveness of the formulations.

The local formulations that have been discussed in this paper have been designed to have a nutrient composition in line with the 2012 WHO technical note on foods for the treatment of MAM [3]. Ready-to-use supplementary foods with different recipes and nutrient composition may face additional challenges in meeting the dietary needs of children with MAM, particularly in children under 2 years of age, and specifically when only unfortified local foods are used [15, 29].

An operations research agenda on the use of ready-to-use products in programs at scale should include the evaluation of interventions and technological innovations to ensure product quality and safety. Future operations research should also include behavioral science to investigate drivers of motivation for caregivers to use these products for the prevention or treatment of MAM in their children. Partnerships with the private sector, including their marketing expertise, may help to understand these barriers and enablers of behavioral change.

Successful as well as unsuccessful business models and experiences of setting up production by local manufacturers should be documented more. In addition, more evidence is required from operations research on

the successful use and cost-effectiveness of these products in integrated programs addressing both prevention and treatment of MAM. There is currently limited consensus on how to operationalize cost-effective use of these products in program settings. Only rigorous program evaluations will help provide evidence on the most cost-effective intervention packages in a given context, but these require a thorough understanding of program impact pathways leading to adequate growth in children [30].

In conclusion, depending on the context, ready-to-use foods are one of the options to ensure adequate nutrient intakes in children suffering from MAM, along with other interventions such as dietary diversification and fortification of staple foods. Local formulations and local production of these products have been shown feasible, and the use of locally made ready-to-use foods in programs should be encouraged, provided challenges related to a safe and cost-efficient local production can be overcome.

Programs need to ensure a strengthening of the health system [31] and integrate the use of these products with other public health interventions to ensure a continuum of care from prevention to treatment of MAM. These interventions have been described in detail in other papers of this Supplement [32] and include behavior change interventions and counseling on MAM treatment [33] and adequate infant and young child feeding practices, including interventions on promotion of breastfeeding and complementary feeding with adequate dietary diversity. In addition, the treatment and prevention of MAM requires interventions on water, sanitation, and hygiene (WASH), early child development, and nutrition-sensitive interventions including conditional cash transfers and agricultural interventions [34].

Conflicts of interest

Hilina Belete is employed by Hilina Enriched Food, Addis Ababa, Ethiopia. Mamane Zeilani is employed by NutriSet S.A.S., Malaunay, France. Both companies produce ready-to-use foods. Saskia Osendarp worked for Unilever until January 2012. All other authors have no conflicts of interest to report.

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References

1. World Health Organization/World Food Programme/United Nations Standing Committee on Nutrition/UNICEF. Community-based management of severe acute malnutrition. Geneva: WHO, 2007.
2. WHO/UNICEF. Global strategy for infant and young child feeding. Geneva: WHO, 2003. Available at: http://www.who.int/nutrition/publications/infantfeeding/9241562218/en/. Accessed 5 November 2014.
3. World Health Organization. Technical note: supplementary foods for the management of moderate acute malnutrition in infants and children 6–59 months of age. Geneva: WHO, 2012.
4. Arimond M, Zeilani M, Jungjohann S, Brown KH, Ashorn P, Allen LH, Dewey KG. Considerations in developing lipid-based nutrient supplements for prevention of undernutrition: experience from the International Lipid-Based Nutrient Supplements (iLiNS) Project. Matern Child Nutr 2013 May 6. doi: 10.1111/mcn.12049. [Epub ahead of print].
5. de Pee S, Bloem MW. Current and potential role of specially formulated foods and food supplements for preventing malnutrition among 6- to 23-month-old children and for treating moderate malnutrition among 6- to 59-month-old children. Food Nutr Bull 2009;30(3 suppl):S434–63.
6. Lenters LM, Wazny K, Webb P, Ahmed T, Bhutta ZA. Treatment of severe and moderate acute malnutrition in low- and middle-income settings: a systematic review, meta-analysis and Delphi process. BMC Public Health 2013;13(suppl 3):S23.
7. Briend A, Akomo P, Bahwere P, de Pee S, Dibari F, Golden MH, Manary M, Ryan K. Developing food supplements for moderately malnourished children: lessons learned from ready-to-use therapeutic foods. Food Nutr Bull 2015;36:S53–8.
8. Golden MH. Proposed recommended nutrient densities for moderately malnourished children. Food Nutr Bull 2009;30:S267–343.
9. World Health Organization. Proceedings of the WHO UNICEF WFP UNHCR informal consultation on the management of moderate malnutrition in under-5 children. Geneva, Oct. 2008. Food Nutr Bull 2009;30:S464–74.
10. Briend A, Darmon N, Ferguson E, Erhardt JG. Linear programming: a mathematical tool for analysing and optimizing children's diets during the complementary feeding period. J Pediatr Gastroenterol Nutr 2003;36:12–22.
11. Ferguson EL, Darmon N, Fahmida U, Fitriyanti S, Harper TB, Premachandra IM. Design of optimal food-based complementary feeding recommendations and identification of key "problem nutrients" using goal programming. J Nutr 2006;136:2399–404.
12. Daelmans B, Ferguson E, Lutter CK, Singh N, Pachon H, Creed-Kanashiro H, Woldt M, Mangasaryan N, Cheung E, Mir R, Pareja R, Briend A. Designing appropriate complementary feeding recommendations: tools for programmatic action. Matern Child Nutr. 2013 Sep;9

Suppl 2:116-30. doi: 10.1111/mcn.12083.
13. Frega R, Lanfranco JG, De Greve S, Bernardini S, Geniez P, Grede N, Bloem M, de Pee S. What linear programming contributes: World Food Programme experience with the "Cost of the Diet" tool. Food Nutr Bull 2012;33:S228–34.
14. Dibari F, Diop EHI, Collins S, Seal A. Low-cost, ready-to-use therapeutic foods can be designed using locally available commodities with the aid of linear programming. J Nutr 2012;142:955–61.
15. Owino VO, Irena AH, Dibari F, Collins S. Development and acceptability of a novel milk-free soybean-maize-sorghum ready-to-use therapeutic food (SMS-RUTF) based on industrial extrusion cooking process. Matern Child Nutr 2014;10:126–34.
16. Skau JK, Bunthang T, Chamnan C, Wieringa FT, Dijkhuizen MA, Roos N, Ferguson EL. The use of linear programming to determine whether a formulated complementary food product can ensure adequate nutrients for 6- to 11-month-old Cambodian infants. Am J Clin Nutr 2014;99:130–8.
17. Dibari F, Bahwere P, Huerga H, Irena AH, Owino V, Collins S, Seal A. Development of a cross-over randomized trial method to determine the acceptability and safety of novel ready-to-use therapeutic foods. Nutrition 2013;29:107–12.
18. Dube B, Rongsen T, Mazumder S, Taneja S, Rafiqui F, Bhandari N, Bhan MK. Comparison of ready-to-use therapeutic food with cereal legume-based khichri among malnourished children. Indian Pediatr 2009;46:383–8.
19. Ahmed T, Choudhury N, Hossain MI, Tangsuphoom N, Islam MM, de Pee S, Steiger G, Fuli R, Sarker SA, Parveen M, West KP Jr, Christian P. Development and acceptability testing of ready-to-use supplementary food made from locally available food ingredients in Bangladesh. BMC Pediatr 2014;14:164.
20. Phuong H, Nag TT, Mathieson R, Nguyen M, Hop le T, Hoa do TB, Minh HN, Tuyen le D, Berger J, Wieringa FT. Development and implementation of a locally produced ready-to-use therapeutic food (RUTF) in Vietnam. Food Nutr Bull 2014;35(2 suppl):S52–6.
21. LaGrone L, Cole S, Schondelmeyer A, Maleta K, Manary MJ. Locally produced ready-to-use supplementary food is an effective treatment of moderate acute malnutrition in an operational setting. Ann Trop Paediatr 2010;30:103–8.
22. Briend A, Ferguson E, Darmon N. Local food price analysis by linear programming: a new approach to assess the economic value of fortified food supplements. Food Nutr Bull 2001;22:184–9.
23. Hurrell RF, Juillerat MA, Reddy MB, Lynch SR, Dassenko SA, Cook JD. Soy protein, phytate, and iron absorption in humans. Am J Clin Nutr 1992;56:573–8.
24. Greenfield H, Southgate DAT. Food composition data. Production, management and use, 2nd ed. Rome: Food and Agriculture Organization, 2003.
25. Guinot P, Jallier V, Blasi A, Guyondet C, Van Ameringen M. GAIN Premix Facility: an innovative approach for improving access to quality vitamin and mineral premix in fortification initiatives. Food Nutr Bull 2012;33(4 suppl):S381–9.
26. Manary MJ. Local production and provision of ready-to-use therapeutic food (RUTF) spread for the treatment of severe childhood malnutrition. Food Nutr Bull 2006;27(3 suppl):S83–9.
27. Henry CJ, Xin JL. Application of Hazard Analysis Critical Control Point in the local manufacture of ready-to-use therapeutic foods (RUTFs). Food Nutr Bull 2014;35(2 suppl):S57–63.
28. Abbeddou S, Hess SY, Yakes Jimenez E, Some JM, Vosti SA, Guissou RM, Ouedraogo JB, Brown KH. Comparison of methods to assess adherence to small-quantity lipid-based nutrient supplements (SQ-LNS) and dispersible tablets among young Burkinabe children participating in a community-based intervention trial. Matern Child Nutr 2014 Dec 17. doi: 10.1111/mcn.12162. [Epub ahead of print].
29. Allen LH. Adequacy of family foods for complementary feeding. Am J Clin Nutr 2012;95:785–6.
30. Rawat R, Nguyen PH, Ali D, Saha K, Alayon S, Kim SS, Ruel M, Menon P. Learning how programs can achieve their impact: embedding theory-driven process evaluation and other program learning mechanisms in alive & thrive. Food Nutr Bull 2013;34(3 suppl):S12–25.
31. Choudhury N, Ahmed T, Hossain MI, Mandal BN, Mothabbir G, Rahman M, Islam MM, Husain MM, Nargis M, Rahman E. Community-based management of acute malnutrition in Bangladesh: feasibility and constraints. Food Nutr Bull 2014;35:277–85.
32. de Pee S. Grais R, Fenn B, Brown R, Briend A, Frize J, Shoham J, Leroy J, Kiess L. Prevention of acute malnutrition: distribution of special nutritious foods and cash, and addressing underlying causes—what to recommend when, where, for whom, and how. Food Nutr Bull 2015;36:S24–9.
33. Nikièma L, Huybregts L, Kolsteren P, Lanou H, Tiendrebeogo S, Bouckaert K, Kouanda S, Sondo B, Roberfroid D. Treating moderate acute malnutrition in first-line health services: an effectiveness cluster-randomized trial in Burkina Faso. Am J Clin Nutr 2014;100:241–9.
34. Bhutta ZA, Das JK, Rizvi A, Gaffey MF, Walker N, Horton S, Webb P, Lartey A, Black RE. Evidence-based interventions for improvement of maternal and child nutrition: What can be done and at what cost? Lancet 2013;382:452–77.