FANTA III

FOOD AND NUTRITION TECHNICAL ASSISTANCE

USAID FROM THE AMERICAN PEOPLE

STRENGTHENING THE EVIDENCE BASE FOR NUTRITION INTERVENTIONS DURING THE "1,000 DAYS":

FANTA Research Explores How to Optimize the Prevention of Malnutrition

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Abbreviations and Acronyms

BCC	behavior change communication
CSB	corn-soy blend
DHS	Demographic and Health Survey
FANTA	Food and Nutrition Technical Assistance III Project
FFP	Office of Food for Peace
FFR	full family ration
IFA	iron and folic acid
IFPRI	International Food Policy Research Institute
LAZ	length-for-age z-score
LNS	lipid-based nutrient supplement(s)
MMT	multi-micronutrient tablet(s)
MNP	micronutrient powder(s)
NFR	no family ration
NGO	nongovernmental organization
PM2A	preventing malnutrition in children under 2 approach
RFR	reduced family ration
SQ-LNS	small-quantity lipid-based nutrient supplement(s)
UCD	University of California, Davis
USAID	U.S. Agency for International Development
WASH	water, sanitation, and hygiene
WRA	women of reproductive age

COVER IMAGES: Posters supporting the SBCC strategy for SQ-LNS for both children and pregnant and lactating women in Guatemala.

Introduction

The "first 1,000 days" of life—from conception to a child's second birthday—is a critical window of opportunity for optimizing the nutritional, health, and development outcomes of current and future generations. The nutritional status of a woman at conception and during pregnancy, along with nutrition during the child's first 2 years of life, affect the short- and long-term health of her offspring, including long-term chronic disease outcomes such as obesity and diabetes.[1, 2] Once born, children have high nutritional needs for the first 2 years of life because of their rapid physical growth and cognitive development. Suboptimal infant feeding practices and frequent infections during this period increase their risk of undernutrition, the consequences of which—stunted growth and delayed cognitive development—may not be easily recouped later, creating long-term implications for a country's health and economic prosperity.[1] Thus, a "preventive approach" to malnutrition during the first 1,000 days—supported by available research—has been promoted by global movements and adopted by development agencies[3] (Box 1).

Still, addressing malnutrition in low- and middle-income countries continues to be a significant challenge, and there have been few evaluations of preventive approaches that target the entire 1,000-day period. Meeting the unique nutritional needs of young children requires a rich source of nutrients—e.g., through nutrient-rich or fortified foods, or provision of nutritional supplements—which can be out of reach for families experiencing poverty and food insecurity. At the same time, while nutrition is an essential component of achieving optimal physical growth, development, and health, there are many other important determinants of these same outcomes, including infection and disease; access to and use of health services; access to safe water, sanitation, and hygiene (WASH); and women's empowerment and education. Understanding what combinations of interventions will best address the multifactorial causes of malnutrition in different contexts, how to implement them effectively at scale, and at what cost is an ongoing area of investigation.

Box 1. 'An Ounce of Prevention Is Worth a Pound of Cure': The Evolution of PM2A in FFP Development Programming

From 2002 to 2006, FANTA partner International Food Policy Research Institute conducted a rigorous evaluation of what was then called a Title II multi-year food assistance program in Haiti and found that the blanket provision of a food-assisted maternal and child health and nutrition program to all children 6–23 months of age (a "preventive" approach) was more effective at reducing the community prevalence of stunting, wasting, and underweight than the traditional approach, which was based on providing services to underweight children only (a "recuperative" approach).* In light of these findings, the USAID Office of Food for Peace (FFP) invited proposals to replicate the preventive approach (PM2A) in Guatemala and Burundi from 2010–2014, and in collaboration with FANTA, incorporated a rigorous research and development program linked to the implementation of PM2A in the two countries. Such collaboration aimed to learn about and refine the approach and to generate lessons for future PM2A programming. The results of that work are presented in this report.

Current FFP guidance recommends that partners implementing what are now called FFP development food assistance programs focus on a preventive approach during the first 1,000 days of life.** The primary components of PM2A include:***

- **Conditional food rations.** These consist of individual rations for the participating woman (during pregnancy and the first 6 months of lactation) or child (from 6–23 months of age) and a family ration for their household. Specific food commodities vary by setting but frequently include a fortified blended food (e.g., corn-soy blend) for the individual ration and fortified vegetable oil and other grains and legumes for the family ration.
- **Preventive and curative health and nutrition services.** These are provided to children 0–23 months of age, pregnant women, and mothers of children 0–23 months of age, according to national guidelines. A minimum level of attendance at these services is required for program eligibility and receipt of food rations.
- **Behavior change communication (BCC).** In PM2A, BCC covers optimal infant feeding practices; nutrition practices for sick/severely malnourished children; prevention of micronutrient deficiencies; safe water, hygiene, and sanitation practices; the importance of preventive care services; and optimal reproductive health practices. A minimum level of participation in BCC activities is required for program eligibility and receipt of food rations.

These three components are expected to act in concert to improve maternal and child nutrition and health outcomes through increasing availability of staple foods as well as intake of micronutrient-rich foods; motivating participation in program activities; improving dietary diversity and quality; increasing adoption of optimal nutrition, health, hygiene, and curative/preventive health practices; and increasing demand for and use of health services (both preventive and curative).

* Menon, P. et al. 2007. *Prevention or Cure? Comparing Preventive and Recuperative Approaches to Targeting Maternal and Child Health and Nutrition Programs in Rural Haiti—Executive Summary of the Evaluation Report.* Washington, DC: FANTA/FHI 360.

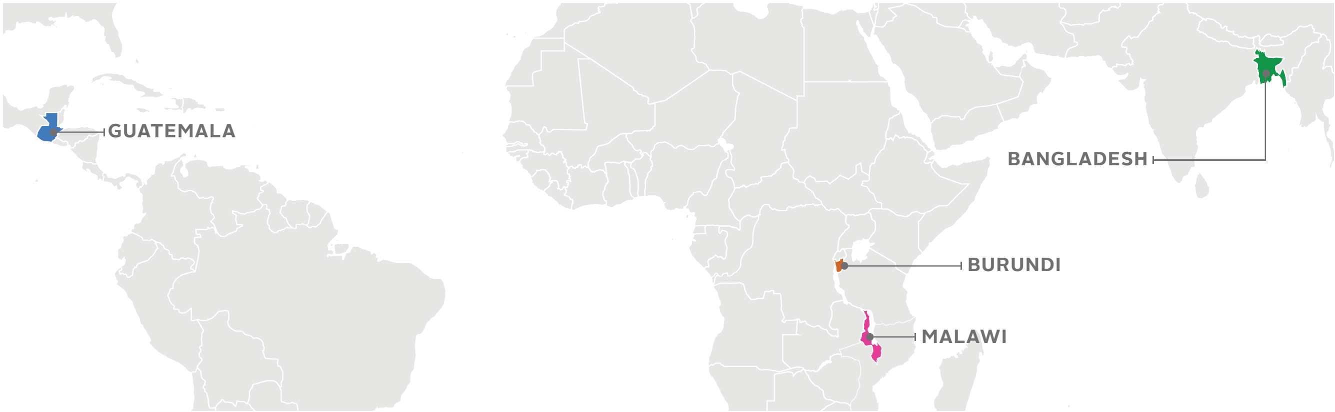
** Office of Food for Peace. 2017. *Technical References for Development Food Security Activities.* Washington, DC: U.S. Agency for International Development (USAID).

*** Food and Nutrition Technical Assistance II Project (FANTA-2). 2010. *TRM-01: Preventing Malnutrition in Children Under 2 Approach (PM2A): A Food-Assisted Approach, Revised November 2010.* Washington, DC: FANTA-2/FHI 360.

Overview of Four FANTA Studies on the 1,000 Days

One of the core research-related objectives of the Food and Nutrition Technical Assistance III Project (FANTA) is to expand the evidence base on interventions aimed at preventing undernutrition during the 1,000 days, with an eye toward informing effective policies and programs that low- and middle-income countries can implement in their specific contexts. Beginning in 2008, FANTA and some of its research partners implemented four large research studies to improve the understanding and implementation of interventions focused on the first 1,000 days. The four studies encompassed a variety of geographic settings with differing nutrition and food security profiles (Figure 1). Two of the studies, in Guatemala and Burundi, were conducted in the context of a U.S. Agency for International Development (USAID) Office of Food for Peace (FFP) development food security activity implementing the preventing malnutrition in children under 2 approach (PM2A) (Box 1). These studies aimed to build the evidence around PM2A, including how the approach could be best implemented in terms of optimal ration size, composition, and duration of assistance, among other research questions.

The two other studies were focused primarily on evaluating nutritional supplements—micronutrient powders (MNP) and small-quantity lipid-based nutrient supplements (SQ-LNS) (Box 2)—to improve nutritional outcomes among pregnant women and children. One study, in Bangladesh, was conducted in the context of a community health and development program run by a local nongovernmental organization (NGO); the second, in Malawi, was an intervention evaluating SQ-LNS (supplied by the researchers) and its effects on birth outcomes. The Guatemala PM2A study also evaluated SQ-LNS and MNP in the context of a FFP development food security activity. Three of the four studies assessed the cost and cost-effectiveness of the respective interventions, and all studies examined the pathways and processes that were hypothesized to lead to the desired outcomes. Summaries of each study's aims and methods, along with the primary research questions, are provided below.



Box 2. Lipid-Based Nutrient Supplements and Micronutrient Powders

Lipid-based nutrient supplements (LNS) are a category of products that are used to deliver nutrients to vulnerable groups,* from “small-quantity” (SQ) LNS added to foods to prevent undernutrition, to ready-to-use therapeutic foods used in larger quantities to treat severe acute malnutrition (e.g., Plumpy’nut). This family of products is “lipid-based” because most of the supplements’ energy (i.e., calories) comes from fats (lipids). LNS contains a broad and modifiable range of micronutrients—they can be customized to meet the nutrient needs of different target populations—and also provide protein, energy, and essential fatty acids.* The LNS in the FANTA research studies in Bangladesh, Malawi, and Guatemala was SQ-LNS, in that it was intended to be added to food to enhance its nutritional content and provided in small quantities (about 20 g per day). This SQ-LNS contained 22 micronutrients and was formulated to provide the recommended daily nutrient intake for pregnant/lactating women or children 6–23 months of age for most of these 22 nutrients.

Packets of MNP for children in Bangladesh.

Micronutrient powders (MNP) are single-serving sachets that contain a mix of micronutrients (vitamins and minerals) in powdered form and can be added to foods prepared at home.* The composition of MNP can be tailored to the target group, desired outcome (e.g., prevention of anemia), and the specific nutritional deficiencies present, though standard formulations generally contain 3, 5, or 15 micronutrients. MNP is recommended where dietary diversity is low, consumption of fortified foods is limited, and dietary bioavailability of micronutrients is low due to dietary inhibitors. The MNP used in the PM2A research in Guatemala contained 22 micronutrients (provided in two sachets per day) to match the nutrient composition of the SQ-LNS used there.** The MNP used in Bangladesh had the standard 15-nutrient formulation.***

* Home Fortification Technical Advisory Group. n.d. “Frequently Asked Questions: Lipid-Based Nutrient Supplements (LNS) and Micronutrient Powders (MNP).” Accessed October 31, 2017. Available from: http://www.hftag.org/page.asp?content_id=33987.

** Heckert, J. et al. 2017. *Strengthening and Evaluating the Preventing Malnutrition in Children under 2 Years of Age Approach: Guatemala Follow-Up Report.* Washington, DC: FANTA/FHI 360.

*** Home Fortification Technical Advisory Group. 2013. *Manual on Micronutrient Powder (MNP) Composition: Guidelines and Specifications for Defining the Micronutrient Composition of Single-Serve Sachets for Specified Target Populations in Low- and Middle-Income Countries with High Prevalence of Anaemia and Micronutrient Deficiencies.* Geneva: Home Fortification Technical Advisory Group.

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Evaluating the Impact and Cost-Effectiveness of PM2A in Guatemala and Burundi

PM2A in Guatemala

The International Food Policy Research Institute (IFPRI) evaluated PROCOMIDA, a FFP development food security activity that followed the PM2A model, implemented by Mercy Corps in Guatemala's Alta Verapaz department from 2010 to 2015.[4] The aim of the research was to assess PROCOMIDA's impact on child and maternal nutritional outcomes and its cost-effectiveness and to determine how varying the food rations' composition and size in a PM2A program would affect these outcomes. Researchers randomly assigned health centers and their catchment areas to one of six research groups, which included five versions of PM2A within PROCOMIDA and one control group (no PROCOMIDA participation). The main research objectives were to:

- Investigate PROCOMIDA's impact on maternal and child nutritional outcomes and its cost-effectiveness.
- Compare how different family ration sizes [full family ration (FFR) vs. a reduced family ration (RFR) vs. no family ration (NFR)] affect nutritional outcomes.
- Evaluate the impact of replacing the individual ration of corn-soy blend (CSB) (provided to women during pregnancy and the first 6 months postpartum and to children 6–23 months of age) with either MNP or SQ-LNS, while still providing the FFR.

Photo credit: Mercy Corps

The family ration included rice, pinto beans, and vegetable oil; the individual ration consisted of a CSB, a fortified blended food.[a] The MNP used in the Guatemala PM2A research contained 22 nutrients,[b] to match the micronutrient content of SQ-LNS (but not its fat, protein, and carbohydrate content). All groups, except the control group, participated in the same behavior change communication (BCC) and health program components. Research participants were followed from pregnancy until their children turned 24 months of age, with data collected at eight time points on maternal nutritional status, children's growth and cognitive development, and prevalence of anemia in the mothers and children. IFPRI also evaluated the cost-effectiveness of the different study interventions[5] and conducted a process evaluation to understand the pathways leading to the desired program effects.[6]

a The monthly FFR consisted of 4 kg of beans, 6 kg of rice, and 1.85 kg of oil. The RFR included 3 kg of beans, 3 kg of rice, and 0.925 kg of oil. Both the FFR and RFR were provided from the time a pregnant woman first enrolled in the program until her child reached 24 months of age. The monthly individual ration consisted of either 4kg CSB, 20g/day of SQ-LNS (in 1 sachet for mothers, split into 2 sachets for children), or 60 sachets of MNP (2 per day).

b While MNP formulations can vary, common MNP formulations for children contain between 3 and 15 micronutrients. A 15-micronutrient formulation is recommended by the Home Fortification-Technical Advisory Group to address anemia and micronutrient deficiencies among 6–23 month old children. The MNP formulation used in the PM2A research in Guatemala was a customized formulation designed to match the quantities of micronutrients in the SQ-LNS, but not SQ-LNS' fat, protein, and carbohydrate content. Because of the "bulkiness" of some of the additional nutrients in the PM2A formulation, as well as the potential effects on palatability, the daily dose of MNP was divided into 2 sachets, to be consumed daily (by both mothers and children).

PM2A in Burundi

In Burundi, IFPRI evaluated Tubaramure, a FFP development food security activity that followed the PM2A model, implemented by a consortium of NGOs led by Catholic Relief Services in eastern Burundi from 2010 to 2014.[7] The aim of the research was to assess the program's impact on maternal and child nutritional outcomes and its cost-effectiveness, and to evaluate how varying the *timing and duration* of food ration provision would affect these outcomes. Researchers randomly assigned study participants to one of four research groups, which included three versions of PM2A within Tubaramure and one control group. The main research objectives were to:

- Investigate Tubaramure's impact on maternal and child nutritional outcomes and its cost-effectiveness.
- Determine how long food rations should be provided (from pregnancy through 24 months of age [T24] vs. from pregnancy to 18 months of age [T18] vs. from birth to 24 months of age [TNFP, for "*Tubaramure—No food during pregnancy*"]).

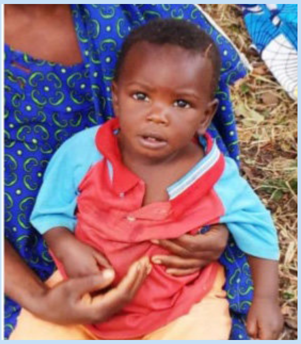


Photo credit: Burundi CRS-IMC-MoH

Children monitored in the Tubaramure program in Burundi.

Both the family and individual rations included CSB and vegetable oil.[c] All groups except the control participated in the same BCC and health program components. Three cross-sectional surveys were conducted to collect data on maternal nutritional status and birth outcomes, as well as child growth; infant feeding practices; and child morbidity, cognitive development, and anemia. The surveys were timed to assess outcomes at baseline, during program implementation, and at the end of the program, to evaluate Tubaramure's effect on beneficiaries who participated in the program during the first 1,000 days. IFPRI also evaluated the cost-effectiveness of the different study interventions[5] and conducted a process evaluation to understand the pathways leading to the desired program effects.[6]

c The monthly family ration consisted of 12 kg of (CSB) and 1.2 kg of oil. The individual ration consisted of 6 kg of CSB and 0.6 kg of oil for pregnant and lactating mothers (through 6 months postpartum), and 3 kg of CSB and 0.3 kg of oil for children 6–23 months of age. In the T24 arm, both family and individual rations were provided from enrollment during pregnancy until the child reached 24 months of age. In the T18 arm, both family and individual rations were provided from enrollment during pregnancy until the child reached 18 months of age. In the TNFP arm, both the family and individual rations were provided from the birth of the child until he/she reached 24 months of age.

Figure 1. Key Contexts and Findings of the Four FANTA Studies

KEY: DHS Demographic and Health Survey; WRA women of reproductive age; U5 children under 5; WASH water, santitation, and hygiene

PM2A in Guatemala

Selected country statistics

Nutrition (DHS 2014–15)

	Stunted (short stature)	Wasted	Overweight/ obese	Anemic
U5	46.5%	0.7%	4.7%/NA	32.4%
WRA	25.3%	--	31.9%/20.0%	13.6%

WASH (DHS 2014–15)

Households with an improved, non-shared toilet	78.6%
Households with an improved water source	57.3%

Poverty (World Bank)

Households living in poverty (in 2016)	59%

Key Research Findings

- PM2A reduced child stunting most effectively when providing a full family ration.
- An "enhanced" 22-micronutrient MNP reduced child stunting and avoided negative effects on maternal weight and maternal/child anemia.

SQ-LNS in Bangladesh

Selected country statistics

Nutrition (DHS 2011*; DHS 2014)

	Stunted (short stature)	Wasted	Overweight/ obese	Anemic
U5	36.1%	14.3%	1.4%/NA	51.3%*
WRA	12.6%	NA	15.1%/5.6%	42.4%*

WASH (DHS 2014)

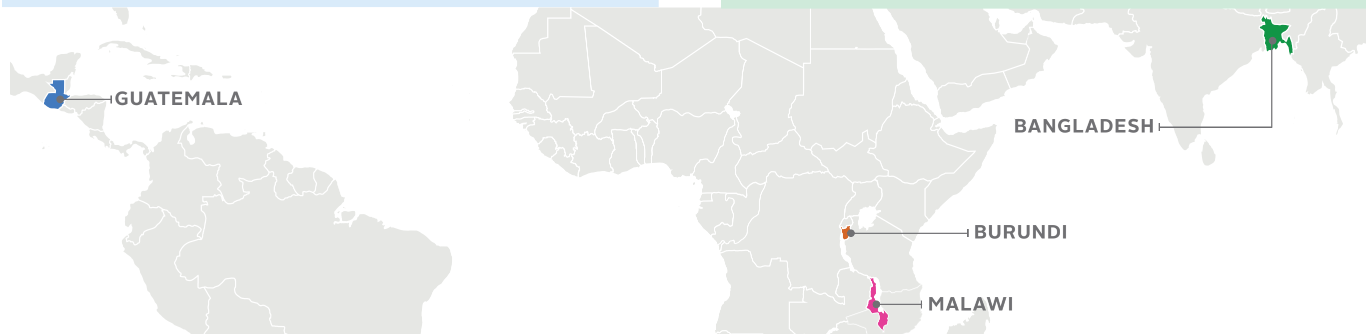
Households with an improved, non-shared toilet	47.8%
Households with an improved water source	97.6%

Poverty (World Bank)

Households living in poverty (in 2016)	24%

Key Research Findings

- SQ-LNS provided prenatally reduced newborn stunting and, along with postnatal SQ-LNS, reduced stunting at 18 months of age.
- Both SQ-LNS and MNP improved child development.



SQ-LNS in Malawi

Selected country statistics

Nutrition (DHS 2015–16)

	Stunted (short stature)	Wasted	Overweight/ obese	Anemic
U5	37.1%	2.7%	5.0%/NA	62.6%
WRA	2.8%	NA	15.1%/5.6%	32.7%

WASH (DHS 2015–16)

Households with an improved, non-shared toilet	55.1%
Households with an improved water source	87%

Poverty (World Bank)

Households living in poverty (in 2010)	51%

Key Research Findings

- Prenatal SQ-LNS did not significantly improve birth outcomes.
- Determinants of pregnancy and birth outcomes in this setting included nutrition, but also maternal/fetal infections and inflammation, and maternal stress.

PM2A in Burundi

Selected country statistics

Nutrition (DHS 2010)

	Stunted (short stature)	Wasted	Overweight/ obese	Anemic
U5	57.7%	5.8%	2.7%/NA	44.5%
WRA	5.0%	--	5.9%/1.6%	18.5%

WASH (DHS 2010)

Households with an improved, non-shared toilet	6.8%
Households with an improved water source	79%

Poverty (World Bank)

Households living in poverty (in 2016)	65%

Key Research Findings

- PM2A reduced child stunting most effectively when rations were provided for the entire 1,000 days.
- PM2A also had protective effects on child morbidity, maternal and child anemia, and child development.

Evaluating the Impact of Nutritional Supplements on Maternal and Child Nutritional Outcomes in Bangladesh and Malawi

SQ-LNS in Bangladesh

FANTA partner University of California, Davis (UCD), in collaboration with ICDDR,B (previously known as the International Centre for Diarrheal Disease Research in Bangladesh), evaluated the impact and cost-effectiveness of adding SQ-LNS and MNP to an ongoing community health and development program implemented by the NGO LAMB (previously known as Lutheran Aid to Medicine in Bangladesh) in rural northwest Bangladesh.[8] Researchers randomly assigned clusters of study participants to one of four research groups (three study interventions and one control group) within the LAMB program. The main research objectives were to:

- Compare the impact of SQ-LNS during pregnancy on maternal and birth outcomes as compared to standard care (iron and folic acid [IFA] supplementation during pregnancy)
- Determine how long SQ-LNS should be provided to optimize child outcomes (providing SQ-LNS during the entire 1,000 days vs. SQ-LNS only to children during the 6–23 months period)
- Compare the impact of SQ-LNS versus MNP on child outcomes (SQ-LNS during the 6–23 months period vs. MNP during the same period).

The MNP provided to children had the standard 15-micronutrient formulation.[9, d] Research participants were followed from enrollment during early pregnancy through the child's second birthday (with additional follow-up evaluations at 4 years of age) to collect data on maternal nutritional status and birth outcomes, as well as child growth, cognitive development, anemia, and micronutrient deficiencies. UCD also evaluated the cost-effectiveness of adding SQ-LNS to the LAMB program[10] and conducted a process evaluation to to understand the pathways leading to the desired program effects.[11]

SQ-LNS in Malawi

FANTA partners UCD and the University of Tampere, Finland, in collaboration with the University of Malawi College of Medicine, evaluated the efficacy of SQ-LNS in preventing adverse birth outcomes (e.g., prematurity and low birth weight), as compared to multi-micronutrient tablets (MMT) and IFA supplementation.[12] Researchers randomly assigned study participants to three study groups (receiving SQ-LNS, IFA, or MMT) and followed them through pregnancy and birth to evaluate a variety of outcomes, including maternal nutritional status, birth outcomes such as birth weight and gestational age, maternal infections (including malaria and reproductive tract infections), and maternal stress. Using these data, the researchers were also able to analyze the relationships between different maternal characteristics, including illness/infection, stress, and nutrition, on the pathway to adverse birth outcomes.[13]

d Note that the MNP formulation used in Bangladesh did not match the nutritional content of the SQ-LNS used in that study (15 micronutrients in MNP vs. 22 micronutrients in SQ-LNS), nor the MNP used in the PM2A research in Guatemala (a 22-nutrient formulation).

Summary of Main Findings of the FANTA Research

The main findings of the four studies are presented below, and complete results for the studies are available on FANTA’s website:

- PM2A in Guatemala and Burundi
- SQ-LNS in Bangladesh
- SQ-LNS in Malawi

The primary research questions addressed by each study are presented in Table 1.

Evaluating PM2A in Guatemala and Burundi

PM2A reduced child stunting in Guatemala and Burundi.

Compared to their respective control groups, PROCOMIDA in Guatemala reduced stunting by 11.1 percentage points,[4] while Tubaramure in Burundi reduced stunting by 7.4 percentage points.[7]

Providing the FFR combined with CSB as the individual ration had the greatest impact on reducing stunting in Guatemala. However, providing only the FFR plus CSB or the RFR plus CSB as the individual ration, had some unintended negative effects.

In Guatemala, providing the FFR plus CSB as the individual ration reduced stunting at 24 months of age by 11.1 percentage points.[4] The FFR appeared to work as intended—motivating participation in the program’s health, nutrition, and BCC components; protecting the individual ration; and reducing household hunger.[4] The groups that received NFR or the RFR did not experience significant reductions in child stunting as compared to the control group (which received no program interventions).

However, unexpectedly, mothers in the group that received CSB as the individual ration lost less weight postpartum, resulting in higher postpartum weight, presumably due to their consumption of CSB (including consuming CSB past the recommended 6 months postpartum).[11] In addition, although the prevalence of anemia declined over time among children in all groups, and was less than 20 percent at 24 months of age, children who received CSB as the FFR or RFR had a significantly higher prevalence of anemia, compared to the control group. A similar result was found among mothers.

Providing the FFR and two sachets of a 22-micronutrient MNP as the individual ration had the second greatest impact on stunting, while avoiding negative maternal and child effects in Guatemala.

Replacing the individual ration of CSB with an MNP containing 22 micronutrients had significant positive effects on child growth—stunting declined 6.5 percentage points, compared to the control group—but did not cause unwanted effects on maternal weight, maternal anemia, or child anemia.[12] Replacing the individual ration with SQ-LNS did not have significant effects on reducing stunting. As noted, the MNP used in the Guatemala PM2A research matched the micronutrient content of SQ-LNS.

Table 1. Primary Research Questions Addressed by FANTA Research Studies

Research question	PM2A in Guatemala	PM2A in Burundi	SQ-LNS in Bangladesh	SQ-LNS in Malawi
What is the impact of PM2A on maternal and child nutritional status?	x	x		
What is the optimal size of food rations? (i.e., can the family ration be reduced?)	x			
What is the optimal composition of food rations?	x			
What is the optimal timing and duration of PM2A, including the length of ration provision?		x		
What are the cost implications of PM2A? What option(s) is/are most cost-effective in terms of reducing stunting?	x	x		
What is the impact of nutritional supplements (e.g., SQ-LNS and MNP) during the 1,000 days on maternal and child nutritional status?	x		x	x
How does providing SQ-LNS during pregnancy affect maternal and birth outcomes?	x		x	x
What are the pathways, in terms of maternal exposures/ characteristics, that lead to shortened pregnancies and smaller birth size (length, weight, head circumference)?				x
How does providing SQ-LNS during the entire 1,000-day period affect maternal and child outcomes?	x		x	
How does provision of SQ-LNS compare to provision of MNP and "standard care" in terms of growth, child development, micronutrient status, and anemia?	x		x	
What are the cost implications of using SQ-LNS and/or MNP? What option(s) is/are most cost-effective in terms of reducing stunting?	x		x	

Providing family and individual rations for the entire 1,000 days had the greatest impact on child stunting in Burundi.

The Tubaramure PM2A version that provided rations throughout the entire 1,000-day period had the greatest impact on stunting, reducing it by 7.1 percentage points.[7, 15] The PM2A option that provided rations from pregnancy to 18 months of age also had a significant, though smaller, effect on reducing stunting (5.2 percentage points). The version that provided no food during pregnancy had a marginally significant effect, a 4.6 percentage-point reduction in stunting.

In Burundi, PM2A had a positive impact on anemia and hemoglobin in both mothers and children. The plausible pathways identified highlight the importance of addressing multiple determinants of anemia.

The three Tubaramure PM2A versions had a modest protective effect on maternal and child anemia during program implementation, as compared to the control group.[14] The program also had significant impacts on intermediary factors that are known determinants of hemoglobin and anemia, including: dietary diversity, consumption of iron-rich foods, morbidity, and fever for child hemoglobin; and dietary diversity, consumption of iron-rich foods, and current bed-net use for maternal anemia.

In Burundi, PM2A improved child motor and language development and reduced child morbidity; in Guatemala, PM2A did not have significant impacts on child development or morbidity.

In Burundi, Tubaramure had a protective effect on child morbidity (general morbidity symptoms as well as key symptoms such as fever, diarrhea, and vomiting), including after the program had concluded.[7] Tubaramure also had a protective effect on child development outcomes—including motor and language milestones—in the TNFP, T24, and T18 groups.[7] In Guatemala, there were no significant program impacts on child motor development scores, morbidity (e.g., prevalence of symptoms of illness), or care-seeking behaviors for dangerous illnesses, though there were modest improvements in the use of oral rehydration salts for diarrhea and medications for fever.[4]

The cost of providing the PM2A program (all services) ranged from $857 to $1,081 per beneficiary in Guatemala, and from $676 to $766 per beneficiary in Burundi.

Food distribution costs formed the bulk of overall program costs (44 percent in Burundi and 30 percent in Guatemala), followed by costs associated with the BCC component (13 percent in Burundi and 17 percent in Guatemala).[5] Health system strengthening activities accounted for 9 percent of program costs in Burundi and 12 percent of program costs in Guatemala. The most cost-effective option in Guatemala was providing the FFR plus CSB as the individual ration ($97 per beneficiary per percentage point reduction in stunting), though this arm had negative effects on maternal weight and maternal and child anemia. The most cost-effective option in Burundi was the PM2A option that provided individual and family rations during the entire 1,000 days ($103 per beneficiary per percentage point reduction in stunting).

Evaluating Nutritional Supplements in Bangladesh and Malawi

SQ-LNS during pregnancy improved birth outcomes in Bangladesh but not Malawi.

In Bangladesh, provision of SQ-LNS during pregnancy reduced the prevalence of newborn stunting by 4 percentage points, compared to provision of IFA during pregnancy.[16] Women who received SQ-LNS during their pregnancy gave birth to infants with significantly greater birth weight, length, body mass index, and head circumference than those who received IFA. Provision of SQ-LNS had no significant effect on pregnancy duration or preterm birth. The impact of SQ-LNS provision on improved birth outcomes was greater in women from food-insecure households and in younger women. In contrast, in Malawi, SQ-LNS provided during pregnancy did not have a significant effect on most birth outcomes, including birth weight, length, head circumference, and pregnancy duration.[12] Provision of SQ-LNS did not have additional effects on indicators of maternal infection, inflammation, and stress in this population.

Front and back of SQ-LNS sachet used in Bangladesh for pregnant and lactating women.

In Malawi, pregnancy duration and fetal growth are associated with maternal nutritional status, as well as maternal infection, inflammation, and stress levels.

Follow-on analyses of the Malawi research explored the multifactorial nature of fetal growth and pregnancy duration.[13] Pregnancy duration was predicted by maternal and fetal infections (e.g., malarial parasitemia in early pregnancy, certain types of oral infections, severe infections of the fetal membranes), maternal nutritional status (e.g., hemoglobin concentration), and maternal stress.[13] Newborn size measurements were all predicted by the duration of pregnancy, placental weight, and maternal inflammation.

In Bangladesh, SQ-LNS provided during the entire 1,000-day period significantly improved length-for-age z-scores (LAZ) at 24 months of age (vs. 15-micronutrient MNP provided to children 6–23 months of age) and head circumference at 24 months of age (vs. the control group).

Providing SQ-LNS to pregnant women and then to their infants from 6–23 months of age, significantly reduced stunting at 18 months of age, as compared to children who received MNP from 6–23 months of age, a difference of 7.8 percentage points.[8] The difference between these two groups was no longer significant at 24 months of age (5.2 percentage points). The two groups that received SQ-LNS (for the entire 1,000 days or from 6–23 months) had similar prevalence of stunting and mean LAZ at 24 months of age.

Both MNP and SQ-LNS had positive effects on child motor and/or language development, child hemoglobin, and reduced maternal and child iron deficiency and anemia in Bangladesh.

Compared to the control group (which received only IFA during pregnancy), children who received MNP from 6–23 months of age had significantly higher mean motor development scores—all three intervention groups had similar mean scores.[8] All three intervention groups also had higher "receptive" language development scores at 24 months of age than the control group; while the group that received SQ-LNS for the entire 1,000 days, and the group in which children 6–23 months received MNP, had higher scores in "expressive" language than the control group. At 18 months of age, all three intervention groups experienced significant positive effects on child hemoglobin and iron status, with the largest benefit being in the group that received SQ-LNS throughout the 1,000 days.

Providing the SQ-LNS intervention from pregnancy to 18 months of age through the Bangladesh community health and development program cost $123 per beneficiary.

The cost to add SQ-LNS (product, delivery, and nutritional messages) to LAMB's community health and development platform did not include costs associated with delivery of the community health and development program itself, training costs, or the costs of delivering the SQ-LNS to individual recipients.[10]

Left: Label on plastic container distributed in Bangladesh to caregivers for storing SQ-LNS for children in the home.
Right: Zip-lock bag in Guatemala containing SQ-LNS sachets for children.

Lessons Learned and Recommendations for Future Programming and Research

Implementing PM2A within a FFP Development Food Security Activity

The Guatemala and Burundi studies show that a food-assisted preventive approach that includes strengthening access to health care and providing BCC to improve health, nutrition, and hygiene knowledge and practices significantly reduced child stunting in different contexts. Results from that combined research indicate that:

For maximum participation and impact, provide full family rations for the entire 1,000-day period.

The Guatemala and Burundi trials indicate that providing full family rations has several beneficial effects—including promoting program participation, reducing household hunger, and reducing sharing of the individual ration—and that the largest impact on stunting reduction comes from providing rations throughout the 1,000 days.

Replacing an individual ration with nutrient supplements such as MNP, while providing a full family ration can reduce stunting, though the formulation is likely critical.

The PM2A research shows for the first time, that an intervention that includes the provision of MNP along with the full family ration and the other program components, can reduce stunting. The MNP formulation used in Guatemala, which included 22 micronutrients at levels that matched those in the SQ-LNS, has not been used programmatically or evaluated in other settings. Past systematic reviews found that the MNP more commonly used in programs—containing 3 to 15 micronutrients—has not been effective at reducing stunting in a variety of settings.[17]

The combined research also found that while PM2A was successful, there is still room for improvement:

There is no "one-size-fits-all" option for preventing malnutrition: Choose interventions for desired impact(s) and consider trade-offs to avoid unwanted effects.

While providing both the FFR and CSB as the individual ration in Guatemala had the largest impact on stunting, it also had unanticipated negative effects on maternal/child anemia and maternal postpartum weight retention. In Guatemala, about half of women (51 percent) are either overweight or obese,[18] and the negative effects of additional CSB consumption on maternal body weight and maternal and child anemia may make repeating such an approach undesirable in the future, despite its effect on stunting. On the other hand, in settings where energy intake is more limited, these negative effects may be absent: For example, negative impacts from the FFR plus an individual ration (both of which included CSB in Burundi) were not observed in Burundi, where food insecurity is more severe.

Use process evaluations to understand and identify constraints to improving program impact.

Both PM2A programs showed evidence of program impact on factors along the hypothesized pathways to optimal outcomes (e.g., improved breastfeeding practices, increased dietary diversity), though each also identified areas where improvement was needed. Understanding the hypothesized pathways to reach optimal nutritional and health outcomes, how program components will act on those pathways, and whether those program components act as intended, is crucial for identifying areas where improvements/adjustments can be made.

The Role of SQ-LNS and MNP in the First 1,000 Days

The research questions related to SQ-LNS and MNP were spread across three of the FANTA research study settings: Guatemala, Bangladesh, and Malawi (Table 1). The contexts of these three studies differed—geographically, as well as programmatically—as did the formulations of the specific products used in some cases (e.g., MNP used in Guatemala vs. MNP used in Bangladesh), and the results. The variety of products, settings, and results in these studies adds a level of richness to the body of literature on this topic and offers the opportunity to interpret the studies in the larger context of research on these supplements.

Providing SQ-LNS prenatally appears to improve birth outcomes in some settings. Providing SQ-LNS pre- and/or postnatally prevents child stunting in many settings. However, the optimal duration of supplementation is still unclear.

In the FANTA research, SQ-LNS provided to pregnant women in Bangladesh significantly improved birth size and reduced newborn stunting,[16] whereas a similar approach in Malawi did not,[12] potentially because high levels of infection limited maternal response to SQ-LNS in the Malawi setting. In other research trials, prenatal SQ-LNS provided to pregnant women had a significant impact on birth weight in Ghana,[15] and a similar approach used in Burkina Faso improved birth length.[19]

In Bangladesh, SQ-LNS provided either for the entire 1,000-day window or from 6–23 months of age, reduced stunting at 18 months of age (more than a 15-micronutrient MNP).[8] These results aligned with other studies that investigated the impact of pre- and/or postnatal SQ-LNS on child stunting and found preventive effects, including in Ghana,[15, 20] Burkina Faso,[21] and Haiti.[22] They contrasted with the results of studies done in other sites, where SQ-LNS did not have an impact, including the FANTA PM2A research in Guatemala[4] and additional research done in Malawi that evaluated the effect of postnatal SQ-LNS on child growth.[23, 24] Whether prenatal SQ-LNS is needed for optimal child growth outcomes is not fully understood (e.g., in Ghana, the largest benefits to child stunting appeared to come from effects on birth size; in contrast, in Bangladesh, while prenatal SQ-LNS reduced newborn stunting, children who received SQ-LNS only postnatally "caught up" to those whose mothers also received it prenatally). The effects of prenatal SQ-LNS provision likely vary by setting.

Programmatic Implications

When contemplating preventive interventions during the 1,000 days, particularly involving SQ-LNS or MNP, several factors are important to consider:

Context matters: It is important to understand a population's ability to benefit from an intervention (i.e., whether there is room for improvement in an outcome) and a population's ability to respond to it (i.e., whether there are other constraints to growth besides nutrition that may limit a response).

At least some of the heterogeneity of results seen with preventive interventions for malnutrition such as SQ-LNS and MNP, including in the FANTA research, likely is due to the different presentations and causes of malnutrition in diverse settings. How a population will respond to a particular intervention is difficult to know from the outset. However, understanding the context and answering several key questions before selecting an intervention may help determine whether particular interventions are ideal for a given setting:[25]

- What are the key constraints to healthy growth and development in the target population (e.g., nutrition, food insecurity, infectious disease, access to/utilization of health services, WASH)?

- What data are available on the dietary practices of mothers and children, and what do they indicate in terms of nutrient needs not being met, and for which nutrients? What other food security and nutrition-related conditions are of note?
- How are other determinants of malnutrition (WASH, health care) being addressed, and will they limit response to a nutritional intervention?

It is also important to consider what the primary nutritional concerns are (e.g., anemia or micronutrient deficiencies, stunted growth) and what intervention may address them most effectively (and cost-effectively).

Undernutrition is multifactorial: Intervention packages should be multifaceted to address multiple causes of malnutrition.

Achieving optimal health and development outcomes requires a multi-pronged approach. As the PM2A studies recognized, interventions must take many factors into account along the causal pathway to undernutrition. The FANTA research in Malawi also underscored the multifactorial causes of undernutrition, showing strong associations between infection (specifically maternal infection) and maternal stress on one hand, and undernutrition on the other. FANTA research confirmed that undernutrition needs should be addressed by both nutrition-specific and nutrition-sensitive interventions that cover factors including infection and disease, reproductive health practices, access to and utilization of mental and physical health services, WASH, and knowledge and practices related to a host of health and nutrition topics.

Looking Ahead

As part of their mission to expand the nutrition evidence base, FANTA and its partners have shared this research and its findings through several journal articles, reports, conferences, and workshops. While these studies help advance knowledge about optimizing nutrition interventions during the critical 1,000-day window of opportunity, more research is needed to further strengthen both the preventive approach and the use of nutrition supplements such as CSB, SQ-LNS, and MNP—particularly in combination with a multisectoral approach. It is hoped that these studies will be built upon and eventually translated into effective nutrition-specific and nutrition-sensitive policies and programs that reduce malnutrition among mothers and young children.

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