Micronutrient Malnutrition among Women and Young Children in the Western Highlands of Guatemala: What Are the Needs and What Can Be Done?

Micronutrient malnutrition is a serious problem in Guatemala, particularly in the Western Highlands. In some areas of this region, nearly two-thirds of children under 5 are anemic, as are almost a third of pregnant women (Chaparro 2012). Zinc, folate, and vitamin B12 deficiencies are also high (MSPAS 2010a). Such deficiencies have long-term effects on the health and productivity of the population (see Box 1). The first 1,000 days from pregnancy until a child turns 2 have been identified as the window of opportunity when malnutrition in childhood can be prevented and children can be given the best opportunity to grow and develop optimally. This is also a period when micronutrient malnutrition can be prevented to ensure optimal growth and development of children.

Micronutrient deficiencies have been addressed previously in Guatemala through government initiatives. For example, vitamin A deficiency was a widespread problem that was addressed by government adoption of regulations to fortify sugar with vitamin A and vitamin A supplementation of children under 5 years of age. Currently, the Guatemalan Ministry of Health distributes a multiple micronutrient powder, known as Chispitas, to be used as a home-fortificant to be added to complementary foods for children 6–23 months of age. The Ministry of Health also distributes iron-folic acid tablets to pregnant and lactating women. In addition, for pregnant and lactating women and children 6–23 months of age, the Ministry of Health is responsible for distributing Vitacereal, a fortified blended flour to supplement the local diet to close nutrient gaps. However, an important challenge has been the inconsistent distribution of these products,

A woman prepares corn as a young child watches in Patzún, Chimaltenango, Guatemala. Photo credit: Olga Santizo, courtesy of Photoshare

which has resulted in low coverage. The persistent deficiencies in iron, zinc, folate, and vitamin B12 suggest that current distribution efforts have not reached women and children consistently to prevent deficiencies.

While it is known that the frequency of feeding and diversity of foods offered to young children in the Western Highlands are low, much less is understood about the extent to which the micronutrient content of the diet of children under 2 and that of pregnant and lactating women can be improved using local foods and whether families are able to adopt improved dietary practices. In an effort to better understand the feasibility of using local foods to meet micronutrient needs, the Food and Nutrition Technical Assistance III Project (FANTA), funded by the U.S. Agency for International Development, partnered with the Institute of Nutrition of Central America and Panama (INCAP) to conduct a study

to identify and test a set of evidence-based and population-specific dietary messages known as food-based recommendations (FBRs) for children 6–23 months of age and pregnant and lactating women in the Western Highlands of Guatemala.

A software program called Optifood was used to determine which combination of local foods would provide the best diets for the target groups, taking into account cost and availability of the food, as well as local preferences. Optifood testing showed that without fortified foods or supplements, even if families made optimal use of local foods, women and children would be unable to meet all micronutrient requirements during the critical 1,000-day window of opportunity. With this information, FBRs were developed that included local food as well as fortified blended flour and micronutrient supplements to fill nutrient gaps.

Trials were then conducted to see if the FBRs were feasible for the target groups to adopt. The FBR trials

Box 1. Micronutrient Deficiencies in Guatemala and Their Consequences

National surveys indicate that 48% of children under 5 years of age and 72% of children 6–11 months of age are anemic, while in some areas of the Western Highlands up to 62% of children under 5 are anemic (MSPAS 2010b). Nationwide 35% of children suffer from zinc deficiency, and it is estimated that this may be much higher in the Western Highlands given the very high levels of chronic malnutrition (up to 82% in some departments) (MSPAS 2010a; de Benoist 2007).[1] Among pregnant women in the Western Highland departments of Huehuetenango, Quetzaltenango, Quiché, San Marcos, and Totonicapán, 30% are anemic (Chaparro 2012). Although data for vitamin B12 and folate deficiency are not available for the Western Highlands, vitamin B12 deficiency affects 19% of women nationally and 30% of women in the lowest wealth quintile, while folate deficiency affects 7% of women nationally and 17% of women in the lowest wealth quintile (MSPAS 2010a). Consequences of these deficiencies are serious. Research shows that:

- Anemia in young children increases the risk of suffering from infectious diseases and can impair cognitive, behavioral, motor, and language development and achievement in school (Black et al. 2013; Balarajan et al. 2011; Walker et al. 2007).
- Anemia among pregnant women is associated with maternal and neonatal deaths and is a major cause of low birth weight (Black et al. 2013). Infants with low birth weight are five times more likely to die within the first month of life than infants with normal birth weight (Katz et al. 2013).
- In the long term, iron deficiency contributes to reduced work capacity and labor productivity, impeding agricultural and industrial production and slowing national development (Balarajan et al. 2011; Horton and Levin 2001; Horton and Ross 2003, 2007; Haas and Brownlie 2001).
- Zinc deficiency is associated with poor child growth and increased risk of infection and mortality (Black et al. 2013). In women, zinc deficiency can result in infertility, poor fetal growth, prolonged labor, or embryonic or fetal death (Hess et al. 2009).
- Folate deficiency at the time of conception increases the risk of neural tube defects in the fetus (Black et al. 2013).
- Vitamin B12 deficiency in women during pregnancy is associated with increased risk of neural tube defects, spontaneous abortion, pre-eclampsia, and low birth weight, and in children can impair infant growth, psychomotor function, and brain development, which may be irreversible (Finkelstein et al. 2015).

[1] Chronic malnutrition is a proxy for zinc deficiency (de Benoist et al. 2007).

revealed that for pregnant and lactating women, young children, and their families, the recommended foods were generally acceptable but the feasibility of trying each at the recommended frequency and quantity was more challenging, with cost of the food itself or transport to local markets being the main barrier. Based on the findings, the FBRs were revised to make their adoption easier (see Box 2), and three additional sets of Optifood testing were carried out to determine the nutrient adequacy of different combinations of the FBRs, micronutrient supplements, Chispitas for home fortification, and/or fortified blended flour. The combinations tested include: (1) the revised FBRs plus Chispitas for children and iron-folic acid supplements for pregnant and lactating women, (2) the revised FBRs without fortified blended flour, but with Chispitas for children and iron-folic acid supplements for pregnant and lactating women, and (3) the revised FBRs for pregnant and lactating women with fortified blended flour plus Chispitas or iron-folic acid supplements.

Analysis of FBRs with Micronutrient Supplements

The first set of additional analyses tested the nutrient adequacy of the revised FBRs with micronutrient supplementation (Chispitas) for children and iron-folic acid tablets for pregnant and lactating women. Nutrient needs that could be met under these circumstances are indicated as squares in Figure 1. Key findings include the following:

- Supplementation using Chispitas was essential to meet adequacy for some modeled nutrients, especially vitamin C, iron, and zinc for children 6–11 months of age and iron for children 12–23 months of age.
- Modifying vitamin B6 content in supplements or fortified products would be necessary to meet B6 requirements for children 6–11 months. Also, calcium for children 9–11 months would be needed.

Box 2: Summary of Revised FBRs*

- **Pregnant and lactating women:** liver, vegetables, and a thick drink made from fortified blended flour
- **Children 6–11 months:** eggs, beans, and a porridge made from fortified blended flour
- **Children 12–23 months:** green leafy vegetables, eggs, beans, and a porridge made from fortified blended flour

* The FBR foods are consumed in addition to the regular diet.

- Tailoring a new multiple micronutrient powder especially for pregnant and lactating women that contains vitamin C, or reformulating the iron-folic acid tablet to contain vitamin C, would be necessary to meet vitamin C requirements.[2]
- Despite folic acid supplementation, pregnant and lactating women's needs are not met. Reformulation of fortified products or a review of supplementation would be needed to meet nutrient adequacy for folate among pregnant and lactating women.

Analysis of FBRs with Micronutrient Supplements and without Fortified Blended Flour

The second analysis tested the revised FBRs with Chispitas for children 6–23 months and iron-folic acid for pregnant and lactating women, but without fortified blended flour. This was done because it was estimated to be less expensive per beneficiary for the government to distribute Chispitas and iron-folic acid than for the government to provide beneficiaries with Vitacereal, or for families to purchase Incaparina.[3] Also, because women's and children's calorie and protein intake are generally acceptable, and overweight and obesity are growing problems among

[2] The Guatemalan Ministry of Health norm for supplementation for pregnant and lactating women currently only includes iron-folic acid tablets.

[3] Incaparina and Vitacereal are corn-soy blend products fortified with iron and other micronutrients. Incaparina is privately produced and sold, while provision of Vitacereal is part of the Government of Guatemala's social support programs for children 6–23 months and pregnant and lactating women.

women in Guatemala (MSPAS 2010b), a greater focus on micronutrients rather than calories and protein may be warranted. The circles in Figure 1 show the nutrients that would be adequately provided under this scenario. Key points from the analysis include:

- For pregnant and lactating women, zinc was inadequate without the fortified blended flour (as well as folate and vitamin C, which were inadequate even consuming fortified blended flour).
- For children 6–11 months, not having fortified blended flour results in 4–5 nutrients being inadequate. Additional fortification of the micronutrient powder could be considered to fill this gap, if feasible.
- For children 12–23 months, calcium and iron were inadequate and would need to be addressed.
- For children 6–23 months, if a micronutrient powder was used without the fortified blended flour, it should be sprinkled on a nutritionally dense, thick maize porridge to provide the needed caloric density and micronutrients, rather than in a thin, liquid maize drink.

To remove the fortified blended flour from the set of FBRs, it would be *crucial* to further adapt micronutrient supplements to replace the missing nutrients for children and pregnant and lactating women. Another option would be to maintain the fortified blended flour for children, who were missing more nutrients without it, but remove it from the FBRs for women. In addition, it would be critical to ensure adequate coverage of micronutrient supplementation, as supplementation of children and postpartum women in the study area was low, below 50%, and generally representative of low levels of coverage throughout a majority of the country (FANTA 2014).

Figure 1. Nutrient Adequacy Achievable using Micronutrient Supplements and FBRs, with and without Fortified Blended Flour*

■ Nutrient needs met with FBRs plus micronutrient supplements

● Nutrient needs met with FBRs, without fortified blended flour, plus micronutrient supplements

	Children			Women	
	6–8 months	9–11 months	12–23 months	Pregnant	Lactating
Calcium	■		■	■ ●	■ ●
Vitamin C	■ ●	■ ●	■ ●		
Thiamin	■	■	■ ●	■ ●	■ ●
Riboflavin	■ ●	■ ●	■ ●	■ ●	■ ●
Niacin	■	■	■ ●	■ ●	■ ●
Vitamin B6		●	■ ●	■ ●	■ ●
Folate	■ ●	■ ●	■ ●		
Vitamin B12	■ ●	■ ●	■ ●	■ ●	■ ●
Vitamin A	■ ●	■ ●	■ ●	■ ●	■ ●
Iron	■ ●	■ ●	■	■ ●	■ ●
Zinc	■	■	■ ●	■	■

* Nutrient adequacy defined as ≥ 65% of recommended nutrient intake met in minimized diet in Optifood module 3 (represents lower tail of nutrient intake). Supplementation included 3 sachets per week of Chispitas for children 6–23 months and iron-folic acid supplements for pregnant and lactating women as per government guidelines.

Analysis Comparing Chispitas and Iron-Folic Acid Supplements in FBRs for Pregnant and Lactating Women

Lastly, testing was done to see if a micronutrient powder such as Chispitas rather than an iron-folic acid supplement would better address nutrient adequacy for pregnant and lactating women in combination with the revised FBRs (including fortified blended flour), and possibly at a lower cost (see Figure 2). A key finding from this analysis is that either iron-folic acid supplements or Chispitas reach similar levels of nutrient adequacy when used with the FBRs, but folate and vitamin C were inadequate under both scenarios. Although either supplement could be adjusted to increase folic acid, a micronutrient powder could more easily include additional vitamin C and is a potential option to replace iron-folic acid supplements for pregnant and lactating women as it could provide at least the existing level of nutrient adequacy in combination with FBRs. However, Chispitas is slightly more expensive than the iron-folic acid tablets and would require women to adopt a new behavior, as taking iron-folic acid is already well-established and actively promoted by the health sector, although problems of availability at health facilities and adherence among pregnant women do exist and still need to be overcome (MSPAS 2014; Angeles et al. 2014).

Implications

The analyses demonstrate that when micronutrient supplements are consumed along with a feasible set of FBRs, which include fortified blended flour, this combination is capable of filling most nutrient gaps for pregnant and lactating women and children 6–23 months, provided the supplements have an optimal micronutrient formulation and are consistently available and consumed with the recommended frequency. However, results from the FBR trials and Optifood testing consistently show a lack of micronutrients in the diet and inability to meet micronutrient needs, given current combinations of local foods and poor access to fortified blended flour and/or micronutrient supplements for pregnant and lactating women and young children in the Western Highlands of Guatemala. The implications of these

Figure 2. Analysis of the Revised FBRs for Pregnant and Lactating Women Comparing Micronutrient Powder (MNP) with Iron-Folic Acid (IFA) Supplements*

FBR set tested	# of nutrients not met	Nutrients not met (% recommended nutrient intake achieved in minimum diet)	Estimated cost/day to families (Q)	Estimated cost/ person/day to government (Q)
Lactating women				
FBRs with Vitacereal and IFA supplement	2	Vitamin C (33.1%), folate (55.6%)	10.30	0.46
FBRs with Vitacereal and MNP	2	Vitamin C (46%), folate (51.4%)	10.30	0.52
Pregnant women				
FBRs with Vitacereal and IFA supplement	2	Vitamin C (33%), folate (43.2%)	8.80	0.46
FBRs with Vitacereal and MNP	2	Vitamin C (50.1%), folate (39.7%)	8.80	0.52

* Revised FBRs for pregnant and lactating women include liver once a week, thick fortified *atole* 7 times a week, and vegetables 14 times a week.

Note: Analysis assumes that MNP, IFA supplements, and Vitacereal would be provided free to recipients, as such, no cost to families is added for these products. The cost of purchasing cooking fuel and time costs are not considered, nor are costs related to distribution of the products.

findings are relevant for improving national programs and policies and economic and market access. These include:

- **Formulation of micronutrient supplements and fortified products.** Ensure that micronutrient supplements and fortified products are appropriately formulated and targeted to fill nutrient gaps identified by Optifood, taking into account the particular needs of each target group (children 6–8 months, children 9–11 months, pregnant women, and lactating women).
- **Government provision of fortified products and micronutrient supplements.** Ensure an adequate budget to consistently procure and distribute micronutrient supplements and fortified complementary foods to maintain planned frequency of consumption according to Ministry of Health norms.
- **Use of micronutrient supplements and fortified products.** Support strategies to improve recipient uptake of and compliance with programs that provide micronutrient supplements and fortified products and support review of packaging and educational information for micronutrient supplements and fortified products to improve acceptability and use.
- **Micronutrient powder option to replace fortified blended flour.** Explore opportunities to provide an improved multiple micronutrient powder for children 6–23 months and pregnant and lactating women, in place of a fortified blended flour, if programmatic challenges can be addressed. This could enable the government to reorient resources for the distribution of necessary micronutrients without the cost of producing, procuring, or transporting bulky foods. For pregnant and lactating women, a multiple micronutrient powder that fills nutrient gaps could replace iron-folic acid supplements.
- **Access to fortified blended flour.** Promote economic access or vouchers for a fortified blended flour (e.g., Incaparina) if Vitacereal is not being distributed to households for pregnant and lactating women and young children.

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Recommended Citation: Food and Nutrition Technical Assistance III Project (FANTA). 2015. *Technical Brief: Micronutrient Malnutrition among Women and Young Children in the Western Highlands of Guatemala: What Are the Needs and What Can Be Done?* Washington, DC: FHI 360/FANTA.

This brief is made possible by the generous support of the American people through the support of the Office of Health, Infectious Diseases, and Nutrition, Bureau for Global Health, U.S. Agency for International Development (USAID) and USAID/Guatemala, under terms of Cooperative Agreement No. AID-OAA-A-12-00005, through the Food and Nutrition Technical Assistance III Project (FANTA), managed by FHI 360.